**Electronic Supplemental Material**

**Title:** Removal of the Invasive Shrub *Lonicera maackii* (Amur honeysuckle) from a Headwater Stream Riparian Zone Shifts Taxonomic and Functional Composition of the Aquatic Biota

**Authors:** R.E. McNeish[[1]](#footnote-1)\*, M.E. Benbow, and R.W. McEwan

Table S1: Description of functional trait states assigned to each taxonomic identification. Taxonomic names in parenthesis indicates taxa that were used to substitute unknown traits states for the corresponding taxon. Trophic habitat letter represent collector-gatherer (CG), collector-filterer (CF), herbivore (H), predator (P), and detritivore/shredder (D)

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **Ecology** | | |  | **Life History** | |  | **Morphology** | |  |
| **Order** | **Taxa** | **Trophic Habitat** | **Thermal Preference** | **Habitat** |  | **Voltinism** | **Development** |  | **Respiration** | **Size at Maturity** | **Citations** |
| Diptera | Chironomidae (*Diamesinae*) | CG | Cold/Cool Stenothermal | Sprawler |  | Univoltine | Fast Seasonal |  | Gill | Small | 5, 6 |
| Diptera | *Simulium* (Simuliidae) | CF | Cool/Warm Eurythermal | Clinger |  | Bi- or Multivoltine | Fast Seasonal |  | Tegument | Small | 5, 6, 9 |
| Diptera | Tipulidae | D | Cool/Warm Eurythermal | Burrower |  | Univoltine | Slow Seasonal |  | Gill | Medium | 5, 6 |
| Diptera | *Dasyhelea* (Ceratopogonidae) | CG | Cold/Cool Stenothermal | Sprawler |  | Univoltine | Fast Seasonal |  | Gill | Small | 6, 9 |
| Diptera | Empididae | P | Cool/Warm Eurythermal | Sprawler |  | Univoltine | Slow Seasonal |  | Tegument | Medium | 5, 6 |
| Diptera | *Ceratopogon* (Ceratopogonidae) | P | Cool/Warm Eurythermal | Sprawler |  | Univoltine | Fast Seasonal |  | Tegument | Small | 5, 6 |
| Diptera | *Psychoda* (*Maruina*) | CG | Cold/Cool Stenothermal | Burrower |  | Bi- or Multivoltine | Fast Seasonal |  | Tegument | Small | 5, 6, 9 |
| Diptera | *Forcipomyia* (Ceratopogonidae) | CG | Cold/Cool Stenothermal | Sprawler |  | Univoltine | Fast Seasonal |  | Gill | Small | 6, 9 |
| Diptera | Atrichopogon (Ceratopogonidae) | P | Cool/Warm Eurythermal | Sprawler |  | Semivoltine | Fast Seasonal |  | Tegument | Small | 6, 9 |
| Diptera | *Culicoides* (Ceratopogonidae) | P | Cold/Cool Stenothermal | Burrower |  | Univoltine | Fast Seasonal |  | Gill | Small | 6, 9 |
| Diptera | *Maruina* | H | Cold/Cool Stenothermal | Clinger |  | Univoltine | Fast Seasonal |  | Tegument | Small | 6 |
| Haplotaxida | Naididae | D | Cool/Warm Eurythermal | Burrower |  | Bi- or Multivoltine | Non-Seasonal |  | Tegument | Small | 8, 9 |
| Cerithioidea | *Pleurocera* (Pleuroceridae) | H | Cool/Warm Eurythermal | Clinger |  | Bi- or Multivoltine | Non-Seasonal |  | Gill | Large | 8, 9 |
| Trichoptera | *Cheumatopsyche* | CF | Cold/Cool Stenothermal | Clinger |  | Univoltine | Slow Seasonal |  | Gill | Medium | 5, 6 |
| Trichoptera | *Hydropsyche* | CF | Cool/Warm Eurythermal | Clinger |  | Univoltine | Slow Seasonal |  | Gill | Medium | 5, 6 |
| Trichoptera | *Ceratopsyche* | CF | Cool/Warm Eurythermal | Clinger |  | Univoltine | Slow Seasonal |  | Gill | Medium | 5, 6 |
| Trichoptera | *Hydroptila* | H | Cool/Warm Eurythermal | Clinger |  | Univoltine | Slow Seasonal |  | Gill | Small | 5, 6 |
