



Common Name: **Beetles-Carabid Group**
Scientific Name: **Beetles-Carabid Group**
Species Group: **Invert**

Conservation Assessment

Final Assessment: Medium Priority

Global Rank:

Global Trend:

State Rank:

State Trend: Unknown

Extirpated in VT?

Regional SGCN?

Assessment Narrative:

This group contains a great number of species that are ranked as rare, but for which more information is needed before conservation strategies can be developed. Compilation of existing information as well as gathering new data is required. Our understanding of distribution, abundance, and status of the many rare species in this group is limited. Existing information is currently being gathered and compiled. These beetles vary in their distribution and habitat requirements. This group includes 30 species:

- Agonum crenistriatum*: two VT locations. Uses vulnerable habitat.
- Agonum darlingtoni*: 4 locations. Habitat specialist; uses vulnerable habitat.
- Agonum decorum*: nineteen locations. Occurs along much of Lake Champlain shoreline. Remove
- Agonum moerens*: three locations. Low elevation species near Lake Champlain.
- Agonum picicornoides*: six locations. Habitat specialist.
- Agonum punctiforme*: one location. Uses human-influenced areas.
- Agonum superioris*: ten locations. Variety of locations in state. Northern species; may be vulnerable to climate change.
- Amara erratica*: one location. Uses vulnerable habitat.
- Amara laevipennis*: ten locations. Uses forest openings, including human influenced sites.
- Apristus latens*: two locations. Specialist of habitat along rivers (dry, unshaded sand).
- Atranus pubescens*: two locations. Found in beaver lodges.
- Bembidion affine*: three locations. Southern species that extends well to south of VT.
- Bembidion cordatum*: one location. May be recent "irruption" from western populations.
- Bembidion grapii*: seven locations. Uses vulnerable habitat.
- Bembidion mutatum*: six locations. High mountain, relict populations in VT.
- Bembidion quadratum*: two locations. Uses vulnerable habitat. Northern species on edge of range in VT.
- Bembidion robusticolle*: one location. On northeast edge of range in VT; uses common habitat.
- Bembidion rolandi* ten locations. Sites include many on Lake Champlain.
- Bembidion rufotinctum*: six locations. Habitat specialist.
- Blethisa hudsonica*: six locations. Status uncertain.
- Blethisa julii*: one location. Found only at one somewhat unique site.
- Blethisa quadricollis*: two locations. Uses specialized habitat.
- Carabus goryi* thirteen locations. Appears to be advancing northward.
- Carabus maeander*: six locations. Many locations on or near Lake Champlain.
- Dicaelus dilatatus dilatatus*: three locations. Habitat specialist.
- Dicaelus teter*: three locations. Uses localized habitat.
- Dicheirotrichus cognatus*: four locations. Uses rare habitat.
- Diplocheila impressicollis*: five locations. Uses common habitat over a large area of VT.
- Diplocheila striatopunctata*: six locations. Uses specialized habitat.
- Dyschirius brevispinus*: one location. On northeast edge of range; uses human-influenced habitat.
- Dyschirius erythrocerus*: six locations. On northeast edge of range; status uncertain.
- Dyschirius politus politus*: seven locations. Northern species on edge of range.
- Elaphropus dolosus*: three locations. Western species on edge of range in VT; possible recent arrival.
- Elaphropus levipes*: one location. Status uncertain.
- Elaphrus fuliginosus*: five locations. Rare even though VT is within the general range.
- Geopinus incrassatus*: four locations. Sites are localized along one river.



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- Harpalus fulvilabris*: four locations. Limited occurrences, including high elevation sites; unclear whether a habitat specialist.
- Harpalus indigenus*: six locations. Found over large area in VT in generalized habitat.
- Harpalus providens* three locations. Appears to be somewhat of a habitat generalist over a large area of VT.
- Lophoglossus scrutator*: four locations. Localized in VT.
- Nebria suturalis*: one location. Highly localized in specialized habitat (Mt. Mansfield).
- Notiobia sayi*: three locations. Though limited area of occurrence, it utilizes common habitat.
- Notiophilus aquaticus*: two locations. Although one occurrence is high elevation, it may utilize more common habitats.
- Notiophilus borealis*: one location. Apparently limited to one site on rare habitat (Mt. Mansfield).
- Notiophilus nemoralis*: nine locations. High elevation specialist; habitat may be vulnerable to climate change.
- Notiophilus novemstriatus*: one location. Though localized, it is a southern species on edge of range.
- Olisthopus micans*: four locations. Specialist of habitat that is limited along Lake Champlain.
- Patrobus foveocollis*: two locations. Specialist of high elevation sites. Northern species on edge of range; may be vulnerable to climate change.
- Pentagonica picticornis*: four locations. Habitat specialist, but on fairly common habitat. Southern species on edge of range.
- Pericompsus ephippiatus*: four locations. Southern species on edge of range.
- Philodes alternans*: one VT location. Rare species, though not on edge of range.
- Philodes rectangularis*: two VT locations. Northern species on edge of range. Uses common habitat by Lake Champlain.
- Platynus cincticollis*: three locations. Utilizes variety of habitats. Southern species.
- Platypatrobus lacustris*: three locations. Probably more widespread than occurrences indicate, due to difficulty of collection.
- Pseudamara arenaria*: six locations. Most specimens from mid-, high elevation; but some habitat uncertainty.
- Pterostichus brevicornis brevicornis*: seven locations. High elevation specialist; mountain crests. Northern species; on edge of range.
- Pterostichus castor*: six locations. Common habitat type.
- Pterostichus pinguedineus*: three locations. High elevation and habitat specialist. Northern species on edge of range.
- Pterostichus punctatissimus*: fourteen locations. Several occurrences, but specialized on rare habitats in limited area.
- Scaphinotus bilobus*: three locations. Status uncertain.
- Schizogenius ferrugineus*: two locations. Few occurrences, but in common habitat. Southern species.
- Sericoda obsoleta*: two locations. Status uncertain.
- Sericoda quadripunctata*: three locations. Widespread species; status uncertain.
- Sphaeroderus nitidicollis*: six locations. Northern species with relict populations in Adirondacks and New England mountains.
- Tachys oblitus*: six locations. Occurs over wide area of VT; uses common habitat.
- Tachys rhodeanus*: two locations. Only two occurrences despite use of common habitat and VT being in interior of range.
- Tetragonoderus fasciatus*: four locations. Widespread species to south and west of VT. On edge of range.
- Tetraleucus picticornis*: one location. Widespread species to south and west of VT. On edge of range



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Distribution

Information is being gathered and compiled regarding known occurrences of these species. Biophysical regions of known collection sites are reflected below for each species. Additional collection effort is needed to gain a more complete picture of distributions.

- Agonum crenistriatum*: Champlain Valley
- Agonum darlingtoni*: Champlain Valley, Northern Green Mountains, Southern Green Mountains
- Agonum moerens*: Champlain Valley
- Agonum picicornoides*: Northern Green Mountains, Southern Green Mountains
- Agonum punctiforme*: Vermont Valley
- Agonum superioris*: Champlain Valley, Northern Highlands, Northern Green Mountains, Southern Green Mountains, Southern Vermont Piedmont
- Amara erratica*: Northern Green Mountains
- Amara laevipennis*: Northern Highlands, Northern Green Mountains, Taconic Mountains, Southern Vermont Piedmont
- Apristus latens*: Northern Green Mountains, Southern Vermont Piedmont
- Atranus pubescens*: Northern Green Mountains
- Bembidion affine*: Southern Green Mountains, Southern Vermont Piedmont
- Bembidion cordatum*: Champlain Valley
- Bembidion grapii*: Northern Green Mountains, Southern Green Mountains
- Bembidion mutatum*: Northern Green Mountains
- Bembidion quadratum*: Northern Highlands, Northern Green Mountains
- Bembidion robusticolle*: Champlain Valley
- Bembidion rolandi*: Champlain Valley, Southern Green Mountains, Taconic Mountains
- Bembidion rufotinctum*: Champlain Valley, Northern Vermont Piedmont, Southern Vermont Piedmont
- Blethisa hudsonica*: Champlain Valley
- Blethisa julii*: Northern Green Mountains
- Blethisa quadricollis*: Northern Highlands, Northern Green Mountains
- Carabus goryi*: all biophysical regions possible except Northern Highlands
- Carabus maeander*: Champlain Valley, Champlain Hills
- Dicaelus dilatatus dilatatus*: Champlain Valley, Northern Vermont Piedmont
- Dicaelus teter*: Champlain Valley
- Dicheirotrichus cognatus*: Northern Highlands, Northern Green Mountains
- Diplocheila impressicollis*: Champlain Valley, Northern Vermont Piedmont
- Diplocheila striatopunctata*: Champlain Valley
- Dyschirius brevispinus*: Champlain Valley
- Dyschirius erythrocerus*: Champlain Valley, Vermont Valley
- Dyschirius politus politus*: Champlain Valley, Northern Highlands
- Elaphropus dolosus*: Champlain Valley, Southern Vermont Piedmont
- Elaphropus levipes*: Champlain Valley
- Elaphrus fuliginosus*: Champlain Valley, Northern Highlands, Northern Green Mountains, Northern Vermont Piedmont
- Geopinus incrassatus*: Champlain Valley
- Harpalus fulvilabris*: Northern Green Mountains, Southern Green Mountains
- Harpalus indigenus*: Northern Highlands, Northern Green Mountains, Northern Vermont Piedmont, Southern Vermont Piedmont, Taconic Mountains, Champlain Valley
- Harpalus providens*: Champlain Valley, Vermont Valley
- Lophoglossus scrutator*: Champlain Valley
- Nebria suturalis*: Northern Green Mountains
- Notiobia sayi*: Champlain Valley

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- Notiophilus aquaticus: Champlain Valley, Northern Green Mountains
- Notiophilus borealis: Northern Green Mountains
- Notiophilus nemoralis: Northern Green Mountains, Southern Green Mountains, Taconic Mountains
- Notiophilus novemstriatus: Champlain Valley
- Olisthopus micans: Champlain Valley
- Patrobus foveocollis: Northern Green Mountains
- Pentagonica picticornis: Champlain Valley, Northern Green Mountains
- Pericompsum ephippiatus: Southern Vermont Piedmont
- Philodes alternans: Taconic Mountains
- Philodes rectangularis: Champlain Valley
- Platynus cincticollis: Champlain Valley, Northern Green Mountains
- Platypatrobus lacustris: Champlain Valley, Northern Green Mountains
- Pseudamara arenaria: Champlain Valley, Northern Green Mountains
- Pterostichus brevicornis brevicornis: Northern Green Mountains
- Pterostichus castor: Northern Green Mountains
- Pterostichus pinguedineus: Northern Green Mountains
- Pterostichus punctatissimus: Northern Green Mountains
- Scaphinotus bilobus: Northern Highlands, Northern Green Mountains, Southern Vermont Piedmont
- Schizogenius ferrugineus: Champlain Valley, Northern Highlands
- Sericoda obsoleta: Champlain Valley, Northern Green Mountains
- Sericoda quadripunctata: Champlain Valley, Northern Green Mountains, Southern Vermont Piedmont
- Sphaeroderus nitidicollis: Northern Highlands, Northern Green Mountains, Northern Vermont Piedmont
- Tachys oblitus: Champlain Valley, Northern Green Mountains, Southern Vermont Piedmont
- Tachys rhodeanus: Champlain Valley, Southern Vermont Piedmont
- Tetragonoderus fasciatus: Champlain Valley, Southern Vermont Piedmont
- Tetraleucus picticornis: Champlain Valley

Distribution by Biophysical Region:

| | | | |
|-------------------------------|-----------|-----------------------------|-----------|
| Champlain Valley | Confident | Southern VT Piedmont | Confident |
| Champlain Hills | Confident | Vermont Valley | Confident |
| Northern Green Mtns | Confident | Southern Green Mtns | Confident |
| Northern VT Piedmont | Confident | Taconic Mtns | Confident |
| Northeastern Highlands | Confident | | |

Distribution by Watershed:

Habitat Description

Habitat Information is based on the following:

Limited Local Knowledge Extensive Local Knowledge Regional Literature General Literature

Existing information on habitat use and requirements of these beetles is being gathered and compiled. Much work is still needed to better defined habitat use and needs. Some are known to use specialized habitats and natural communities.

--Agonum crenistriatum: One from an area of sand dunes (since destroyed). The other were on limestone pavements (alvars). Elsewhere this species has been collected from other hot, dry habitats, such as gravel pits, sandy fields and croplands, sea and lake shores.



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- Agonum darlingtoni*: Sphagnum bogs.
- Agonum moerens*: Soft, wet mud by ponds, streams, and fens. In VT restricted to very low elevations, below 35 m near Lake Champlain.
- Agonum picicornoides*: In VT, usually by beaver ponds, bare mud in willow, alder thickets. Usually at 300 m or above (never at Sphagnum bogs).
- Agonum punctiforme*:: Open areas such as croplands, pastures, also forests.
- Agonum superioris*: Among emergent vegetation in marshes, bogs, and swamps, usually above 300 m.
- Amara erratica*: Grasslands on high mountains.
- Amara laevipennis*: Clearings in forests, such as beaver ponds, clearcuts, roadsides.
- Apristus latens*: Dry, unshaded sand along rivers.
- Atranus pubescens*: In VT, taken from an abandoned beaver house. Elsewhere, it has been found in heaps of leaves, sticks, and mud along rivers and brooks (flood debris) as well as beaver houses. The larva has been found in beaver houses.
- Bembidion affine*: VT specimens were taken on bare, wet mud on the margins of marshy pools.
- Bembidion cordatum*: Mud or muddy sand beside lakes, ponds, impounded sections of streams.
- Bembidion grapii*: Restricted to high mountains where it is found on rocky summits which are bare or have only small or stunted trees. Most records are from 1200 m or higher and are associated with some tundra plants.
- Bembidion mutatum*: High mountain relict populations. In VT, collected under dry clumps of moss on barren, smooth bedrock. Records are mostly from alpine tundra. Further north, it has been recorded from barren spots on dry moraines. More northern records from QC are from roadsides, fields, and sand pits.
- Bembidion quadratum*: Sphagnum mats of bogs.
- Bembidion robusticolle*: Sand banks by rivers.
- Bembidion rolandi*: Gravelly areas along lakes and rivers, especially in the angular shale gravel below bluffs along Lake Champlain.
- Bembidion rufotinctum*: On rock ledges along big rivers by rapids or falls. Usually they are within a meter of the water's edge where spray moistens and cools the rocks. Often there are thin mats of hair-like green algae. They can be found on isolated rocks or islets within the rapids.
- Blethisa hudsonica*: Floating mats of vegetation in lakes and still portions of rivers.
- Blethisa julii*: In NH, occurs in moss and grass beside small high elevation lakes. VT location is a lower (220m) elevation pond, which is shaded most of the day.
- Blethisa quadricollis*: Sphagnum mats in acid bogs.
- Carabus goryi*: Deciduous forest at least to 300 m elevation.
- Carabus maeander*: An amphibious species inhabiting swampy spots with shallow water usually with cattails (*Typha*) or sedges (*Carex*).
- Dicaelus dilatatus dilatatus*: Dry deciduous forests and sand areas. Adapted to dry conditions.
- Dicaelus teter*: Deciduous forests, especially oaks growing on limestone. Forages at night on fallen logs and climbs standing trees. Recorded as feeding on snails and caterpillars.
- Dicheirotrichus cognatus*: Open areas just below the tree line, and in the alpine tundra. Has been taken several times in beaver houses.
- Diplocheila impressicollis*: In cattail (*Typha*) marshes and other wetlands.
- Diplocheila striatopunctata*: In VT, only in bottomland, swamp forests by Lake Champlain.
- Dyschirius brevispinus*: VT specimens were taken under small stones on bare cultivated soil. Elsewhere it has been collected in gravel pits.
- Dyschirius erythrocerus*: Recorded habitats include river banks, lake shore, and sea beaches. Most of our specimens however, were caught at light traps.
- Dyschirius politus politus*: According to general literature, it is found in sand by rivers and lakes but also in sand pits. It is rarely found in riverside or lakeside sand in the Burlington area where the similar *D. sphaericollis* is abundant. Relatively common in light traps despite its apparent rarity along rivers.
- Elaphropus dolosus*: Bare sand along rivers and lake shores.



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- Elaphropus levipes*: River banks on muddy sand. Shelters by day in soil or under bark.
- Elaphrus fuliginosus*: Habitat difficult to characterize and variously described in literature, but generally open places with sparse vegetation on wet, sandy or fine mud soils; sometimes with mosses such as sphagnum.
- Geopinus incrassatus*: Sand or very sandy soil, especially in the higher, drier parts of sand banks along rivers. A specialized burrower, usually deeply buried by day.
- Harpalus fulvilabris*: Open or partially shaded areas in the mountains, including exposed bedrock.
- Harpalus indigenus*: Open areas on poor soil, usually sand, but also found on a sterile, sloping field of clay and gravel.
- Harpalus providens*: A forest species, with records from a forestry plantation on sand, and from an open oak forest on a limestone ridge.
- Lophoglossus scrutator*: In VT, on very soft mud on natural levees within river delta; most found under large logs embedded in the soft, shaded mud. Reported elsewhere from open marsh habitats among dense vegetation.
- Nebria suturalis*: In VT, confined to above 1200 m elevation on Mount Mansfield. Confined to series of deep joint crevices in warm or dry weather; in cool, wet weather may extend to nearby fell field and talus. Larva has been found in crevices where snow lingers until early summer.
- Notiobia sayi*: Sand areas near Lake Champlain among sparse vegetation, including croplands.
- Notiophilus aquaticus*: Relatively dry, open ground in alpine tundra on Mt. Mansfield, but also found on bare soil in a low elevation apple orchard near Lake Champlain.
- Notiophilus borealis*: Alpine tundra. Reported from dry moss.
- Notiophilus nemoralis*: Found amid litter and mosses in spruce-fir forests, 900 – 1200 m elevation.
- Notiophilus novemstriatus*: General habitat is dry forest edges.: VT specimens found in tufts of grass on quartzite ledges above cliffs. Reported from IL in oak forest at edge of shale bluffs along river valleys.
- Olisthopus micans*: By river mouths, in forests that are flooded by Lake Champlain in the springtime.
- Patrobus foveocollis*: Dry openings in spruce-fir forest of high elevation (900-1200 m).
- Pentagonica picticornis*: In VT, quartzite and schist rock ledges. Also reported as found under moss clumps on boulders.
- Pericompso ephippiatus*: Found only on short stretch of Connecticut River in southeastern VT.: Barren or sparsely vegetated sand bars where sand is usually dry but close to the water.
- Philodes alternans*: Found under a large flat stone at the margin of the Battenkill, below an eroding bank about 1.3 m height.
- Philodes rectangularis*: records are from the wet mud banks by Lake Champlain at the mouths of two small rivers, elevation about 30 m.
- Platynus cincticollis*: Floodplain forests and forests bordering ponds and slow streams. Occasionally found in beaver houses, tree cavities, or under plant debris on beaches.
- Platypatrobus lacustris*: Active beaver huts (beaver present).
- Pseudamara arenaria*: Usually above 400 m elevation, in mountain forests.: Some habitat uncertainty.
- Pterostichus brevicornis brevicornis*: High, cold parts of the coniferous forest; 750-1130 m elevation.
- Pterostichus castor*: Beaver houses, both active and abandoned.
- Pterostichus pinguedineus*: Most specimens collected in deep rock crevices at or above tree line on mountain tops. Share habitat with *Nebria suturalis*. Lowest VT record is 750 m elevation; others all above 1200 m.
- Pterostichus punctatissimus*: Boreal species. Two habitat types: (1) in higher mountains above 900 m, found under cover (especially mosses) in fir and spruce forests; (2) near some bogs where cold air accumulates
- Scaphinotus bilobus*: Generally spruce forests.
- Schizogenius ferrugineus*: Clean sand or sandy fields, often near water. Found under woody debris or in grass tufts.
- Sericoda obsoleta*: Found in wood ashes. Have been taken under bark of standing dead trees, in fire places in campgrounds, and in houses which have wood stoves or furnaces. May arrive at sites while fires are still burning.
- Sericoda quadripunctata*: Found in wood ashes. Have been taken under bark of standing dead trees, in fire places in campgrounds, and in houses which have wood stoves or furnaces. May arrive at sites while fires are



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still burning.

--*Sphaeroderus nitidicollis*: Coniferous and mixed forest, generally higher elevation in VT, 600-750 m.

--*Tachys oblitus*: Muddy borders of lakes and rivers, usually in vegetation.

--*Tachys rhodeanus*: On margins of slow rivers, lakes, and marshes; on very moist soil which is bare or with sparse vegetation.

--*Tetragonoderus fasciatus*: Dry sand areas near large rivers and lakes; found in sunny spots, but usually near shade. Less than 90 m elevation.

--*Tetraleucus picticornis*: South of VT, reported from cypress swamps and along swampy shore of rivers.: VT specimens were found beneath driftwood along a seasonally flooded ditch beside a dirt road within forest.

Habitat Types:

Upland Shores

Outcrops and Alpine

Cliffs and Talus

Spruce Fir Northern Hardwood

Northern Hardwood

Oak-Pine Northern Hardwood

Open Peatlands

Marshes and Sedge Meadows

Wet Shores

Shrub Swamps

Building or Structure

Grasslands, Hedgerows, Old Field, Shrub, or Orchard

Lawns, Gardens, and Row Crops

Other Cultural

Aquatic: Man-Made Water Bodies

Current Threats

Habitat Threats:

Conversion of Habitat

Energy Infrastructure and Development

Habitat Succession

Habitat Alteration

Sedimentation

Habitat Fragmentation

Impacts of Roads or Transportation Systems

Climate Change

Incompatible Recreation



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Description of habitat threat(s): Habitat problems are known for some species, and are related to habitat loss, change, and degradation. Being rare species, habitat fragmentation would lead to smaller, more vulnerable populations.

Non-Habitat Threats:

Genetics

Pollution

Unknown Non-Habitat Threats

Trampling or Direct Impacts

Description of non-habitat threat(s): The problems not related to habitat are poorly known for these beetles and need study. As rare species with often small populations, loss of metapopulation structure and function would be a problem. Some species are alpine, where heavy recreational use can result in trampling.

Research and Monitoring Needs

| Type | Need | Priority | Description |
|-------------|--------------------------------|-----------------|---|
| Research | Habitat Requirements | High | Gather information on habitats in which each SGCN carabid species reportedly occurs (literature research, consult researchers and hobbyists, etc.); this will be needed to refine distributional field surveys. |
| Research | Basic Life History | High | Life history information is needed for all species |
| Research | Distribution and Abundance | High | Conduct literature research and field surveys to update information on distribution of SGCN carabid species in Vermont. |
| Research | Threats and Their Significance | High | Research is needed on the vulnerability of species to various significant limiting factors to each habitat type. |
| Monitoring | Population Change | High | Revisit and survey sites with previous records of SGCN carabids to determine presence/absence; where present, determine |
| Monitoring | Range Shifts | High | Document changes in distribution, utilizing historic and recent records. |

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Species Strategies

| Strategy Type | Strategy Priority | Strategy Description | Performance Measure | Potential Partners | Potential Funding Sources |
|---|--------------------------|---|---|--|----------------------------------|
| Research | High | Visit known sites of occurrences which has undergone recent development or other disturbance. | Number of sites visited. | FWD, VMC | SWG |
| Technical Assistance, Training, Learning Networks | High | Sponsor training workshops for carabid identification, survey techniques, web database use | Number of workshops; number of participants | FWD, FPR, VCE, Eagle Hill | SWG |
| Research | High | Revisit historic sites to update records and monitor species. | Number of historic sites visited. | FWD | SWG |
| Alliance Development | High | Develop web-based database accessible to professionals and site record providers. | Publication on web site | FPR, FWD, VCE, VT Entomological Society, Carabid specialists | SWG, Lintillac Foundation |
| Awareness Raising and Communications | High | Publish "Carabidae of Vermont and New Hampshire", which is currently in final draft, as a hard copy and on-line resource. | Availability of Carabidae information | FPR, FWD, VCE, VMC, VT Entomological Society | SWG, Lintillac Foundation, UVM |



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Bibliography

- Allegra, G., and R. Sciaky. 2003. Assessing the potential role of ground beetles (Coleoptera, Carabidae) as bioindicators in poplar stands, with a newly proposed ecological index (FAI). *Forest Ecology and Management* 175:275-284.
- Andersen, J. 1985. Humidity responses and water balance of riparian species of Bembidiini (Col., Carabidae). *Ecological Entomology* 10:363-375.
- Andersen, J. 1995. A comparison of pitfall trapping and quadrat sampling of Carabidae (Coleoptera) on river banks. *Entomologica Fennica* 6:65-77.
- Anonymous. 1991. Endangered and threatened wildlife and plants; animal candidate review for listing as endangered or threatened species, proposed rule. Federal register. Department of the Interior. Fish and Wildlife Service.
- Antvogel, H., and A. Bonn. 2001. Environmental parameters and microspatial distribution of insects: a case study of carabids in an alluvial forest. *Ecography* 24:470-482.
- Baars, M. A. 1979a. Catches in pitfall traps in relation to mean densities of carabid beetles. *Oecologia* 41:25-46.
- Ball, G.E. 1979. Carabidae. Pp. 364-366 in H.V. Danks (Ed.). *Canada and its insect fauna*. Memoirs of the Entomological Society of Canada No. 108. 573 pp.
- Belaoussoff, S., P. G. Kevan, S. Murphy, and C. Swanton. 2003. Assessing tillage disturbance on assemblages of ground beetles (Coleoptera: Carabidae) by using a range of ecological indices. *Biodiversity and Conservation* 12:851-882.
- Bell, R.T. 2015. *Carabidae of Vermont and New Hampshire*. Shires Press. Manchester Center, VT.
- Bousquet, Y. 1986. Observations on the life cycle of some species of Pterostichus (Coleoptera: Carabidae) occurring in northeastern North America. *Le Naturaliste canadien* 113 : 295-307.
- Bousquet, Y. 1987. The carabid fauna of Canada and Alaska: range extensions, additions and descriptions of two new species of Dyschirius (Coleoptera: Carabidae). *The Coleopterists Bulletin* 41 : 111-135.
- Bousquet, Y. (Ed.). 1991. Checklist of beetles of Canada and Alaska. Agriculture Canada Publication 1861/E. 430 pp.
- Burel, F. 1989. Landscape structure effects on carabid beetles spatial patterns in western France. *Landscape Ecology* 2:215-226.
- Butterfield, J. 1996. Carabid life-cycle strategies and climate change: a study on an altitude transect. *Ecological Entomology* 21:9-16.
- Campbell, J.M. 1980. Distribution patterns of Coleoptera in eastern Canada. *The Canadian Entomologist* 112 : 1161-1175.
- Darlington, P.J. 1938. The American Patrobini. *Entomologica Americana* 18 : 135-183.
- Davidson, R. 1975. Harpalus (Ophonus) puncticeps Stephens (Coleoptera: Carabidae) in New York and Vermont. *The Coleopterists Bulletin* 29 : 256.
- Davies, K. F., and C. R. Margules. 1998. Effects of habitat fragmentation on carabid beetles: experimental evidence. *Journal of Animal Ecology* 67:460-471.
- Dietrich, H. 1957. Harpalus puncticeps Steph. On Long Island, N.Y. *The Coleopterists Bulletin* 11 : 46.
- Duval, P. & J. Duval. 1977. Première mention de l'Harpalus puncticeps Stephens (Coleoptera: Carabidae) pour le Maine, Etats-Unis d'Amérique. *Cordulia* 3 : 165-166.
- Epstein, M. E., and H. M. Kulman. 1990. Habitat distribution and seasonal occurrence of carabid beetles in East-central Minnesota. *The American Midland Naturalist* 123:209-225.
- Goulet, H. 1965. The habitat of Platypatrobis Darlington (Coleoptera: Carabidae). *Psyche* 72 : 305-306.
- Goulet, H. 1977. Contributions of characters of larvae to systematics of Carabidae. Pp. 205-208 in T.L. Erwin, G.E. Ball, D.R. Whitehead and A.L. Halpern (eds), *Carabid beetles: their evolution, natural history, and classification*. Junk, The Hague.