| Planorboidea | *Physella* | H | Cool/Warm Eurythermal | Clinger |  | Bi- or Multivoltine | Fast Seasonal |  | Aerial | Medium | 8, 9 |
| Planorboidea | *Menetus dilatatus* | H | Cool/Warm Eurythermal | Clinger |  | Bi- or Multivoltine | Fast Seasonal |  | Aerial | Small | 8, 9 |
| Basommatophora | *Ferrissia* (*Ferrissia rivularis*) | H | Cool/Warm Eurythermal | Clinger |  | Univoltine | Non-Seasonal |  | Aerial | Small | 1, 4 |
| Veneroidea | *Pisidium* | CF | Cool/Warm Eurythermal | Burrower |  | Univoltine | Non-Seasonal |  | Gill | Small | 8, 9, 2 |
| Coleoptera | *Stenelmis* (Elmidae) | CG | Cool/Warm Eurythermal | Clinger |  | Semivoltine | Non-Seasonal |  | Tegument | Small | 6, 9 |
| Coleoptera | *Ectopria* | H | Cool/Warm Eurythermal | Clinger |  | Semivoltine | Slow Seasonal |  | Gill | Medium | 5, 6 |
| Coleoptera | Haliplidae (*Brychius*) | H | Cold/Cool Stenothermal | Clinger |  | Bi- or Multivoltine | Slow Seasonal |  | Gill | Small | 7, 9 |
| Coleoptera | Lampyridae (*Luciola ficta*) | P | Cool/Warm Eurythermal | Climber |  | Univoltine | Slow Seasonal |  | Tegument | Medium | 9, 3 |
| Arhynchobdellida | *Erpobdella punctata* | P | Warm Eurythermal | Climber |  | Semivoltine | Slow Seasonal |  | Tegument | Large | 9 |
| Rhynchobdellida | *Helobdella fusca* (*H. stagnalis*) | P | Warm Eurythermal | Climber |  | Bi- or Multivoltine | Non-Seasonal |  | Tegument | Medium | 9 |
| Rhynchobdellida | *Helobdella stagnalis* | P | Warm Eurythermal | Climber |  | Bi- or Multivoltine | Non-Seasonal |  | Tegument | Medium | 8, 9 |
| Lumbriculida | Lumbriculidae | D | Cold/Cool Stenothermal | Burrower |  | Bi- or Multivoltine | Non-Seasonal |  | Tegument | Large | 8, 9 |
| Tricladida | Planariidae (Turbellaria) | P | Cool/Warm Eurythermal | Climber |  | Bi- or Multivoltine | Fast Seasonal |  | Tegument | Medium | 8 |
| Ephemoropetera | Baetidae (*Baetis*) | CG | Cool/Warm Eurythermal | Swimmer |  | Bi- or Multivoltine | Fast Seasonal |  | Gill | Small | 6 |
| Hemiptera | *Microvelia* (Planorbidae) | P | Cool/Warm Eurythermal | Skater |  | Bi- or Multivoltine | Fast Seasonal |  | Aerial | Small | 5, 6 |
| Zygoptera | *Agria* | P | Cool/Warm Eurythermal | Clinger |  | Semivoltine | Slow Seasonal |  | Tegument | Medium | 6 |
| Zygoptera | *Calopteryx* | P | Cool/Warm Eurythermal | Climber |  | Semivoltine | Slow Seasonal |  | Gill | Large | 5, 6 |
| Amphipoda | *Gammarus* | D | Cold/Cool Stenothermal | Swimmer |  | Univoltine | Non-Seasonal |  | Gill | Medium | 8, 9 |
| Amphipoda | *Hyalella* | D | Cold/Cool Stenothermal | Climber |  | Bi- or Multivoltine | Non-Seasonal |  | Gill | Small | 8, 9 |
| Copepoda | Copepoda | D | Cool/Warm Eurythermal | Swimmer |  | Bi- or Multivoltine | Non-Seasonal |  | Tegument | Small | 8 |
| Decapoda | *Orconectes rusticus* | D | Cool/Warm Eurythermal | Climber |  | Semivoltine | Non-Seasonal |  | Gill | Large | 7, 8, 9 |
| Isopoda | *Caecidotea* | D | Cold/Cool Stenothermal | Clinger |  | Bi- or Multivoltine | Non-Seasonal |  | Gill | Medium | 8, 9 |

**Table S1 References**

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Table S2: Taxonomic and functional diversity metrics, FFG relative abundance, and ambient conditions statistical comparisons between honeysuckleand removal stream reaches.

|  |  |  |
| --- | --- | --- |
| **Parameter** | **W-Value** | ***P*-Value** |
| Density | 1807.5 | < 0.0010 |
| Diversity | 2460.0 | 0.4434 |
| Richness | 0167.5 | < 0.0001 |
| Functional Richness | 0188.0 | 0.5077 |
| Functional Evenness | 0200.0 | 0.9553 |
| Functional Dispersion | 0271.0 | 0.4400 |
| Collector-Gatherer | 2008.5 | 0.0760 |
| Collector-Filterer | 2190.0 | 0.6453 |
| Herbivore | 3241.0 | 0.0138 |
| Predator | 1380.5 | 0.3023 |
| Detritivore | 2014.5 | 0.9625 |
| Canopy Cover | 4986.0 | < 0.0001 |
| Light Availability | 0063.0 | < 0.0001 |
| Phosphorous | 0445.5 | 0.7444 |
| Nitrite | 0296.5 | 0.9932 |
| Nitrate | 0352.5 | 0.3145 |
| Ammonia | 0422.0 | 0.1642 |
| TSS | 0365.0 | 0.9419 |

Table S3: Macroinvertebrate taxonomic and abundance list that were sampled over a 31 month period in both the removal and honeysuckle stream reaches at BO park.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | **Honeysuckle Reach** | |  | **Removal Reach** | |
| **Order** | **Taxa** | **Total Abundance** | **Relative Abundance** |  | **Total Abundance** | **Relative**  **Abundance** |
| Diptera | Chironomidae | 4032 | 47.98 |  | 9797 | 55.05 |
| Diptera | *Simulium* | 104 | 01.24 |  | 448 | 02.52 |
| Diptera | Tipulidae | 24 | 00.29 |  | 109 | 00.61 |
| Diptera | *Dasyhelea* | 18 | 00.21 |  | 25 | 00.14 |
| Diptera | Empididae | 13 | 00.15 |  | 46 | 00.26 |
| Diptera | *Ceratopogon* | 3 | 00.04 |  | 2 | 00.01 |
| Diptera | Cyclorrhaphas-Brachycera | 2 | 00.02 |  | 1 | 00.01 |
| Diptera | *Psychoda* | 2 | 00.02 |  | 6 | 00.03 |
| Diptera | *Forcipomyia* | 1 | 00.01 |  | 2 | 00.01 |
| Diptera | *Atrichopogon* | 0 | 00.00 |  | 2 | 00.01 |
| Diptera | *Culicoides* | 0 | 00.00 |  | 4 | 00.02 |
| Diptera | Dolchopodidae | 0 | 00.00 |  | 1 | 00.01 |
| Diptera | Ephydridae | 0 | 00.00 |  | 1 | 00.01 |
| Diptera | *Maruina* | 0 | 00.00 |  | 2 | 00.01 |
| Diptera | Muscidae | 0 | 00.00 |  | 1 | 00.01 |
| Haplotaxida | Naididae | 3066 | 36.49 |  | 5601 | 31.47 |
| Cerithioidea | *Pleurocera* | 433 | 05.15 |  | 236 | 01.33 |
| Trichoptera | *Cheumatopsyche* | 186 | 02.21 |  | 326 | 01.83 |
| Trichoptera | *Hydroptila* | 93 | 01.11 |  | 495 | 02.78 |
| Trichoptera | *Hydropsyche* | 41 | 00.49 |  | 132 | 00.74 |
| Trichoptera | *Ceratopsyche* | 6 | 00.07 |  | 64 | 00.36 |
| Planorboidea | *Physella* | 89 | 01.06 |  | 170 | 00.96 |
| Planorboidea | *Menetus dilatatus* | 4 | 00.05 |  | 0 | 00.00 |
| Basommatophora | *Ferrissia* | 1 | 00.01 |  | 1 | 00.01 |
| Veneroidea | *Pisidium* | 77 | 00.92 |  | 25 | 00.14 |
| Coleoptera | *Stenelmis* | 65 | 00.77 |  | 79 | 00.44 |
| Coleoptera | *Ectopria* | 3 | 00.04 |  | 3 | 00.02 |
| Coleoptera | Haliplidae | 2 | 00.02 |  | 0 | 00.00 |
| Coleoptera | Lampyridae | 1 | 00.01 |  | 0 | 00.00 |
| Arhynchobdellida | *Erpobdella punctata* | 41 | 00.49 |  | 51 | 00.29 |
| Lumbriculida | Lumbriculidae | 26 | 00.31 |  | 26 | 00.15 |
| Tricladida | Planariidae | 25 | 00.30 |  | 34 | 00.19 |
| Rhynchobdellida | *Helobdella stagnalis* | 17 | 00.20 |  | 10 | 00.06 |
| Rhynchobdellida | *Helobdella fusca* | 1 | 00.01 |  | 2 | 00.01 |
| Ephemeroptera | Baetidae | 12 | 00.14 |  | 21 | 00.12 |
| Hemiptera | *Microvelia* | 3 | 00.04 |  | 0 | 00.00 |
| Hemiptera | Homoptera | 2 | 00.02 |  | 3 | 00.02 |
| Collembola | Actaletidae | 2 | 00.02 |  | 0 | 00.00 |
| Collembola | Bourletiella | 1 | 00.01 |  | 0 | 00.00 |
| Collembola | Spinactaletes | 1 | 00.01 |  | 2 | 00.01 |
| Collembola | Hypogastruridae | 0 | 00.00 |  | 1 | 00.01 |
| Zygoptera | *Argia* | 1 | 00.01 |  | 2 | 00.01 |
| Zygoptera | *Calopteryx* | 1 | 00.01 |  | 4 | 00.02 |
| Amphipoda | *Gammarus* | 1 | 00.01 |  | 4 | 00.02 |
| Amphipoda | *Hyalella* | 0 | 00.00 |  | 1 | 00.01 |
| Copepoda | Copepoda | 1 | 00.01 |  | 51 | 00.29 |
| Decapoda | *Orconectes rusticus* | 1 | 00.01 |  | 3 | 00.02 |
| Lepidoptera | Noctuidae | 1 | 00.01 |  | 0 | 00.00 |
| Hydrachnidia | Hydrachnidia | 0 | 00.00 |  | 3 | 00.02 |
| Isopoda | *Caecidotea* | 0 | 00.00 |  | 1 | 00.01 |
|  | Total | 8403 | 100.00 |  | 17798 | 100.00 |
|  | Species Richness | 40 |  |  | 43 |  |