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Common Name: Beetles-Carabid Group
Scientific Name: Beetles-Carabid Group
Species Group: Invert

- Greene, A. 1975. Biology of the five species of Cychrini (Coleoptera: Carabidae) in the steppe region of southeastern Washington. *Melandieria* 19:1-43.
- Halme, E., and J. Niemälä. 1993. Carabid beetles in fragments of coniferous forest. *Annales Zoologici Fennici* 30:17-30.
- Hallsall, N. B., and S. D. Wratten. 1988. The efficiency of pitfall trapping for polyphagous predatory Carabidae. *Ecological Entomology* 13:293-299.
- Heliola, J., M. Koivula, and J. Niemälä. 2001. Distribution of carabid beetles (Coleoptera, Carabidae) across a boreal forest-clearcut ecotone. *Conservation Biology* 15:370-377.
- Honek, A. 1997. The effect of temperature on the activity of Carabidae (Coleoptera) in a fallow field. *European Journal of Entomology* 94:97-104.
- Joyce, K. A., J. M. Holland, and C. P. Doncaster. 1999. Influences of hedgerow intersections and gaps on the movement of carabid beetles. *Bulletin of Entomological Research* 89:523-531.
- Koivula, M. 2002. Alternative harvesting methods and boreal carabid beetles (Coleoptera, Carabidae). *Forest Ecology and Management* 167:103-121.
- LaBonte, J. R. 2002. Habitat associations of riparian beetles (Coleoptera) at Big Beaver Creek Research Natural Area, North Cascades National Park, Washington. M.S. thesis. Oregon State University, Corvallis, Oregon.
- Larochelle, A. 1975. Les Carabidae du Québec et du Labrador. *Bulletin du Département de Biologie du Collège Bourget, Rigaud* 1 : 1-255.
- Larochelle, A., and M.-C. Larivière. 2003. A natural history of the ground-beetles (Coleoptera: Carabidae) of America north of Mexico. *Pensoft Series Faunistica* No. 27, Sofia, Bulgaria.
- Lindroth, C.H. 1957. The faunal connections between Europe and North America. Stockholm. 344 pp.
- Lindroth, C. 1961. The ground-beetles (Carabidae excl. Cicindelinae) of Canada and Alaska. Part 2. *Opuscula Entomologica Supplementum* 20 : 1-200.
- Lindroth, C. 1963. The ground-beetles (Carabidae excl. Cicindelinae) of Canada and Alaska. Part 3. *Opuscula Entomologica Supplementum* 24 : 201-408.
- Lindroth, C. 1966. The ground-beetles (Carabidae excl. Cicindelinae) of Canada and Alaska. Part 4. *Opuscula Entomologica Supplementum* 29 : 409-648.
- Lindroth, C. 1968. The ground-beetles (Carabidae excl. Cicindelinae) of Canada and Alaska. Part 5. *Opuscula Entomologica Supplementum* 33 : 649-944.
- Lindroth, C. 1969. The ground-beetles (Carabidae excl. Cicindelinae) of Canada and Alaska. Part 6. *Opuscula Entomologica Supplementum* 34 : 945-1192.
- Magura, T., B. Tothmeresz, and T. Molnar. 2001. Forest edge and diversity: carabids along forest-grassland transects. *Biodiversity and Conservation* 10:287-300.
- Neve, G. 1994. Influence of temperature and humidity on the activity of three Carabus species. Pages 189-192 in K. Desender, M. Dufrene, M. Loreau, M. L. Luff, and J.-P. Maelfait, editors. *Carabid beetles: ecology and evolution*. Kluwer Academic Publishers, Dordrecht, The Netherlands.
- Niemälä, J., Y. Haila, E. Halme, T. Lahti, T. Pajunen, and P. Punttila. 1988. The distribution of carabid beetles in fragments of old coniferous taiga and adjacent managed forests. *Zoologici Fennici* 25:107-119.
- Niemälä, J., D. Langor, and J. R. Spence. 1993a. Effects of clear-cut harvesting on boreal ground-beetle assemblages (Coleoptera: Carabidae) in western Canada. *Conservation Biology* 7:551-561.
- Niemälä, J., J. R. Spence, D. Langor, Y. Haila, and H. Tukia. 1993b. Logging and boreal ground-beetle assemblages on two continents: implications for conservation. Pages 29-50 in K. J. Gaston, T. R. New, and M. J. Samways, editors. *Perspectives on insect conservation*. Intercept, Ltd., Andover, United Kingdom.

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Common Name: Beetles-Carabid Group
Scientific Name: Beetles-Carabid Group
Species Group: Invert

Rykken, J. J., D. E. Capen, and S. P. Mahabir. 1997. Ground beetles as indicators of land type diversity in the Green Mountains of Vermont. *Conservation Biology* 11:522-530.

Spence, J. R. 1979. Riparian carabid guilds--a spontaneous question generator. Pages 525-537 in T. L. Erwin, G. E. Ball, and D. W. Whitehead. *Carabid beetles: their evolution, natural history, and classification*. W. Junk Publishers, The Hague, The Netherlands.

Spence, J. R., D. W. Langor, J. Niemalä, H. A. Carcamo, and C. R. Currie. 1996. Northern forestry and carabids: the case for concern about old-growth species. *Annales Zoologici Fennici* 33:173-184.

Spence, J. R., and J. K. Niemalä. 1994. Sampling carabid assemblages with pitfall traps: the madness and the method. *The Canadian Entomologist* 126:881-894.

Spence, J.R. and D.H. Spence. 1988. Of ground-beetles and man: introduced species and the synanthropic fauna of western Canada. *Memoirs of the Entomological Society of Canada* 144 : 151-168.

Strong, A. M., C. A. Dickert, and R. T. Bell. 2002. Ski trail effects on a beetle (Coleoptera: Carabidae, Elateridae) community in Vermont. *Journal of Insect Conservation* 6: 149-159.

Sustek, Z. 1994a. Classification of the carabid assemblages in the floodplain forests in Moravia and Slovakia. Pages 371-376 in K. Desender, M. Dufrene, M. Loreau, M. L. Luff, and J.-P. Maelfait, editors. *Carabid beetles: ecology and evolution*. Kluwer Academic Publishers, Dordrecht, The Netherlands.

Thiele, H.-U. 1977. *Carabid beetles in their environments. A study on habitat selection by adaptations in physiology and behaviour*. Springer-Verlag, Berlin. Xvii + 369 pp.

Thompson, R.G. 1977. A synoptic list of the described ground beetle larvae of North America (Coleoptera: Carabidae). *Proceedings of the Biological Society of Washington* 90 : 99-107.

Trudel-Levesque, C. 1971. *Etude des Coléoptères Carabidae de forêts décidues des Laurentides (Québec), particulièrement en fonction de l'activité locomotrice*. M.Sc. Thesis, Université de Montréal. 86 pp.

Zulka, K. P. 1994. Carabids in a Central European floodplain: species distribution and survival during inundations. Pages 399-405 K. Desender, M. Dufrene, M. Loreau, M. L. Luff, and J.-P. Maelfait, editors. *Carabid beetles: ecology and evolution*. Kluwer Academic Publishers, Dordrecht, The Netherlands



Common Name: **Beetles-Tiger Beetle Group**
Scientific Name: **Beetles-Tiger Beetle Group**
Species Group: **Invert**

Conservation Assessment

Final Assessment: High Priority

Global Rank:

Global Trend:

State Rank:

State Trend: Declining

Extirpated in VT? No

Regional SGCN? Yes

Assessment Narrative:

This group includes three state-threatened species, one of which is also federally threatened, and four rare species, three of which are known from only one or two collections and includes:

--Boulder-beach Tiger Beetle (*Cicindela ancocisconensis*): This rarely observed beetle is known from only single collections on two widely separated rivers. Globally rare (G3), RSGCN*. Species appears to be in decline globally.

--Hairy-necked Tiger Beetle (*Cicindela hirticollis*): This state-threatened beetle's habitat and range has been greatly reduced and fragmented in Vermont by lakeshore development. It was formerly known from several sites along the northern Lake Champlain shores, but is now reduced to a single site. This habitat is protected by the Winooski Valley Park District.

--Boreal Long-lipped Tiger Beetle (*Cicindela longilabris*): There are few records of this little known beetle in VT. It is a northern species found in VT at moderately high elevations. More survey work is needed.

--Cobblestone Tiger Beetle (*Cicindela marginipennis*): There are few records of this state-threatened species scattered around the state in uncommon habitat. It has been studied in VT to a greater degree than other *Cicindela*. At least one site appears to no longer support the species. Habitat losses along the Connecticut River and possibly other rivers have been significant due to impoundments. Globally rare (G2), RSGCN*.

--Northern Barrens Tiger Beetle (*Cicindela patruela*): This is a very rare species throughout the Northeast; known in VT from a single historic collection. Globally rare (G3), RSGCN*. It uses restricted habitat (sand plains), which has been extensively destroyed in VT and elsewhere; global occurrences are now highly fragmented. It is now a rare, relict species.

--Puritan tiger beetle (*Cicindela puritana*): This federally threatened species is known from a single historic VT collection, although other historic records were known along the New Hampshire side of the river.

Impoundments along the Connecticut River likely caused the extirpation of this species. Other habitat losses may have also been a factor. Reintroduction could be considered if sufficient habitat improvements are made. Riverside recreational use has had a significant impact on populations at other New England sites. RSGCN*

--Eastern Red-bellied Tiger Beetle (*Cicindela rufiventris*): Known from a single VT location. Its status is unknown.

*Regional Species of Greatest Conservation Need (RSGCN) among the 13 Northeastern states

Distribution

--Boulder-beach Tiger Beetle (*Cicindela ancocisconensis*): Reported from Underhill historically. More recently from West River and Third Branch of the White River. Biophysical regions: Southern Green Mountains, Northern Green Mountains.

--Hairy-necked Tiger Beetle (*Cicindela hirticollis hirticollis*): Historically six locations on Lake Champlain, three of which probably represented dispersing individuals. Only a single extant breeding population now known in Colchester. Biophysical regions: Champlain Valley.

--Boreal Long-lipped Tiger Beetle (*Cicindela longilabris*): Three locations. Restricted to the mountains and northern plateau in VT. Biophysical regions: Northern Green Mountains, Northern Highlands.

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Species Group: **Invert**

--Cobblestone Tiger Beetle (*Cicindela marginipennis*): Known from West, White, and Winooski rivers. It is reported that populations along the Connecticut River are believed to use islands (NH) for larval sites, though adults will forage on the west (VT) shore. Biophysical regions: Southern Vermont Piedmont, Northern Green Mountains, Champlain Hills.

--Northern Barrens Tiger Beetle (*Cicindela patruela*): Single historic record from Burlington. Sand plains in and around Burlington have largely been destroyed by urban growth. Biophysical regions: Champlain Valley.

--Puritan Tiger Beetle (*Cicindela puritana*): On historic location in Hartland. Biophysical regions: Southern Vermont Piedmont.

--Eastern Red-bellied Tiger Beetle (*Cicindela rufiventris*): One location in Sandgate. Biophysical regions: Taconic Mountains.

Distribution by Biophysical Region:

| | | | |
|-------------------------------|--------------|-----------------------------|-----------|
| Champlain Valley | Confident | Southern VT Piedmont | Confident |
| Champlain Hills | Confident | Vermont Valley | Probable |
| Northern Green Mtns | Confident | Southern Green Mtns | Confident |
| Northern VT Piedmont | Not Probable | Taconic Mtns | Confident |
| Northeastern Highlands | Confident | | |

Distribution by Watershed:

Habitat Description

Habitat Information is based on the following:

Limited Local Knowledge Extensive Local Knowledge Regional Literature General Literature

Habitat Types:

Upland Shores
Outcrops and Alpine
Spruce Fir Northern Hardwood
Oak-Pine Northern Hardwood
Open Peatlands
Wet Shores

Current Threats

Habitat Threats:

Conversion of Habitat
Habitat Succession



Common Name: **Beetles-Tiger Beetle Group**
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Species Group: **Invert**

Habitat Alteration

Sedimentation

Inadequate Disturbance Regime

Invasion by Exotic Species

Incompatible Recreation

Climate Change

Description of habitat threat(s): Regular scouring of river shores by high water events helps keep habitat open by reducing vegetation; damming of rivers impacts this process downstream of these structures and may degrade habitat. Replenishment of substrates is also reduced downstream of dams, which can alter substrate composition along shores. Excessive fine sediments that enter streams and rivers can alter the substrate composition along shores, thereby reducing the suitability of habitat. Development along shores of Lake Champlain and rivers has reduced the availability of habitat. Loss of sand plain habitat has probably caused extirpation of one species. Northern species on the southern edge of their range in Vermont may be impacted by climate change. Invasive plants that colonize river shores could eliminate tiger beetle populations.

Non-Habitat Threats:

Genetics

Trampling or Direct Impacts

Description of non-habitat threat(s): Small, isolated populations may be at risk genetically. 4-wheelers on rivershores and islands can crush larvae and make habitat unsuitable for sustaining burrows. Use of beaches and sand shores can also cause trampling of areas used by larvae.