Table S4: ADONIS multiple permutation result for taxonomic and functional trait community dynamics between stream reaches, season, and their interaction and between stream reaches for each season.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Taxonomic** | | |  | **Functional** | | |
| **Grouping Factor** | **R2** | **F-Statistic** | ***P*-Value** |  | **R2** | **F-Statistic** | ***P*-Value** |
| Stream Reach | 0.0135 | 3.8056 | 0.0004 |  | 0.0096 | 2.3969 | 0.0402 |
| Season | 0.0650 | 6.0897 | 0.0001 |  | 0.0429 | 3.5704 | 0.0001 |
| Reach × Season | 0.0166 | 1.5550 | 0.0357 |  | 0.0093 | 0.7769 | 0.6820 |
| Spring | 0.0459 | 2.6014 | 0.0190 |  | 0.0125 | 0.6859 | 0.5786 |
| Summer | 0.0451 | 1.6064 | 0.0979 |  | 0.0649 | 2.3606 | 0.0471 |
| Autumn | 0.0344 | 2.8554 | 0.0047 |  | 0.0089 | 0.7196 | 0.6032 |
| Winter | 0.1459 | 0.7551 | 0.6253 |  | 0.2294 | 1.1973 | 0.3092 |

Table S5: Functionally relevant macroinvertebrate taxa for each season. An asterisk indicates taxa that were unique to that season.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Grouping Factor** | **Order** | | **Taxa** | **Observed Value** | ***P-*Value** |
| **Spring** | Diptera | | *Atrichopogon*\* | 0.226 | 0.010 |
| Diptera | | *Ceratopogon*\* | 0.182 | <0.001 |
| Diptera | | *Culicoides* | 0.217 | <0.001 |
| Tricladidae | | Planariidae | 0.258 | <0.001 |
| Ephemeroptera | | Baetidae | 0.253 | <0.001 |
| Amphipoda | | *Hyalella*\* | 0.210 | <0.001 |
| Hydrachnidia | | Hydrachnidia\* | 0.200 | 0.020 |
|  | |  | | | |
| **Summer** | Diptera | | Empididae\* | 0.132 | <0.001 |
|  | Diptera | | Tipulidae\* | 0.201 | <0.001 |
|  | Coleoptera | | *Stenelmis*\* | 0.197 | <0.001 |
|  | Coleoptera | | *Ectopria* | 0.129 | <0.001 |
|  | Coleoptera | | Haliplidae | 0.143 | <0.001 |
|  | Coleoptera | | Lampyridae\* | 0.160 | <0.001 |
|  | Cerithioidea | | *Pleurocera* | 0.142 | <0.001 |
|  | Planorboidea | | *Menetus dilatatus* | 0.184 | <0.001 |
|  | Planorboidea | | *Physella* | 0.158 | <0.001 |
|  | Basommatophora | | *Ferrissia*\* | 0.163 | <0.001 |
|  | Arhynchobdellida | | *Erpobdella punctata*\* | 0.237 | <0.001 |
|  | Rhynchobdellida | | *Helobdella fusca*\* | 0.210 | <0.001 |