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Common Name: **Beetles-Tiger Beetle Group**
Scientific Name: **Beetles-Tiger Beetle Group**
Species Group: **Invert**

Research and Monitoring Needs

| Type | Need | Priority | Description |
|-------------|--------------------------------|-----------------|---|
| Research | Habitat Requirements | High | Define particular habitat requirements of each species within Vermont, utilizing current knowledge of researchers and field investigations. |
| Research | Basic Life History | Medium | Need to rear and describe the larvae of <i>C. marginipennis</i> . |
| Research | Distribution and Abundance | High | 1) Conduct inventories to detect and gather information on new SGCN tiger beetles populations. 2) Obtain baseline distributional and abundance data for all species in group by conducting surveys throughout the state. Efforts should be focused on particular habitats required by each. Abundance information should be collected at sites of known occurrence. Determine if <i>C. marginipennis</i> colonies are disappearing and/or new colonies appearing. |
| Research | Threats and Their Significance | High | 1) Assess potential and existing impacts of limiting factors to habitat. Such limiting factors as habitat loss and degradation, exotic invasive plants, incompatible recreation, and dams should be examined. 2) Investigate how rivershore tiger beetle populations are being affected by dams, and actions that can be taken to restore or mimic natural processes that maintain habitat. |
| Monitoring | Population Change | High | Monitor known SGCN tiger beetle populations. Track population trends at distinct locations. This would follow field surveys and assessments to identify populations judged to be large and viable. Focusing on such large populations would offer greater probability of detecting population shifts. |
| Monitoring | Habitat Change | High | Monitor change in available habitat for each species' specific requirements. Loss, restoration, and other changes to local habitat sites recognized as important to these species should be tracked. |
| Monitoring | Monitor Threats | High | Recreational use of shoreline habitat needs to be monitored, as it can affect several species. |

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Common Name: **Beetles-Tiger Beetle Group**
 Scientific Name: **Beetles-Tiger Beetle Group**
 Species Group: **Invert**

Species Strategies

| Strategy Type | Strategy Priority | Strategy Description | Performance Measure | Potential Partners | Potential Funding Sources |
|-------------------------|--------------------------|---|--|---|----------------------------------|
| Easements | High | Acquisition/easement of high priority SGCN tiger beetle sites | Number of SGCN tiger beetle sites protected | FWD, FPR, USFS, NRCS, VLT, other land trusts | VHCB, SWG, GMNF, EQIP, USFWS |
| Compatible Resource Use | High | Work with land owners to direct recreational use away from necessary rivershore tiger beetle habitat | Number of monitored sites where trampling of habitat is eliminated | FWD, watershed groups, local landowners | |
| Compatible Resource Use | High | Work to restrict recreational vehicles from accessing riverbank and lakeshore SGCN tiger beetle habitat | Number of sites that have eliminated motorized access to SGCN tiger beetle habitat | FWD, NRCS, watershed groups, local landowners | |

Bibliography

Bell, R.T. 2015. Carabidae of Vermont and New Hampshire. Shires Press. Manchester Center, VT.

Leonard, J. G., and R. T. Bell. 1999. Northeastern Tiger Beetles, A Field Guide to Tiger Beetles of New England and Eastern Canada. CRC Press. 176 pp.



Common Name: **Butterflies-Grassland Group**
Scientific Name: **Butterflies-Grassland Group**
Species Group: **Invert**

Conservation Assessment

Final Assessment: High Priority

Global Rank:

Global Trend:

State Rank:

State Trend: Declining

Extirpated in VT?

Regional SGCN?

Assessment Narrative:

This group consists of four species. The first three are very rare in Vermont and their habitat requirements vary within the general grasslands category. The fourth, Regal fritillary, is extirpated in Vermont and almost all of the Northeast.

--Cobweb Skipper (*Hesperia metea*): Two recent sight records only; needs further documentation.

--Dusted Skipper (*Atrytonopsis hianna*): First records from Vermont in 2004. Only in Southern Vermont; highest density populations along I-91 where bluestem grasses planted. May benefit and expand northward from additional plantings in appropriate areas.

--Monarch (*Danaus plexippus*): On-going and sharp decline of eastern North American population has led to recent proposal to list the Monarch as threatened under the U.S. Endangered Species Law. A large factor in the species decline may be habitat loss, particularly of milkweed (*Asclepias*), which is the host plant.

--Regal fritillary (*Speyeria idalia*): Extirpated from Vermont; ability to re-establish uncertain.

Distribution

2002-2007 butterfly survey (VBS) records by biophysical region:

--Cobweb skipper: 2 sight records in Taconic Mountains and Vermont Valley

--Regal fritillary: extirpated. Historically from collections in Southern Vermont Piedmont and Vermont Valley

--Dusted skipper: Taconic Mountains, Southern Vermont Piedmont

--Monarch: Northern Highlands, Northern Vermont Piedmont, Northern Green Mountains, Champlain Hills, Champlain Valley, Taconic Mountains, Vermont Valley, Southern Green Mountains, Southern Vermont Piedmont

Distribution by Biophysical Region:

| | | | |
|-------------------------------|-----------|-----------------------------|-----------|
| Champlain Valley | Confident | Southern VT Piedmont | Confident |
| Champlain Hills | Confident | Vermont Valley | Confident |
| Northern Green Mtns | Confident | Southern Green Mtns | Confident |
| Northern VT Piedmont | Confident | Taconic Mtns | Confident |
| Northeastern Highlands | Confident | | |

Distribution by Watershed:



Common Name: **Butterflies-Grassland Group**
Scientific Name: **Butterflies-Grassland Group**
Species Group: **Invert**

Habitat Description

Habitat Information is based on the following:

Limited Local Knowledge Extensive Local Knowledge Regional Literature General Literature

This group consists of three species, the habitat requirements of which vary within the general grasslands category. Regal fritillary is extirpated in Vermont and all of North America east of the Mississippi River except for two populations in PA and WV. The other species are very rare in Vermont or in the case of the Monarch, may still be somewhat common in optimal years..

--Cobweb Skipper (*Hesperia metea*) Grasslands, old dry fields, and open barrens. Host plants are Little Bluestem (*Schizachyrium scoparius*) and Big Bluestem (*Andropogon gerardi*). Adults prefer nectaring on low-growing plants such as Labrador Tea (*Ledum groenlandicum*), Wild Strawberry (*Fragaria virginiana*), Blackberry (*Rubus allegheniensis*), Winter Cress (*Barbarea vulgaris*), and Red Clover (*Trifolium pratense*).

--Regal fritillary (*Speyeria idalia*) In Massachusetts, seems to have preferred extensive open areas with a combination of wetlands and upland fields containing an abundance of nectaring plants. Host plants are violets (*Viola* sp.).

--Dusted Skipper (*Atrytonopsis hianna*) Open, dry habitats in far southern Vermont valleys with bluestem grasses. Often found in the same habitat as the Cobweb Skipper. Host plants are Little Bluestem (*Schizachyrium scoparius*) and Big Bluestem (*Andropogon gerardi*). Adults nectar from flowers including Japanese Honeysuckle (*Lonicera japonica*), Wild Strawberry (*Fragaria virginiana*), Blackberry (*Rubus allegheniensis*), Phlox (*Phlox*), Vervain (*Verbena*) and Red Clover (*Trifolium pratense*).

--Monarch (*Danaus plexippus*) Prefers open meadows, weedy areas, marshes, roadsides and disturbed habitats with milkweed. Caterpillars feed on Common Milkweed (*Asclepias syriaca*), Swamp Milkweed (*Asclepias incarnata*), and Showy Milkweed (*Asclepias speciosa*). Blooming later summer/early fall clover fields are important stopover habitat in the Champlain and Connecticut valleys. Monarchs occur in Vermont from as early as mid-May to early November; adults migrate south in the fall to reach overwintering habitat in Mexico. Multiple generations are necessary to reach Vermont in the spring/summer.

Habitat Types:

Oak-Pine Northern Hardwood

Grasslands, Hedgerows, Old Field, Shrub, or Orchard

Other Cultural

Current Threats

Habitat Threats:

Conversion of Habitat

Habitat Succession

Habitat Alteration

Inadequate Disturbance Regime

Habitat Fragmentation



Common Name: **Butterflies-Grassland Group**
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Impacts of Roads or Transportation Systems

Description of habitat threat(s): Loss of grasslands (anthropogenic and natural) and host plants is a threat to members of this group

Non-Habitat Threats:

Pollution

Trampling or Direct Impacts

Loss of Relationship with Other Species

Loss of Prey Base

Description of non-habitat threat(s): --Loss of and impacts to host plants have a negative impact on these grassland butterflies. Increased use of herbicides in agricultural fields may be reducing host plant (milkweeds) density for Monarch in Midwest; impacts in Vermont are unknown.

Research and Monitoring Needs

| <i>Type</i> | <i>Need</i> | <i>Priority</i> | <i>Description</i> |
|-------------|--------------------------------|-----------------|---|
| Research | Habitat Requirements | Medium | Define particular habitat requirements of species for which we still have inadequate information, utilizing current knowledge of researchers and field investigations. This has been completed for most SGCN grassland butterflies. |
| Research | Threats and Their Significance | High | Assess potential and existing impacts of threats to habitat, host plants, and individual butterflies. Such threats as habitat loss and degradation, exotic invasive plants, disease, and host plant loss should be examined. |
| Research | Population Genetics | Low | Reintroduction of regal fritillary would need to identify the source populations that are likely most similar to those originally occurring in Vermont. |
| Monitoring | Population Change | Medium | Monitor known SGCN butterfly populations. Track population trends at distinct locations. This would follow field surveys and assessments to identify populations judged to be large and viable. Focusing on such large populations would offer greater probability of detecting population shifts. |
| Monitoring | Habitat Change | High | Grasslands are some of the habitats most vulnerable to loss due to development and intensive agriculture. Landscape level changes in this general habitat type should be monitored. Loss, restoration, and other changes to local habitat sites recognized as important to these species should be tracked. |

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Common Name: **Butterflies-Grassland Group**
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Species Group: **Invert**

Species Strategies

| Strategy Type | Strategy Priority | Strategy Description | Performance Measure | Potential Partners | Potential Funding Sources |
|---|--------------------------|--|---|------------------------------------|----------------------------------|
| Technical Assistance, Training, Workshops | High | Incorporate butterfly SGCN occurrence information into environmental review and technical assistance | Number of sites with butterfly SGCN that received conservation benefits to this group | FWD, USFWS, DEC, ANR, VTrans, NRCS | SWG |
| Easements | High | Acquisition/easement of high priority SGCN butterfly grassland sites | Number of SGCN butterfly sites protected | FWD, VLT, other land trusts | VHCB, SWG, EQIP, USFWS |

Bibliography

- Glassberg, J. 1999. Butterflies through binoculars. A field guide to the butterflies of Eastern North America. Oxford University Press, New York, NY. 242 pp.
- Layberry, R.A., P. W. Hall, and D. J. Lafontaine. 1998. The Butterflies of Canada. University of Toronto Press, Toronto, ON. 280 pp.
- McFarland, K., and S. Zahendra. 2010. Vermont Butterfly Survey 2002-2007; final report to the Natural Heritage Information Project of the Vermont Department of Fish and Wildlife. Vermont Center for Ecostudies.
- NatureServe. 2004. NatureServe Explorer: an online encyclopedia of life [web application]. Version 4.0. NatureServe, Arlington, VA. Available <http://www.natureserve.org/explorer>.
- Opler, P. A., H. Pavulaan, and R. E. Stanford (coordinators). 1995. Butterflies of North America. Jamestown, ND: Northern Prairie Wildlife Research Center Home Page. <http://www.npwr.usgs.gov/resource/distr/lepid/bflyusa/bflyusa.htm> (Version 12 DEC2003).
- Scott, J. A. 1986. The butterflies of North America. Stanford University Press, Stanford, CA. 583 pp.
- Shapiro, A.M. 1974. Butterflies and Skippers of New York State. Cornell Univ. Agricultural Experimental Station, Ithaca, N.Y. Search 4:1-60.
- Unpublished data by the Vermont Butterfly Survey database as of March 23, 2005. Vermont Institute of Natural Science.
- Wagner, D.L., Nelson, M.W., Schweitzer, D.F. 2003. Shrubland lepidoptera of Southern New England and southeastern New York: ecology, conservation, and management. For. Ecol. Manage. 185: 95-112.
- Williams, B. L. 2002. Conservation genetics, extinction and taxonomic status: a case history for the regal fritillary. Conservation Biology 16 (1): 148-157.



Common Name: **Butterflies-Hardwood Forest Group**
 Scientific Name: **Butterflies-Hardwood Forest Group**
 Species Group: **Invert**

Conservation Assessment

Final Assessment: High Priority **Global Rank:** **Global Trend:**
State Rank: **State Trend:** Unknown
Extirpated in VT? No **Regional SGCN?** Yes

Assessment Narrative:

This group consists of four species, the habitat requirements of which vary within the general hardwood forest category.

- West Virginia white (*Pieris virginiensis*): Threatened by exotic garlic mustard, disease, and poor weather conditions; colonies easily extirpated; does not recolonize isolated sites well.
- Early hairstreak (*Erora laeta*): Widely scattered and localized populations. Beech bark disease is killing off large stands of beech in Vermont, often leaving only 1% of trees remaining. The future for the beech and the early hairstreak in Vermont and much of northeastern North America is uncertain. The beaked hazelnut has also been reported as a host plant further west; the extent to which early hairstreak would adapt to this plant in Vermont is unknown.
- Hackberry emperor (*Asterocampa celtis*): First VT record in 2002. Likely to increase with climate change.
- Tawny emperor (*Asterocampa clyton*): First VT record in 2002. Likely to increase with climate change.

Distribution

2002-2007 butterfly survey (VBS) records by biophysical region:

- West Virginia white: Champlain Valley, Taconic Mountains, Vermont Valley, Southern Green Mountains, Southern Vermont Piedmont
- Early hairstreak: Champlain Valley, Northern Green Mountains, Northern Vermont Piedmont, Southern Green Mountains
- Hackberry emperor: Champlain Valley, Taconic Mountains, Northern Green Mountains; possibly Southern Vermont Piedmont
- Tawny emperor: Champlain Valley, Vermont Valley, Northern Green Mountains, Southern Vermont Piedmont

Distribution by Biophysical Region:

| | | | |
|-------------------------------|--------------|-----------------------------|-----------|
| Champlain Valley | Confident | Southern VT Piedmont | Confident |
| Champlain Hills | Probable | Vermont Valley | Confident |
| Northern Green Mtns | Confident | Southern Green Mtns | Confident |
| Northern VT Piedmont | Confident | Taconic Mtns | Confident |
| Northeastern Highlands | Not Probable | | |



Common Name: **Butterflies-Hardwood Forest Group**
Scientific Name: **Butterflies-Hardwood Forest Group**
Species Group: **Invert**

Distribution by Watershed:

Habitat Description

Habitat Information is based on the following:

Limited Local Knowledge Extensive Local Knowledge Regional Literature General Literature

This group consists of several species, the habitat requirements of which vary within the general hardwood forest category.

--West Virginia White (*Pieris virginiensis*) Requires mature, relatively undisturbed rich hardwood forests with large populations of the host plants, Two-leaved Toothwort (*Dentaria diphylla*) and Cut-leaved Toothwort (*Cardamine concatenata*). Adults nectar from Toothworts, Spring Beauty (*Claytonia virginica*), Violets (*Viola*), and other spring wildflowers.

--Early Hairstreak (*Erora laeta*) requires stands of American Beech (*Fagus grandifolia*), the host plant; failure of the beechnut crop, even for a single year, may seriously impact populations. Adults nectar on fleabane (*Erigeron* sp.) and Ox-eyed Daisy (*Chrysanthemum leucanthemum*). Often found on bare ground puddling.

--Hackberry Emperor (*Astrocampa celtis*) Found in floodplain forests with Northern Hackberry (*Celtis occidentalis*), the host plant. Also reported from suburban Hackberry plantings in Burlington. Adults feed on sap, mud, rotting fruit, and excrement, which can sometimes take them outside of their regular habitat.

--Tawny Emperor (*Astrocampa clyton*) Found in floodplain forests with Northern Hackberry (*Celtis occidentalis*), the host plant. Also reported from suburban Hackberry plantings in Burlington. Adults feed on tree sap, rotting fruit, dung, and carrion.

Habitat Types:

Spruce Fir Northern Hardwood
Northern Hardwood
Oak-Pine Northern Hardwood
Floodplain Forests
Softwood Swamps

Current Threats

Habitat Threats:

Conversion of Habitat
Habitat Alteration
Habitat Fragmentation
Invasion by Exotic Species
Climate Change

Description of habitat threat(s): Early hairstreak is limited by the loss of American beech stands due to beech bark disease. Caterpillars feed on the fruits of this tree, which are only produced by individuals 40 years old or more. Invasion of garlic mustard may threaten the West Virginia White, as the adults will lay



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eggs on it. The plant is toxic to eggs and larvae. West Virginia White will not recolonize an isolated site once extirpated because it doesn't fly across open areas. Logging activities may impact West Virginia White and Early Hairstreak.

Non-Habitat Threats:

- Loss of Relationship with Other Species
- Disease
- Pollution
- Loss of Prey Base

Description of non-habitat threat(s): Disease and invasives threaten host plants that are required for egg laying and larval development. Build up of granulosis virus in soil causes premature death of larval West Virginia White. Forest pest control spraying may impact West Virginia White and Early Hairstreak. Beech bark disease poses a significant threat to Early Hairstreak.

--West Virginia White is a poor recolonizer of isolated sites that become extirpated; colonies may be easily lost due to disturbance of habitat.

--Early Hairstreak populations are scattered and highly localized in VT; genetic exchange and recolonization would be unlikely among known sites.

Research and Monitoring Needs

| <i>Type</i> | <i>Need</i> | <i>Priority</i> | <i>Description</i> |
|-------------|--------------------------------|-----------------|--|
| Research | Habitat Requirements | Medium | Define particular habitat requirements of species for which we still have inadequate information, utilizing current knowledge of researchers and field investigations. This has been completed for most SGCN hardwood forest butterflies. |
| Research | Basic Life History | Medium | It is possible that early hairstreak uses beaked hazelnut in Vermont, as well as American beech; but this is unknown. |
| Research | Threats and Their Significance | High | Assess potential and existing impacts of limiting factors to habitat, host plants, and individual butterflies. Such limiting factors as habitat loss and degradation, exotic invasive plants, disease, and host plant loss should be examined. |
| Monitoring | Population Change | High | Monitor known SGCN butterfly populations. Track population trends at distinct locations. This would follow field surveys and assessments to identify populations judged to be large and viable. Focusing on such large populations would offer greater probability of detecting population shifts. |
| Monitoring | Habitat Change | High | Monitor change in available habitat for each species' specific requirements. Loss, restoration, and other changes to local habitat sites recognized as important to these species should be tracked. |

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Common Name: **Butterflies-Hardwood Forest Group**
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Species Strategies

| Strategy Type | Strategy Priority | Strategy Description | Performance Measure | Potential Partners | Potential Funding Sources |
|---|--------------------------|---|---|---------------------------------------|----------------------------------|
| Technical Assistance, Training, Workshops | High | Incorporate butterfly SGCN occurrence information into environmental review and technical assistance | Number of sites with butterfly SGCN that received conservation benefits to this group | FWD, USFWS, DEC, ANR, VTrans, NRCS | SWG |
| Easements | High | Acquisition/easement of high priority SGCN butterfly hardwood forest sites | Number of SGCN butterfly sites protected | FWD, FPR, TNC, VLT, other land trusts | VHCB, SWG, EQIP, USFWS |
| Standards | High | Work with foresters to avoid significant impacts to SGCN butterfly populations and habitats during forest management activities | Number of SGCN butterfly locations indicated and protected in forest management plans (including mature beech stands) | FWD, FPR, USFS, private landowners | |

Bibliography

Glassberg, J. 1999. Butterflies through binoculars. A field guide to the butterflies of Eastern North America. Oxford University Press, New York, NY. 242 pp.

McFarland, K., and S. Zahendra. 2010. Vermont Butterfly Survey 2002-2007; final report to the Natural Heritage Information Project of the Vermont Department of Fish and Wildlife. Vermont Center for Ecostudies.



Common Name: **Butterflies-Wetland Group**
Scientific Name: **Butterflies-Wetland Group**
Species Group: **Invert**

Conservation Assessment

Final Assessment: High Priority

Global Rank:

Global Trend:

State Rank:

State Trend:

Extirpated in VT?

Regional SGCN? Yes

Assessment Narrative:

This group consists of six species, the habitat requirements of which vary within the general wetland category. Their caterpillars require specific food plants.

--Bog copper (*Lycaena epixanthe*): Found only in acidic bogs with cranberries, which are the host plants; few colonies; a weak flier (limited dispersal capability); six VBS survey blocks

--Jutta arctic (*Oeneis jutta*) Only 3 colonies known, all in Northeast Highlands. Restricted to acidic bogs in Northeast Highlands.

--Dion skipper (*Euphyes dion*): Strong flier; a good short-distance colonizer. Typically low densities in colonies. 12 VBS blocks.

--Black dash (*Euphyes conspicua*): First VT record in 2002; found in southern-most VT sedge wetlands, except one possible sighting in the Champlain Valley. Nine VBS blocks.

--Two-spotted skipper (*Euphyes bimaculata*) Low numbers observed in widely scattered colonies; may disappear from a location for several years, then reappear. Only four colonies known; widely separated.

--Mulberry wing (*Poanes massasoit*): Known from limited area Taconic Mountains and Vermont Valley, with two possible observations in Champlain Valley and Southern Green Mountains. Eight VBS blocks.

Distribution

Biophysical regions recorded during 2002-2007 butterfly survey (VBS):

--Bog copper: Northern Highlands, Champlain Hills, Northern Vermont Piedmont, Vermont Valley

--Jutta arctic: Northern Highlands

--Dion skipper: Champlain Valley, Northern Green Mountains, Taconic Mountains, Vermont Valley, Southern Vermont Piedmont

--Two-spotted skipper: Northern Highlands, Champlain Valley, Northern Vermont Piedmont, Southern Green Mountains

--Black dash: Taconic Mountains, Southern Vermont Piedmont; possibly Champlain Valley

--Mulberry wing: Taconic Mountains, Vermont Valley; possibly Champlain Valley, Southern Green Mountains

--Broad-winged skipper: 11 survey blocks in Bennington, Grand Isle, Addison, and Rutland counties



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Distribution by Biophysical Region:

| | | | |
|------------------------|-----------|----------------------|-----------|
| Champlain Valley | Confident | Southern VT Piedmont | Confident |
| Champlain Hills | Confident | Vermont Valley | Confident |
| Northern Green Mtns | Confident | Southern Green Mtns | Confident |
| Northern VT Piedmont | Confident | Taconic Mtns | Confident |
| Northeastern Highlands | Confident | | |

Distribution by Watershed:

Habitat Description

Habitat Information is based on the following:

Limited Local Knowledge Extensive Local Knowledge Regional Literature General Literature

This group consists of several species, the habitat requirements of which vary within the general hardwood forest category. Caterpillars require specific food plants, which are referenced below.

--Bog Copper (*Lycaena epixanthe*): Found only in acidic bogs with cranberries (*Vaccinium* sp.), which are the host plants.

--Jutta Arctic (*Oeneis jutta*): Restricted to Black Spruce bogs in the Northeast Highlands; host plants are Dense Cottongrass (*Eriophorum spissum*), *Carex geyeri*, and *C. confine*. Adults nectar at bog flowers such as Labrador Tea (*Ledum groenlandicum*).

--Dion Skipper (*Euphys dion*): Calcareous sedge wetlands; host plants are narrow-leaved sedges such as Tussock Sedge (*Carex stricta*); adults nectar on Buttonbush (*Cephalanthus occidentalis*), jewelweed (*Impatiens* sp.), and Swamp Thistle (*Cirsium muticum*).

--Black Dash (*Euphys conspicua*): Sedge wetlands in southern-most VT, except also one possible sighting in the Champlain Valley. Host plants are narrow-leaved sedges, predominantly Tussock Sedge (*Carex stricta*), though others are possible. Adults rely on nectar from Buttonbush (*Cephalanthus occidentalis*), jewelweed (*Impatiens* sp.), and Swamp Thistle (*Cirsium pumilum*). Associated with the Mulberry Wing (*Poanes massasoit*).

--Two-spotted Skipper (*Euphys bimacula*): Prefers spruce bogs and sedge wetlands. Larval host plants are sedges, especially Hairy-fruited Sedge (*Carex trichocarpa*) and Tussock Sedge (*C. stricta*); adults nectar on Pickerelweed (*Pontederia cordata*), blue flag iris (*Iris* sp.), Common Milkweed (*Asclepias syriaca*), and spireas (*Spirea* sp.).

--Mulberry Wing (*Poanes massasoit*): Sedge wetlands in southwestern VT, often with Black Dash and Dion Skipper; sometimes found in bogs, fens, and wet meadows. Known host plant is Tussock Sedge (*Carex stricta*), but there are likely others. Adults nectar on Swamp Milkweed (*Asclepias incarnata*), Common Milkweed (*A. syriaca*), and possibly other wetland flowers..



Common Name: **Butterflies-Wetland Group**
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Habitat Types:

- Open Peatlands
- Marshes and Sedge Meadows
- Shrub Swamps

Current Threats

Habitat Threats:

- Conversion of Habitat
- Habitat Succession
- Habitat Alteration
- Habitat Fragmentation
- Invasion by Exotic Species
- Climate Change

Description of habitat threat(s): Wetlands are particularly vulnerable to invasive exotic plants. Invasives threaten to replace native flora, including larval host plants of wetland SGCN butterflies. Wetland impacts due to development can also impact these butterflies.

Non-Habitat Threats:

- Trampling or Direct Impacts
- Loss of Relationship with Other Species

Description of non-habitat threat(s): Loss or reduction of native wetland flora can include SGCN host plants.

Research and Monitoring Needs

| <i>Type</i> | <i>Need</i> | <i>Priority</i> | <i>Description</i> |
|-------------|--------------------------------|-----------------|--|
| Research | Habitat Requirements | Medium | Define particular habitat requirements of species for which we still have inadequate information, utilizing current knowledge of researchers and field investigations. This has been completed for most SGCN wetland butterflies. |
| Research | Threats and Their Significance | High | Assess potential and existing impacts of limiting factors to habitat, host plants, and individual butterflies. Such limiting factors as habitat loss and degradation, exotic invasive plants, disease, pesticides, and host plant loss should be examined. |
| Monitoring | Population Change | High | Monitor known SGCN butterfly populations. Track population trends at distinct locations. This would follow field surveys and assessments to identify populations judged to be large and viable. Focusing on such large populations would offer greater probability of detecting population shifts. |
| Monitoring | Habitat Change | High | Monitor change in available habitat for each species' specific requirements. Loss, restoration, and other changes to local habitat sites recognized as important to these species should be tracked. |
| Monitoring | Monitor Threats | Medium | Monitor the spread (and control) of wetland invasive species that can impact the habitat and host plants of these butterfly species. |

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Common Name: **Butterflies-Wetland Group**
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Species Strategies

| Strategy Type | Strategy Priority | Strategy Description | Performance Measure | Potential Partners | Potential Funding Sources |
|---|--------------------------|--|---|------------------------------------|----------------------------------|
| Technical Assistance, Training, Workshops | High | Incorporate butterfly SGCN occurrence information into environmental review and technical assistance | Number of sites with butterfly SGCN that received conservation benefits to this group | FWD, USFWS, DEC, ANR, VTrans, NRCS | SWG |
| Easements | High | Acquisition/easement of high priority SGCN butterfly wetland sites | Number of SGCN butterfly sites protected | FWD, TNC, VLT, other land trusts | VHCB, SWG, EQIP, USFWS |

Bibliography

McFarland, K., and S. Zahendra. 2010. Vermont Butterfly Survey 2002-2007; final report to the Natural Heritage Information Project of the Vermont Department of Fish and Wildlife. Vermont Center for Ecostudies.

Glassberg, J. 1999. Butterflies through binoculars: the East. New York: Oxford University Press. 242 pp.



Common Name: **Moths Group**
Scientific Name: **Moths Group**
Species Group: **Invert**

Conservation Assessment

Final Assessment: High Priority

Global Rank:

Global Trend:

State Rank:

State Trend:

Extirpated in VT?