|  | Rhynchobdellida | | *Helobdella stagnalis*\* | 0.210 | <0.001 |
|  | Trichoptera | | *Hydroptila* | 0.118 | <0.001 |
|  | Trichoptera | | *Ceratopsyche* | 0.094 | <0.001 |
|  | Trichoptera | | *Cheumatopsyche* | 0.106 | <0.001 |
|  | Trichoptera | | *Hydropsyche* | 0.126 | <0.001 |
|  | Lumbriculida | | Lumbriculidae\* | 0.278 | 0.020 |
|  | Zygoptera | | *Agria* | 0.176 | <0.001 |
|  | Zygoptera | | *Calopteryx*\* | 0.217 | <0.001 |
|  | Amphipoda | | *Gammarus* | 0.195 | <0.001 |
|  | Copepod | | Copepoda\* | 0.237 | 0.041 |
|  | Decapoda | | *Orconectes rusticus*\* | 0.227 | <0.001 |
|  | Hemiptera | | *Microvelia*\* | 0.249 | <0.001 |
|  | Isopoda | | *Caecidotea*\* | 0.181 | <0.001 |
|  | |  | | | |
| **Autumn** | Diptera | | *Psychoda*\* | 0.183 | <0.001 |
|  | Coleoptera | | *Ectopria* | 0.174 | 0.010 |
|  | Coleoptera | | Haliplidae | 0.149 | 0.010 |
|  | Cerithioidea | | *Pleruocera* | 0.180 | 0.041 |
|  | Planorboidea | | *Menetus dilatatus* | 0.191 | 0.020 |
|  | Planorboidea | | *Physella* | 0.185 | <0.001 |
|  | Trichoptera | | *Hydropsyche* | 0.148 | 0.010 |
|  | Trichoptera | | *Ceratopsyche* | 0.128 | 0.011 |
|  | Trichoptera | | *Cheumatopsyche* | 0.127 | <0.001 |
|  | Trichoptera | | *Hydroptila* | 0.140 | 0.010 |
|  | Zygoptera | | *Agria* | 0.224 | 0.041 |
|  | Amphipoda | | *Gammarus* | 0.225 | 0.020 |
|  | |  | | | |
| **Winter** | Diptera | | Chironomidae\* | 0.132 | 0.010 |
| Diptera | | *Culicoides* | 0.222 | <0.001 |
| Diptera | | *Dasyhelea* | 0.199 | <0.001 |
| Tricladida | | Planariidae | 0.247 | <0.001 |
| Ephemeroptera | | Baetidae | 0.252 | <0.001 |

**Supplemental Figures**

Figure S1: Mean light at the surface of the stream between honeysuckleand removal stream reaches. Letters on the x-axis represent sampling months for years indicated.

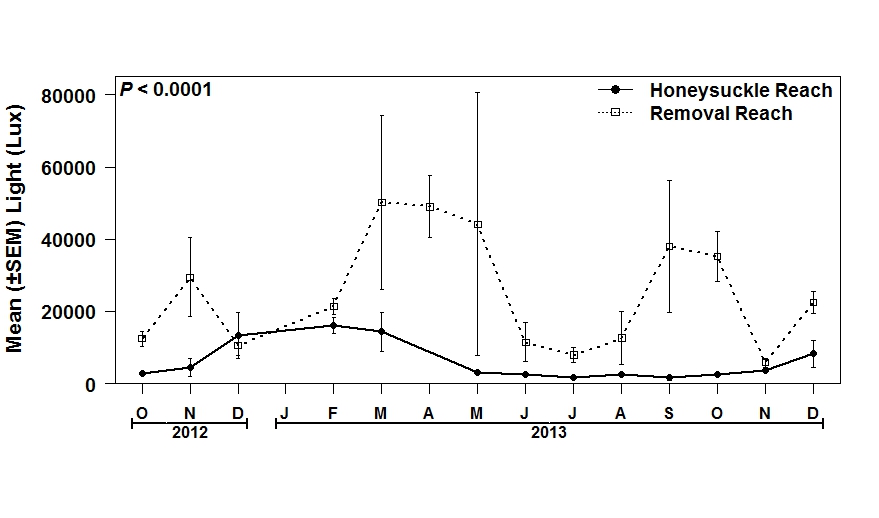
Figure S2: Ambient nutrient and total suspended solid dynamics honeysuckleand removal stream reaches. Letters on the x-axis represent sampling months for years indicated.

Figure S3: Taxonomic richness and diversity for honeysuckleand removal stream reaches. Letters on the x-axis represent sampling months for years indicated.