Regional SGCN? Yes

Assessment Narrative:

Numerous species of moths are considered rare, declining, or extirpated. Very little information is available on the distribution of these species, and there is even less known about their trends throughout the region. This group includes the following 17 species:

--*Eacles imperialis pini*, Imperial Moth: Thought to be extirpated until collected in 2001. Declined drastically or disappeared from VT in 1950's. Probable cause of decline was pesticide spraying and release of *Compsilura concinnata* for gypsy moth control.

--*Eana georgiella*, A tortricid moth: One recent collection from high elevation site. Status unknown.

--*Hemileuca lucina*, New England Buckmoth: Restricted to New England; found in SE VT. Have increased in abundance globally.

--*Lasionycta taigata*, A noctuid moth: One collection in 1975. A bog associate. Status uncertain.

--*Lemmeria digitalis*, A noctuid moth: Several collected in 1991-93. Status uncertain.

--*Lithophane franclemonti*, Franclemont's Lithophane: One VT collection. Globally rare, with evidence of decline.

--*Pachypolia atricornis*, An autumnal noctuid moth: Reported from Chittenden Co. (Proctor Maple Research Forest). Very rarely collected throughout range.

--*Papaipema* sp. 2 nr. *pterisii*, Ostrich Fern Borer moth: Rare outside of VT. Responsibility species. Metapopulation structure is needed for long-term viability. Globally rare (G3G4).

--*Properigea costa*, A noctuid moth: Collected in Chittenden Co. Associated with shale, granite, or limestone barrens. More common globally than previously believed.

--*Speranza ribearia*, Currant Spanworm: Collected Bakersfield, 1991 (Franklin Co). Formerly widespread, now rare through much of range due to eradication of currant in 1920's-'60's (alternate host of white pine blister rust).

--*Sphinx drupiferarum*, Plum Sphinx or Wild Cherry Sphinx: Severe populations declining in Eastern NA; now uncommon to rare throughout range. Reasons for decline unknown, but may include introduction of parasitoid *Compsilura concinnata* and historic aerial (DDT) spraying.

--*Sphinx luscitiosa*, Clemens' Sphinx: Populations declining rangewide. Uncommon or rare throughout Northeast.

--*Sthenopis thule*, Willow Ghost moth: Single specimen, South Hero in 1992. Only reported from VT and ON.

--*Xestia fabulosa*, A noctuid moth: Range not well-known. Recorded from VT, NH, and ON. Status uncertain.

--*Xestia homogena*, A noctuid moth: Found in alpine habitat (high elevation; mountain peaks). Habitat specialist.

--*Zale submediana*, Gray Spring Zale: Associated with rare, highly impacted habitat. Very rare in VT; single report; probably was previously common in sand plains.

--*Zanclognatha martha*, Pine Barrens *Zanclognatha*: Associated with rare habitat. Somewhat rare outside of NJ; single VT report.

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Distribution

- Eacles imperialis pini, Imperial Moth: One collected Grand Isle, 2001; Chittenden Co. historically. Also known from northern NY and southern Canada.
- Eana georgiella A tortricid moth: One recent collection from Jay Peak.
- Hemileuca lucina New England Buckmoth: Restricted to New England; found in SE VT.
- Lasionycta taigata A noctuid moth: Reported from Essex Co. '75 (Moose Pond).
- Lemmeria digitalis A noctuid moth: Several collected in Chittenden Co., 1991-93.
- Lithophane franclemonti Franclemont's Lithophane: Known from one Grand Isle specimen.
- Pachypolia atricornis An autumnal noctuid moth: Reported from Chittenden Co. (Proctor Maple Research Forest).
- Papaipema sp. 2 nr. pterisii Ostrich Fern Borer Moth: Several collections along rivers in VT, including Huntington River. Rare outside of VT.
- Properigea costa A noctuid moth: Collected in Chittenden Co.
- Speranza ribearia Currant Spanworm: Collected Bakersfield, 1991 (Franklin Co).
- Sphinx drupiferarum Plum Sphinx or Wild Cherry Sphinx: Reported from Franklin, Chittenden, Bennington, Orleans, and Lamoille counties.
- Sphinx luscitiosa Clemens' Sphinx: VT distribution unknown.
- Sthenopsis thule A ghost moth: Single specimen, South Hero in 1992.
- Xestia fabulosa A noctuid moth: Range not well-known. Recorded from VT, NH, and ON.
- Xestia homogena A noctuid moth: Found in alpine habitat (high elevation; mountain peaks).
- Zale submediana Gray Spring Zale: Reported from Jericho Research Forest (Chittenden Co.) in '90. Probably was previously common in sand plains.
- Zanclognatha martha Pine Barrens Zanclognatha: Reported from Jericho Research Forest (Chittenden Co.) in '90.

Distribution by Biophysical Region:

| | | | |
|-------------------------------|-----------|-----------------------------|----------|
| Champlain Valley | Confident | Southern VT Piedmont | Probable |
| Champlain Hills | Confident | Vermont Valley | Probable |
| Northern Green Mtns | Confident | Southern Green Mtns | Probable |
| Northern VT Piedmont | Probable | Taconic Mtns | Probable |
| Northeastern Highlands | Confident | | |



Common Name: **Moths Group**
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Distribution by Watershed:

Habitat Description

Habitat Information is based on the following:

Limited Local Knowledge Extensive Local Knowledge Regional Literature General Literature

- Eacles imperialis pini, Imperial Moth: White pine specialist; possibly also pitch pine. Found in coniferous forest.
- Eana georgiella, A tortricid moth: High elevation species. VT specimen collected from summit in a "disturbed area."
- Hemileuca lucina, New England Buckmoth: Found in wet meadows and open fields. May use powerline corridors. Host plants: oak, Prunus serotina, willows, gray birch, Vaccinium; early instars on meadowsweet.
- Lasionycta taigata, A noctuid moth: Bog associate.
- Lemmeria digitalis, A noctuid moth: Reported from wetland habitats in PA. Host plants unknown.
- Lithophane franclemonti, Franclemont's Lithophane: Host plants and habitat unknown.
- Pachypolia atricornis, An autumnal noctuid moth: Found in mesic northern hardwood or mixed forests with non-acidic soils.
- Papaipema sp. 2 nr. pterisii, Ostrich Fern Borer Moth: May occur where there are large areas of ostrich fern, the host plant; particularly along floodplain forests.
- Properigea costa, A noctuid moth: Associated with shale, granite, or limestone barrens.
- Speranza ribearia, Currant Spanworm: Host plants are currant, gooseberry.
- Sphinx drupiferarum, Plum Sphinx or Wild Cherry Sphinx: Found in wooded habitats and suburbs. Host plants: cherry, plum, apple; also lilac and hackberry.
- Sphinx luscitiosa, Clemens' Sphinx: Found in clearings, edges, and meadows in wooded areas. Host plants: willow, poplar, birch, apple, ash. Has been reportedly seen obtaining nourishment from dead fish.
- Sthenopsis thule, Willow Ghost Moth: Host plant: reported on willows, but not well known.
- Xestia fabulosa, A noctuid moth: Reported elsewhere from boreal and montane spruce-fir forests, and high-elevation subalpine forests. Host plants: Vaccinium sp.
- Xestia homogena, A noctuid moth: Found in alpine habitat (high elevation; mountain peaks).
- Zale submediana, Gray Spring Zale: probably was previously common in sand plains. Host plants: jack, pitch, red, and probably other hard pines.
- Zanclognatha martha, Pine Barrens Zanclognatha: Found in pitch pine/ scrub oak barrens in PA northward; Jericho population may have colonized pines from a remnant pine barren.

Habitat Types:

- Outcrops and Alpine
- Spruce Fir Northern Hardwood
- Northern Hardwood
- Oak-Pine Northern Hardwood
- Floodplain Forests
- Open Peatlands
- Marshes and Sedge Meadows
- Grasslands, Hedgerows, Old Field, Shrub, or Orchard
- Lawns, Gardens, and Row Crops



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Other Cultural

Current Threats

Habitat Threats:

Conversion of Habitat
Habitat Succession
Habitat Alteration
Inadequate Disturbance Regime
Habitat Fragmentation
Invasion by Exotic Species
Climate Change

Description of habitat threat(s): Hemileuca lucina, New England Buckmoth Habitat loss, habitat succession.

- Papaipema sp. 2 nr. pterisii Ostrich Fern Borer Moth Metapopulation structure is needed for long-term viability (habitat loss, habitat fragmentation, invasion by exotic species).
- Zale submediana Gray Spring Zale Habitat loss and conversion.
- Zanclognatha martha Pine Barrens Zanclognatha Habitat loss and conversion.
- Habitat threats for other species are not known.

Non-Habitat Threats:

Parasites
Reproductive Traits
Trampling or Direct Impacts
Pollution
Loss of Prey Base

Description of non-habitat threat(s): Eacles imperialis pini, Imperial Moth Declined drastically or disappeared from VT in 1950's. Probable cause of decline was pesticide spraying and release of Compsilura concinnata for gypsy moth control. Use of BTK is also potential problem if used wrong time of year (late June or later).

- Speranza ribearia Currant Spanworm Formerly widespread, now rare through much of range due to eradication of currant in 1920's-'60's (alternate host of white pine blister rust).
- Sphinx drupiferarum Plum Sphinx or Wild Cherry Sphinx Introduced parasitoid Compsilura concinnata was probably involved in the decline of this species, but was not the only factor.
- Xestia homogena A noctuid moth Trampling or disturbance of host vegetation in alpine areas is a potential threat.



Common Name: **Moths Group**
 Scientific Name: **Moths Group**
 Species Group: **Invert**

Research and Monitoring Needs

| Type | Need | Priority | Description |
|------------|--------------------------------|----------|---|
| Research | Habitat Requirements | High | Define Vermont-specific habitat requirements of species for which this information is lacking; utilize field investigations and current knowledge of researchers. |
| Research | Basic Life History | Medium | Larval host plant requirements need to be studied and described or refined. |
| Research | Distribution and Abundance | High | 1) Obtain baseline distributional and abundance data for all species in group by conducting surveys throughout the state. Efforts should be focused on particular habitats required by each and, where appropriate, on regions of expected occurrence within the state (e.g., a northern peripheral species might be expected in the northern tier counties). Abundance information should be collected at sites of known occurrence. 2) Conduct inventories to detect and gather information on new SGCN moth populations. |
| Research | Threats and Their Significance | High | Assess potential and existing impacts of limiting factors to habitat, host plants, and individual moths. Such limiting factors as habitat loss and degradation, exotic invasive plants, diseases, parasitoids, pest control, and host plant loss should be examined. |
| Research | Taxonomy | Medium | Taxonomic uncertainty of some species, such as <i>Eacles imperialis pini</i> , needs to be resolved. |
| Monitoring | Population Change | High | Monitor known SGCN moth populations. Many of these species are declining regionally; trends need to be monitored. |
| Monitoring | Habitat Change | Medium | Monitor change in available habitat for each species' specific requirements. Loss, restoration, and other changes to local habitat recognized as important to these species should be tracked. |
| Monitoring | Monitor Threats | Medium | Several species have been negatively impacted by gypsy moth control methods, including release of exotic parasitoids. Gypsy moth and other species-targeted control needs to be tracked and considered in managing for SGCN moths. Exotic parasitoid populations and distributions need to be assessed also. |

Species Strategies

| Strategy Type | Strategy Priority | Strategy Description | Performance Measure | Potential Partners | Potential Funding Sources |
|---------------|-------------------|--|---|---|---------------------------|
| Easements | High | Acquisition/easement/conservation/restoration of high priority SGCN moth sites | Number of SGCN moth sites protected/restored | FWD, FPR, USFWS, NRCS, VLT, other land trusts | VHCB, SWG, EQIP, USFWS |
| Standards | High | Work with landowners and those who manage forest pests to reduce/eliminate the use of pesticides and exotic species where they may negatively impact SGCN moth species | Area of land where methods detrimental to SGCN moths have been eliminated through management planning | FWD, FPR, USFS, VT Entomological Society, towns, private landowners | SWG |

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Bibliography

- Boettner, G. H., J. S. Elkinton, and C. J. Boettner. 2000. Effects of a biological control introduction on three nontarget native species of saturniid moths. *Conservation Biology* 14: 1798-1806.
- Boone, J. H., J. R. Grehan, B. L. Parker. 2000. A Checklist of Diptera, Hymenoptera and Coleoptera from Mount Mansfield, Vermont. Agricultural Experiment Station, University of Vermont Miscellaneous Publication No. 118.
- Covell, C. V., Jr. 1984. *Moths of Eastern North America. A Roger Tory Peterson Field Guide*. Easton Press, Norwalk, CT. 406 pp.
- Danks, H. V. (ed.). 1979. *Canada and its insect fauna. Memoirs of the Entomological Society of Canada*, No. 108. 573 pp.
- Ferguson, D. C., C. E. Harp, P. A. Opler, R. S. Peigler, M. Pogue, J. A. Powell, and M. J. Smith. 1999. *Moths of North America*. Jamestown, ND: Northern Prairie Wildlife Research Center Home Page. <http://www.npwrc.usgs.gov/resource/distr/lepid/moths/mothsusa.htm> (version 12DEC2003). (Accessed November 11, 2004)
- Forbes, W. T. M. 1923. *Lepidoptera of New York and Neighboring States. Part I (Primitive Forms, Microlepidoptera, Pyralids, Bombyces)*. Cornell University Agricultural Experiment Station Memoir 68. Ithaca, NY. 729 pp.
- Forbes, W. T. M. 1948. *Lepidoptera of New York and Neighboring States. Part II (Geometrida, Lymantriidae, Notodontidae, Sphingidae)*. Cornell University Agricultural Experiment Station Memoir 274. Ithaca, NY. 263 pp.
- Forbes, W. T. M. 1954. *Lepidoptera of New York and Neighboring States. Part III (Noctuidae)*. Cornell University Agricultural Experiment Station Memoir 329. Ithaca, NY. 433 pp.
- Grehan, J. R., B. L. Parker, G. R. Nielsen, D. H. Miller, J. D. Hedbor, M. Sabourin, and M. S. Griggs. 1995. *Moths and butterflies of Vermont (Lepidoptera): a faunal checklist*. Agricultural Experiment Station, University of Vermont; Department of Forests, Parks and Recreation, State of Vermont. Miscellaneous Publication 116. Vermont Monitoring Cooperative Bulletin No. 1.
- Grehan, J. R., M. Sabourin. 1995. *Informal State Ranks for Vermont Moths and Butterflies (Lepidoptera)*. For the Nongame and Natural Heritage Program. Vermont Fish and Wildlife Department.
- Griggs, M. S., J. R. Grehan. 2000. *Biodiversity of the Moth Fauna from a Light Trap Survey at Ethan Allen Firing Range*. For the Vermont Army National Guard.
- Griggs, M. S., J. R. Grehan. 2001. *Light Trap Survey of Moth Biodiversity of Mount Mansfield for 2000*. For the Vermont Monitoring Cooperative.
- Handfield, L. 1997. *Liste des Lepidopteres du Quebec et du Labrador. Fabriques, Supplement 7: 1-155*.
- Holland, W. J. 1968. *The Moth Book*. Dover Publications, Inc. New York, NY. 479 pp.
- Lafontaine, J.D. 1998. *Noctuoidea, Noctuidae (part), Noctuinae (part-Noctuini)*. The moths of America north of Mexico, including Greenland. Fascicle 27.3. Washington, DC: The Wedge Entomological Research Foundation; 348 pp.
- Maier, C. T., C. R. Lemmon, J. M. Fengler, D. F. Schweitzer, and R. C. Reardon. 2004. *Caterpillars on the foliage of conifers in the northeastern United States*. Forest Health Technology Enterprise Team, Morgantown, WV. USDA Forest Service and Connecticut Agricultural Experimental Station. FHTET-2004-01.
- Munroe, E. G. 1972. *Pyraloidea: Pyralidae (in part)*. Pp. 1-304, Fasc. 13.1, A-C in Dominick, R. B., ed. *The moths of America north of Mexico*. E. W. Classey Ltd, London, UK.
- NatureServe. 2004. *NatureServe Explorer: an online encyclopedia of life [web application]*. Version 4.0. NatureServe, Arlington, VA. Available <http://www.natureserve.org/explorer>.
- Neunzig, H. H. 1986. *Phycitinae; Acrobasis and allies*. Fasc. 15.2, in Dominick, R. B., et al. *Moths of American North of Mexico*. Wedge Entomological Research Foundation, Washington, D. C. 112 pp.
- Prentice, R. M. 1962. *Forest Lepidoptera of Canada recorded by the Forest Insect Survey. Vol. 2. Nycteolidae, Notodontidae, Noctuidae, Liparidae*. Forest Entomology and Pathology Branch, Canada Department of Forestry. Bulletin 128. pp. 77-281.
- Prentice, R. M. 1963. *Forest Lepidoptera of Canada recorded by the Forest Insect Survey. Vol. 3. Lasiocampidae, Drepanidae, Thyridae, Geometridae*. Forest Entomology and Pathology Branch, Canada Department of Forestry. Publ. 1013. pp. 282-542.

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Common Name: **Moths Group**
Scientific Name: **Moths Group**
Species Group: **Invert**

Rockburne, E. W., and J. D. Lafontaine. 1976. The Cutworm Moths of Ontario and Quebec. Canada Department of Agriculture, Research Branch Publication 1593, 164 pp.

Schweitzer, Dale W. 2004 personal communications. NatureServe.

Thomas, A. W. 1996. Light-trap catches of moths within and above the canopy of a northeastern Forest. *Journal of the Lepidopterists' Society* 50: 21-45.

Thomas, A. W. 2001. Moth diversity in a northeastern North America red spruce forest. Natural Resources Canada, Information Report M-X-210E. 42 pp.

Wagner, D. L., D. C. Ferguson, T. L. McCabe, and R. C. Reardon. 2001. Geometroid caterpillars of northeastern and Appalachian forests. Forest Health Technology Enterprise Team, Morgantown, WV. USDA Forest Service. FHTET-2001-10.

Wagner, D. L., V. Giles, R. C. Reardon, and M. L. McManus. 1997. Caterpillars of eastern forests. Forest Health Technology Enterprise Team, Morgantown, WV. USDA Forest Service. FHTET-96-34.

Wagner, D. L., Nelson, M. W., Schweitzer, D.F. 2003. Shrubland lepidoptera of Southern New England and southeastern New York: ecology, conservation, and management. *For. Ecol. Manage.* 185: 95-112.

Webster, R. P., A. W. Thomas. 1999. A new species of *Lithophane* (Lepidoptera: Noctuidae: Cuculliinae) from Northeastern North America. *Journal of the Lepidopterists' Society* 53(2): 55-59.

Additional information on Vermont-specific information and collection records gathered through personal communications with Dale Schweitzer (NatureServe) and Jim Hedbor.



Common Name: **Mayflies/Stoneflies/Caddisflies Group**
Scientific Name: **Mayflies/Stoneflies/Caddisflies Group**
Species Group: **Invert**

Conservation Assessment

Final Assessment: High Priority

Global Rank:

Global Trend:

State Rank:

State Trend: Unknown

Extirpated in VT? No

Regional SGCN? Yes

Assessment Narrative:

This group consists eleven species with all but the *Rhyacophila brunnea* considered globally rare (G1-G3). Very little information is available on Vermont populations, making status determination difficult.

--A Mayfly (*Ameletus browni*): This is a globally rare species (G3/G4). Insufficient information is available to determine VT status.

--Tomah Mayfly (*Siphonisca aerodromia*): This is a globally rare species (G2G3). Although not yet recorded from VT, insufficient information is available to determine VT status.

--A Mayfly (*Siphonurus demaryi*): This is a globally rare species (G2G3). Insufficient information is available to determine VT status.

--Roaring Brook Mayfly (*Epeorus frisoni*): This is a globally rare species (G1). Known only recently from a single location in VT. To date, only four small stream populations are known worldwide.

--A Mayfly (*Eurylophella bicoloroides*): This is a globally rare species (G3). Insufficient information is available to determine VT status.

--A Mayfly (*Baetisca rubescens*): This is a globally rare species (G3/G4). Insufficient information is available to determine VT status.

--A Stonefly (*Alloperla voinae*): This is a globally rare species (G3) which is rarely collected. Insufficient information is available to determine VT status.

--Appalachian Stone (*Hansonoperla appalachia*): This is a globally rare species (G3). Insufficient information is available to determine VT status.

--Spiny Salmonfly (*Pteronarcys comstocki*): This is a globally rare species (G3). Insufficient information is available to determine VT status.

--A Caddisfly (*Rhyacophila brunnea*): This species is known from fewer than 10 sites in Vermont.

--A Caddisfly (*Rhyacophila amicus*): This is a globally rare species (G2). Insufficient information is available to determine VT status.

Distribution

--Roaring Brook mayfly (*Epeorus frisoni*): Known in Vermont only from a Battenkill tributary near Dorset. Globally, known from only from NH, VT, and ME.

--*Ameletus browni*: This species is not well documented, but has been reported from Bennington County.

--*Eurylophella bicoloroides*: This species is not well documented, but has been reported from Bennington County.

--Tomah mayfly (*Siphonisca aerodromia*): This mayfly has not yet been documented in VT. It is known only from a few sites in NY, ME, QE, and Labrador. Noted as one of the rarest mayflies in the world.

--*Baetisca rubescens*: Distribution of this species in VT is not known. Only a few U.S and Canadian records.

--*Alloperla voinae*: Distribution of this species in VT is not known. Otherwise known from NY to NS, south to MA.

--*Rhyacophila brunnea*: Known from Killington, Shrewsbury, Mendon, Orange, and Stowe.

--*Siphonurus demaryi*: This species is not well documented, but has been reported from Bennington County. A regional endemic to northeastern U.S and southeastern Canada.

--*Hansonoperla appalachia*: This species is not well documented in Vermont.

--*Pteronarcys comstocki*: This species is not well documented in Vermont.

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Scientific Name: **Mayflies/Stoneflies/Caddisflies Group**
Species Group: **Invert**

--Rhyacophila amicus: This species is not well documented in Vermont.

Distribution by Biophysical Region:

| | | | |
|-------------------------------|--------------|-----------------------------|--------------|
| Champlain Valley | Not Probable | Southern VT Piedmont | Not Probable |
| Champlain Hills | Not Probable | Vermont Valley | Probable |
| Northern Green Mtns | Confident | Southern Green Mtns | Confident |
| Northern VT Piedmont | Confident | Taconic Mtns | Probable |
| Northeastern Highlands | Not Probable | | |

Distribution by Watershed:

Habitat Description

Habitat Information is based on the following:

Limited Local Knowledge Extensive Local Knowledge Regional Literature General Literature

--Tomah mayfly (*Siphonisca aerodromia*) This mayfly inhabits rivers with broad, seasonally flooded sedge-dominated floodplains.

--*Siphonurus demaryi* Larvae have been collected in lake littoral zones near stream inlets and along margins of larger streams among vegetation.

--Roaring Brook mayfly (*Epeorus frisoni*) Found in small, first and second order tributaries of high elevation streams. May be associated with conditions of pristine water quality and minimally or undisturbed riparian habitat.

--*Ameletus browni* Restricted to cold, high elevation, first order streams in undisturbed habitat.

--*Eurlophella bicoloroides* Found in small (2nd order) streams up to medium sized rivers (6th or 7th order). In large streams, has been reported in reaches below reservoirs with hypolimnetic release.

--*Baetisca rubescens* A northern species, restricted to cold, high elevation streams.

--*Alloperla voinae* Habitat is unknown for this species.

--*Rhyacophila brunnea* This species inhabits small, high-elevation streams; these are acid-sensitive streams.

--*Rhyacophila amicus* A coldwater montane stream caddisfly.

--*Hansonoperla appalachia* Occurs in pristine medium-sized streams of the elevated Appalachians. Nymphs were collected in WV from undercut banks of riffle areas where roots of riparian vegetation trapped coarse detritus and caused deposits of sand to accumulate.

--*Pteronarcys comstocki* Prefers medium-sized to large cold streams. An Appalachian species.

Habitat Types:

Marshes and Sedge Meadows

Aquatic: Fluvial

Current Threats

Habitat Threats:

Conversion of Habitat

Habitat Alteration

Sedimentation



Common Name: **Mayflies/Stoneflies/Caddisflies Group**
 Scientific Name: **Mayflies/Stoneflies/Caddisflies Group**
 Species Group: **Invert**

Habitat Fragmentation

Description of habitat threat(s):

Non-Habitat Threats:

Pollution

Description of non-habitat threat(s): Several of these species are known globally from very few sites, which are often widely separated. Recolonization may not be possible if individual populations are lost.

Research and Monitoring Needs

| Type | Need | Priority | Description |
|------------|--------------------------------|----------|--|
| Research | Habitat Requirements | High | Need to determine details of habitat requirements in order to refine distributional searches. |
| Research | Distribution and Abundance | High | 1) Conduct inventories to detect and gather information on SGCN stoneflies, mayflies, and caddisflies. 2) Need statewide surveys to provide basic understanding of distribution for all species. |
| Research | Threats and Their Significance | Medium | Assess threat of high elevation and headwater stream acidification to mayflies, caddisflies, and stoneflies that occupy these waters. |
| Monitoring | Population Change | Medium | 1) Monitor known SGCN stonefly/mayfly/caddisfly populations. 2) Populations should be monitored for presence/absence now; monitor for population changes after baseline abundance data is available. |

Species Strategies

| Strategy Type | Strategy Priority | Strategy Description | Performance Measure | Potential Partners | Potential Funding Sources |
|---------------------|-------------------|--|---|--|---------------------------|
| Habitat Restoration | High | Protect and restore habitats on which SGCN stoneflies, mayflies, and caddisflies are dependent through pollution abatement, riparian buffers, flow regulation, easements, etc. | Number of acres of riparian habitat protected and/or restored | FWD, USFS, Trout Unlimited, Watershed groups, Landowners, NRCS | SWG, EQIP, LCLT, VLT |

Bibliography

Vermont Department of Environmental Conservation, Biomonitoring Database. Maine 2015 Wildlife Action Plan Revision.

Natureserve. 2015. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.0. NatureServe, Arlington, VA. U.S.A. Available <http://explorer.natureserve.org>. (Accessed: 01/21/2015)

Funk, D. H. and B. W. Sweeney. 1994. The Larvae of Eastern North American Eurylophella Tiensuu (Ephemeroptera: Ephemerellidae). Transactions of the American Entomological Society 120(3): 209-286.

Kirchner, R. F., and B. C. Kondratieff. 1985. The Nymph Of Hansonoperla appalachia Nelson (Plecoptera, Perlidae). Proceedings of the Entomological Society of Washington 87: 593-596.



Common Name: **Odonates-Bog/Fen/Swamp/Marshy Pond Group**
Scientific Name: **Odonates-Bog/Fen/Swamp/Marshy Pond Group**
Species Group: **Invert**

Conservation Assessment

Final Assessment: High Priority

Global Rank:

Global Trend:

State Rank:

State Trend: Unknown

Extirpated in VT? No

Regional SGCN? Yes

Assessment Narrative:

Individual species in this group are rare in Vermont; several are regionally or globally rare.

This group consists of 15 species, the habitat requirements of which vary within the general wetland category. Habitats given for each species refer primarily to reproduction and nymphal requirements; adults of many species require various nearby terrestrial habitats as well.