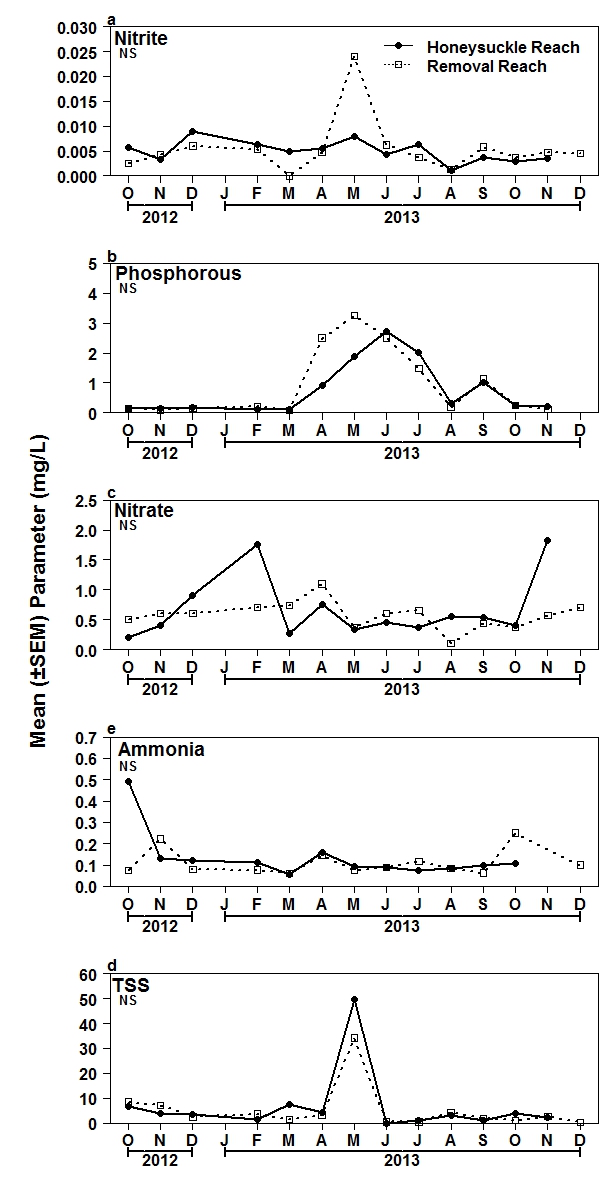
Figure S4: Functional diversity metrics for honeysuckleand removal stream reaches. Letters on the x-axis represent sampling months for years indicated.

Figure S5: Mean macroinvertebrate functional feeding group (FFG) relative abundance between honeysuckle and removal stream reaches. Letters on the x-axis represent sampling months for years indicated.

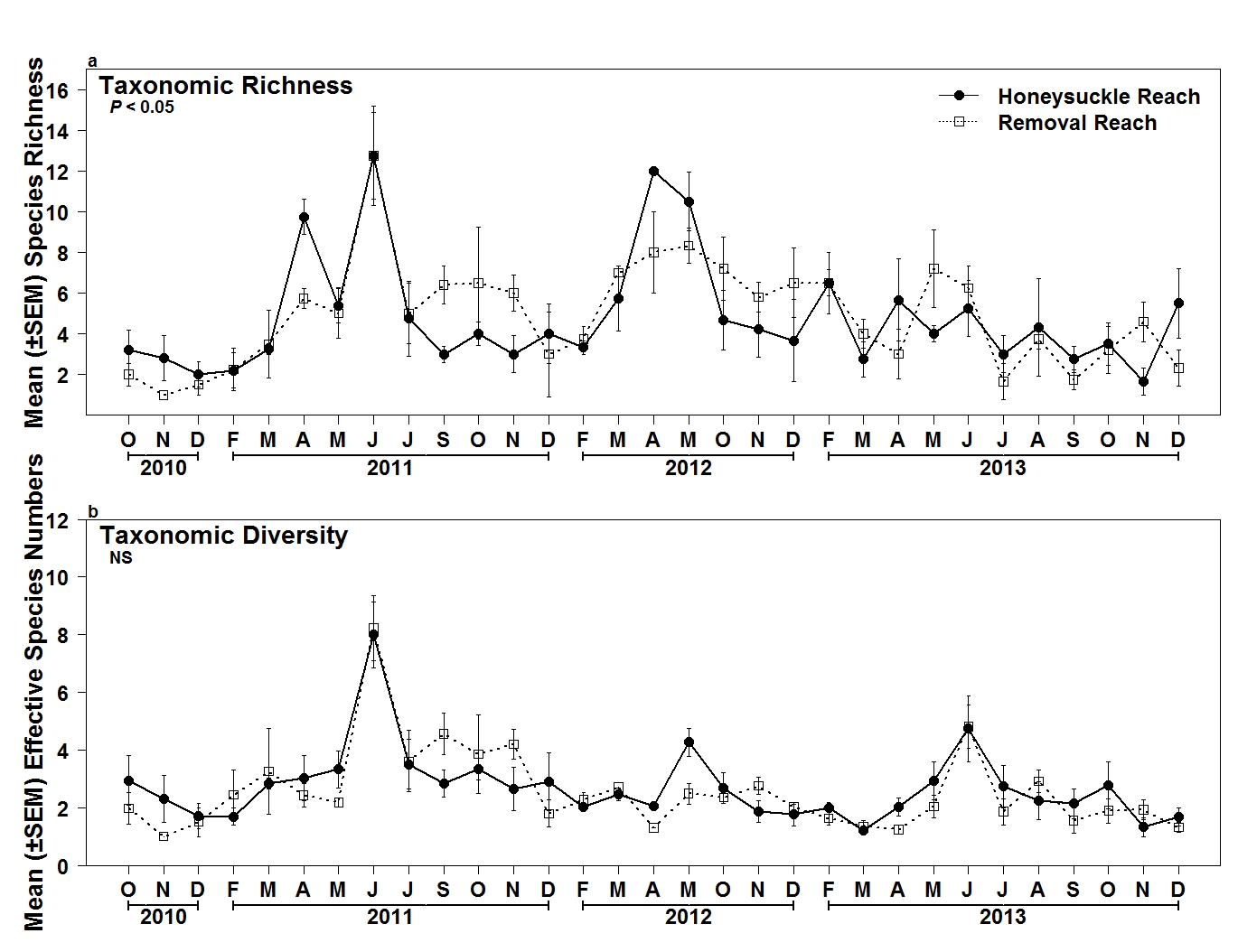
**Fig. S1**

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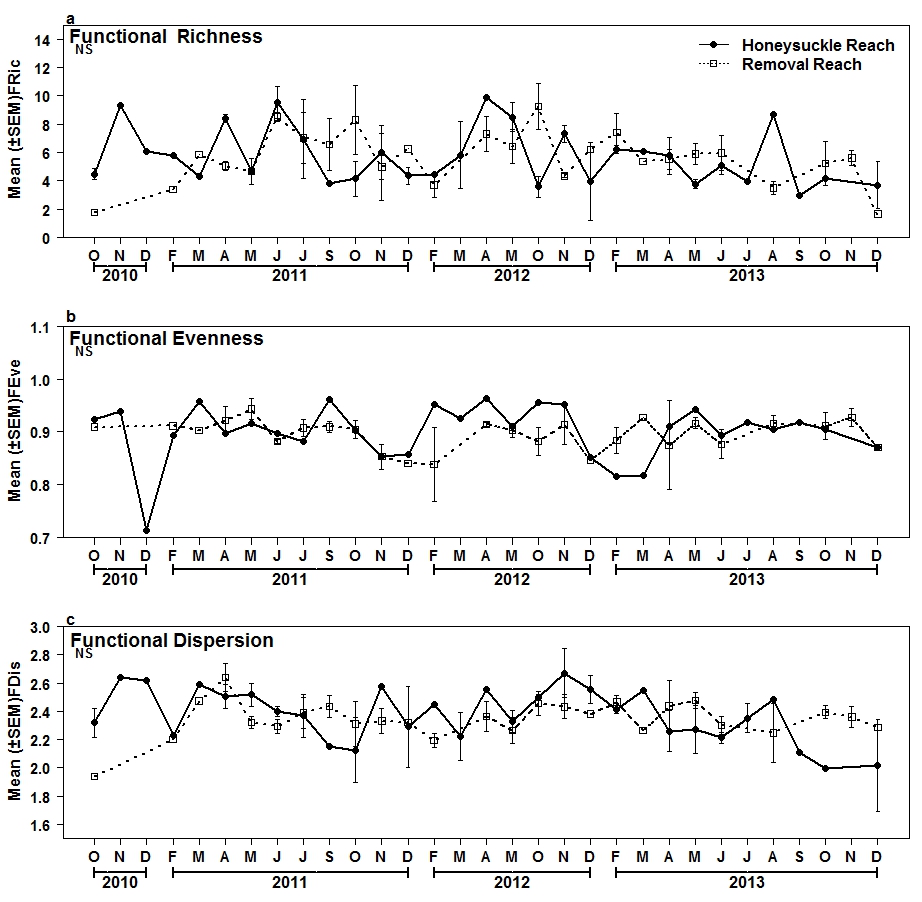
**Fig. S2**

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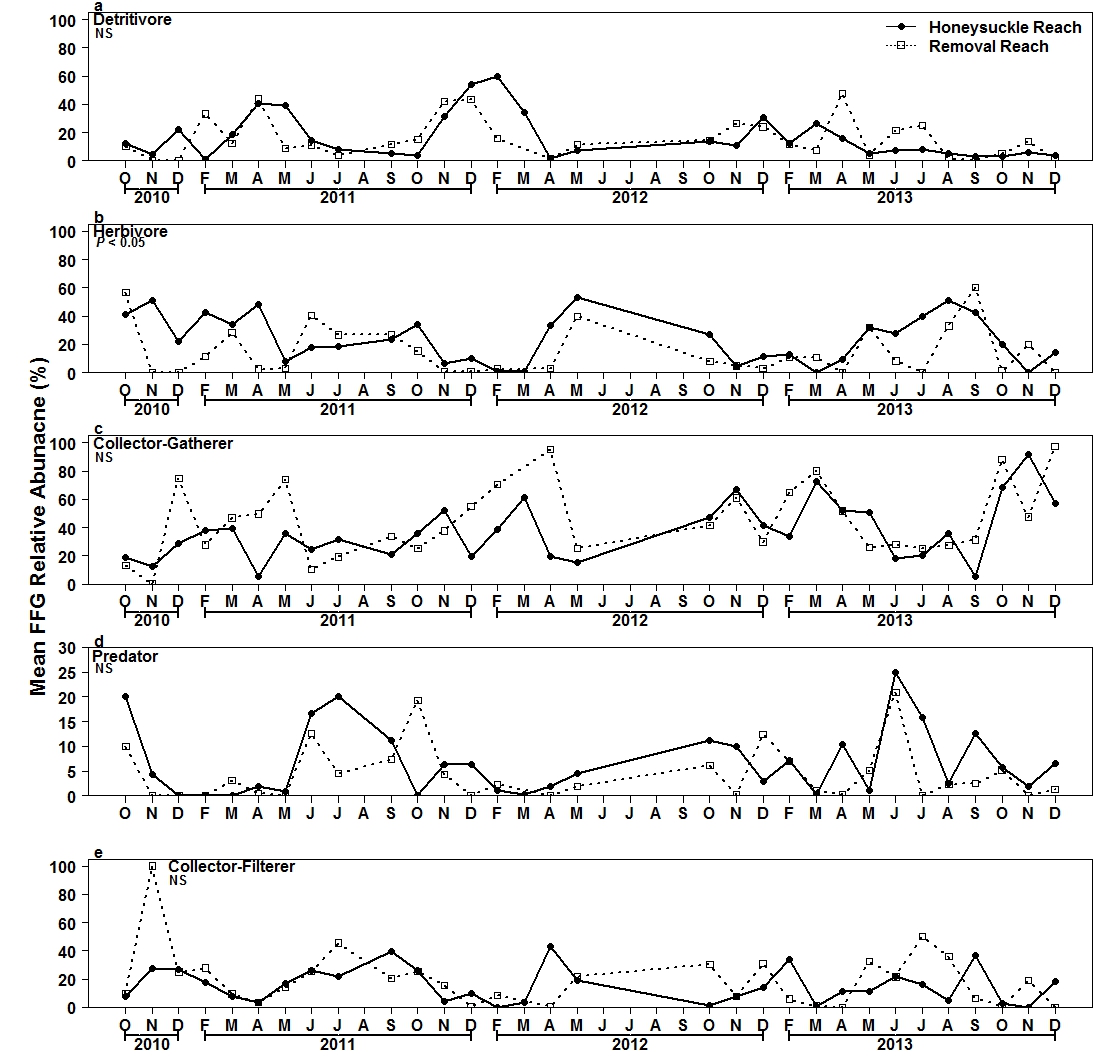
**Fig. S3**

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**Fig. S4**

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**Fig. S5**

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1. \* First and third authors: PhD student and Associate Professor, Department of Biology, University of Dayton, Dayton, OH 45469; Second author: Associate Professor, Department of Entomology and Department of Osteopathic Medical Specialties, Michigan State University, East Lansing, MI 48824. Current address of first author: Post-doctoral Fellow, Department of Biology, Loyola University Chicago, Chicago, IL 60660. Corresponding author’s E-mail: rachel.e.mcneish@gmail.com [↑](#footnote-ref-1)