- Subarctic Bluet (*Coenagrion interrogatum*): Bogs, boggy-edged ponds
- Comet Darner (*Anax longipes*): On northern edge of range in Vermont; one larval record. Vernal pools and semi-permanent ponds (no fish)
- Mottled Darner (*Aeshna clepsydra*): Boggy/marshy edges of lakes
- Zigzag Darner (*Aeshna sitchensis*): Boggy ponds, small bog pools, fen puddles
- Subarctic Darner (*Aeshna subarctica*): Bogs with saturated sphagnum
- Spatterdock Darner (*Rhionaeschna mutata*): Southern species, could advance north with climate change; vegetated ponds
- Swamp Darner (*Epiaeschna heros*): Hardwood swamps
- Cyrano Darner (*Nasiaeschna pentacantha*): Vegetated ponds
- Petite Emerald (*Dorocordulia lepida*): Boggy ponds and lakes, marshes, cedar swamp streams
- Ski-tailed Emerald (*Somatochlora elongata*): Marshy ponds, peatlands
- Forcipate Emerald (*Somatochlora forcipata*): Boggy rills, bogs, and small forested streams
- Delicate Emerald (*Somatochlora franklini*): Bogs, boggy-edged ponds
- Kennedy's Emerald (*Somatochlora kennedyi*): Boggy streams; bogs, fens, and swamps often with flowing water.
- Ebony Boghaunter (*Williamsonia fletcheri*): Bogs, fens
- Black Meadowhawk (*Sympetrum danae*): Marshy ponds, bogs, fens

Distribution

Distributions by biophysical region for bog/fen/swamp/marshy pond odonates are as follows:

- Subarctic Bluet (*Coenagrion interrogatum*): Northern Highlands, Southern Green Mountains
- Comet Darner (*Anax longipes*): Southern Vermont Piedmont
- Mottled Darner (*Aeshna clepsydra*): Champlain Valley, Taconic Mountains, Southern Green Mountains, Southern Vermont Piedmont
- Zigzag Darner (*Aeshna sitchensis*): Northern Highlands
- Subarctic Darner (*Aeshna subarctica*): Northern Highlands, Northern Green Mountains
- Spatterdock Darner (*Rhionaeschna mutata*): Champlain Valley, Northern Green Mountains, Southern Vermont Piedmont
- Swamp Darner (*Epiaeschna heros*): Champlain Valley, Northern Green Mountains, Taconic Mountains, Southern Green Mountains
- Cyrano Darner (*Nasiaeschna pentacantha*): Southern Vermont Piedmont
- Petite Emerald (*Dorocordulia lepida*): Northern Highlands, Northern Vermont Piedmont, Southern Vermont Piedmont, Vermont Valley
- Ski-tailed Emerald (*Somatochlora elongata*): Northern Highlands, Northern Vermont Piedmont, Northern

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Common Name: **Odonates-Bog/Fen/Swamp/Marshy Pond Group**
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Species Group: **Invert**

Green Mountains, Taconic Mountains, Southern Green Mountains, Southern Vermont Piedmont
--Forcipate Emerald (*Somatochlora forcipata*): Northern Highlands, Northern Vermont Piedmont, Vermont Valley, Southern Green Mountains
--Delicate Emerald (*Somatochlora franklini*): Northern Highlands, Northern Vermont Piedmont
--Kennedy's Emerald (*Somatochlora kennedyi*): Northern Highlands
--Ebony Boghaunter (*Williamsonia fletcheri*): Northern Highlands, Northern Vermont Piedmont, Vermont Valley
--Black Meadowhawk (*Sympetrum danae*): Northern Highlands, Northern Vermont Piedmont, Champlain Valley

Distribution by Biophysical Region:

| | | | |
|-------------------------------|-----------|-----------------------------|-----------|
| Champlain Valley | Confident | Southern VT Piedmont | Confident |
| Champlain Hills | Probable | Vermont Valley | Confident |
| Northern Green Mtns | Confident | Southern Green Mtns | Confident |
| Northern VT Piedmont | Confident | Taconic Mtns | Confident |
| Northeastern Highlands | Confident | | |

Distribution by Watershed:

Habitat Description

Habitat Information is based on the following:

Limited Local Knowledge Extensive Local Knowledge Regional Literature General Literature

This group consists of 15 species, the habitat requirements of which vary within the general wetland category. Habitats given for each species refer primarily to reproduction and nymphal requirements; adults of many species require various nearby terrestrial habitats as well. Some dragonflies are known to exhibit "hilltopping" behavior, in which they congregate on tops of hills, which may be fairly distant from egg-laying sites. This would increase the home range requirements for such species.

- Subarctic Bluet (*Coenagrion interrogatum*): Bogs, boggy-edged ponds
- Comet Darner (*Anax longipes*): Vernal pools and semi-permanent ponds (no fish)
- Mottled Darner (*Aeshna clepsydra*): Boggy/marshy edges of lakes
- Zigzag Darner (*Aeshna sitchensis*): Boggy ponds, small bog pools, fen puddles
- Subarctic Darner (*Aeshna subarctica*): Bogs with saturated sphagnum
- Spatterdock Darner (*Rhionaeschna mutata*): Vegetated ponds
- Swamp Darner (*Epiaeschna heros*): Hardwood swamps
- Cyrano Darner (*Nasiaeschna pentacantha*): Vegetated ponds
- Petite Emerald (*Dorocordulia lepida*): Boggy ponds and lakes, marshes, cedar swamp streams
- Ski-tailed Emerald (*Somatochlora elongata*): Marshy ponds, peatlands
- Forcipate Emerald (*Somatochlora forcipata*): Boggy rills, bogs, and small forested streams
- Delicate Emerald (*Somatochlora franklini*): Bogs, boggy-edged ponds
- Kennedy's Emerald (*Somatochlora kennedyi*): Boggy streams; bogs, fens, and swamps often with flowing water.
- Ebony Boghaunter (*Williamsonia fletcheri*): Bogs, fens
- Black Meadowhawk (*Sympetrum danae*): Marshy ponds, bogs, fens



Common Name: **Odonates-Bog/Fen/Swamp/Marshy Pond Group**
Scientific Name: **Odonates-Bog/Fen/Swamp/Marshy Pond Group**
Species Group: **Invert**

Habitat Types:

Hardwood Swamps
Softwood Swamps
Seeps and Pools
Open Peatlands
Marshes and Sedge Meadows
Shrub Swamps
Aquatic: Fluvial
Aquatic: Lacustrine

Current Threats

Habitat Threats:

Conversion of Habitat
Habitat Alteration
Sedimentation
Habitat Fragmentation
Invasion by Exotic Species
Climate Change

Description of habitat threat(s): Many of these wetlands are small, fragile, and could be easily degraded by disturbances within their watershed or groundwater source (e.g., development, clearcutting, hydrologic alterations). There is little specific information available citing negative impacts on these odonates. Several or all of these species utilize a combination of wetland and upland habitat to complete their life cycle; fragmentation of this complex could potentially have a negative effect on these odonates. Climate change may affect bog communities and the odonates that reside in them. Exotic plants such as Phragmites and purple loosestrife can dominate the floral community and make odonate habitat less suitable.

Non-Habitat Threats:

Pollution

Description of non-habitat threat(s): Non-point source nutrients can alter water chemistry, nutrient availability, and benthic habitat.



Common Name: **Odonates-Bog/Fen/Swamp/Marshy Pond Group**
Scientific Name: **Odonates-Bog/Fen/Swamp/Marshy Pond Group**
Species Group: **Invert**

Research and Monitoring Needs

| <i>Type</i> | <i>Need</i> | <i>Priority</i> | <i>Description</i> |
|--------------------|--------------------------------|------------------------|--|
| Research | Habitat Requirements | Low | Define particular habitat requirements of each species within Vermont, utilizing current knowledge of researchers and field investigations. |
| Research | Distribution and Abundance | High | 1) Obtain baseline distributional and abundance data for all species in group by conducting surveys throughout the state. Efforts should be focused on particular habitats required by each and, where appropriate, on regions of expected occurrence within the state (e.g., a northern peripheral species might be expected in the northern tier counties). Abundance information should be collected at sites of known occurrence. 2) Conduct inventories to detect and gather information on new SGCN odonate populations. |
| Research | Threats and Their Significance | Medium | Assess the vulnerability of nymphs of each species to wetland perturbations, such as siltation, temperature and water quality shifts, chemical pollution, and changes in vegetation. Investigate the upland habitat needs of the adults and the effects of such impacts as fragmentation and reduction. |
| Monitoring | Population Change | High | Population monitoring could be employed to track population trends at distinct locations. This would follow field surveys and assessments to identify populations judged to be large and viable. Focusing on such large populations would offer greater probability of detecting population shifts. |

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Common Name: **Odonates-Bog/Fen/Swamp/Marshy Pond Group**
 Scientific Name: **Odonates-Bog/Fen/Swamp/Marshy Pond Group**
 Species Group: **Invert**

Species Strategies

| Strategy Type | Strategy Priority | Strategy Description | Performance Measure | Potential Partners | Potential Funding Sources |
|---|--------------------------|--|--|---|----------------------------------|
| Awareness Raising and Communications | Medium | Educate public and improve appreciation of vulnerable odonate habitats | Number of participants at events/workshops | FWD, VCE, town Cons Comms, media outlets | SWG |
| Technical Assistance, Training, Learning Networks | High | Incorporate odonate SGCN occurrence information into environmental review and technical assistance | Number of sites with odonate SGCN that received conservation benefits to this group. | FWD, USFWS, DEC, ANR, VTrans, NRCS | SWG |
| Compatible Resource Use | Medium | Manage protected areas (wetlands) for odonate conservation | Number of protected sites with odonate protective strategies in place. | FWD, FPR, USFS, USFWS, DEC, NRCS, VLT, other land trusts, town conservation and planning commissions. | SWG, FPR, USFS |
| Easements | High | Acquisition/easement of high priority SGCN odonate wetland sites | Number of SGCN odonate sites protected | FWD, FPR, TNC, VLT, other land trusts | VHCB, SWG, EQIP, USFWS |

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Common Name: **Odonates-Bog/Fen/Swamp/Marshy Pond Group**
Scientific Name: **Odonates-Bog/Fen/Swamp/Marshy Pond Group**
Species Group: **Invert**

Bibliography

- Brunelle, P.M. 1999. Distribution of damselflies and dragonflies (Odonata) of Maine, United States. *Northeastern Naturalist* 6(1):35-38.
- Carle, F. L. 1994. Dragonflies and damselflies (Odonata) known to or likely to occur in Vermont. A report to the Nongame and Natural Heritage Program, Vermont Fish & Wildlife Department. 22 pp.
- Carle, F. L. 1997. Odonates of the Green Mountain National Forest A report to the National Forest Service, Manchester Ranger District.
- Carpenter, V.A. 1997. Dragonflies and damselflies of Cape Cod. Edition 2. The Cape Cod Museum of Natural History, Brewster, Massachusetts. 80 pp.
- Dunkle, S.W. 2000. Dragonflies through binoculars: a field guide to dragonflies of North America. Oxford University Press, New York, NY. 266pp.
- Dunkle, S.W. 1990. Damselflies of Florida, Bermuda and the Bahamas. Scientific Publishers Nature Guide # 3.
- Dunkle, S.W. 1989. Dragonflies of the Florida Peninsula, Bermuda and the Bahamas. Scientific Publishers Nature Guide # 1.
- Lam, E. 2004. Damselflies of the Northeast. Biodiversity Books, Forest Hills, N.Y. 96 pp.
- NatureServe. 2004. NatureServe Explorer: an online encyclopedia of life [web application]. Version 4.0. NatureServe, Arlington, VA. Available <http://www.natureserve.org/explorer>.
- Needham, J. G., M. J., Jr., Westfall, and M. L. May. 2000. Dragonflies of North America. Scientific Publishers, Gainesville FL. 940 pp.
- Nikula, B., J.L. Loose, and M.R. Burne. 2003. A field guide to dragonflies and damselflies of Massachusetts. Natural Heritage and Endangered Species Program. Massachusetts Division of Fisheries and Wildlife. Boston, MA.
- Nothnagle, P. 1988. A provisional list of the odonates (dragonflies and damselflies) of Vermont. Technical Report 1. Nongame and Natural Heritage Program, Vermont Fish and Wildlife Department.
- Pfeiffer, B. M. 2002. *Williamsonia fletcheri* Williamson (Anisoptera: Corduliidae) at Chickering Bog Natural Area, Calais, Vermont: an encounter on June 4, 2002. A report to the Vermont Chapter of The Nature Conservancy. 4 pp.
- Westfall, M.J. and M.L. May. 1996. Damselflies of North America. Scientific Publishers, Gainesville, Florida.



Common Name: **Odonates-Lakes/Ponds Group**
Scientific Name: **Odonates-Lakes/Ponds Group**
Species Group: **Invert**

Conservation Assessment

Final Assessment: High Priority

Global Rank:

Global Trend:

State Rank:

State Trend: Unknown

Extirpated in VT? No

Regional SGCN? Yes

Assessment Narrative:

This group consists of seven species, the habitat requirements of which vary within the general lakes/ponds category. Habitats given for each species refer primarily to reproduction and nymphal requirements; adults of many species depend on various nearby terrestrial habitats as well. Some dragonflies are known to exhibit "hilltopping" behavior, in which they congregate on tops of hills, which may be fairly distant from egg-laying sites. This would increase the home range requirements for such species.

--New England Bluet (*Enallagma laterale*): Vegetated ponds.

--Slender Bluet (*Enallagma traviatum*): Lakes and ponds with vegetation

--Lilypad Forktail (*Ischnura kellicotti*): Ponds with lily pads

--Ringed Emerald (*Somatochlora albicincta*): Cold ponds

--Lake Emerald (*Somatochlora cingulata*): Shallow cold lakes, sluggish rivers and streams

--Banded Pennant (*Celithemis fasciata*): Newly discovered in Vermont. A southern species that may continue to move northward. Vegetated ponds and lakes

--Carolina Saddlebags (*Tamea carolina*): Newly discovered in Vermont. A southern species that may continue to move northward. Vegetated ponds and lakes.

Distribution

Distribution records by biophysical region for lakes/ponds odonates:

--New England Bluet (*Enallagma laterale*): Southern Vermont Piedmont

--Slender Bluet (*Enallagma traviatum*): Champlain Valley, Taconic Mountains, Southern Vermont Piedmont

--Lilypad Fork tail (*Ischnura kellicotti*): Taconic Mountains, Southern Vermont Piedmont

--Ringed Emerald (*Somatochlora albicincta*): Northern Highlands, Northern Green Mountains

--Lake Emerald (*Somatochlora cingulata*): Northern Highlands, Northern Vermont Piedmont, Southern Green Mountains

--Banded Pennant (*Celithemis fasciata*): Southern Green Mountains

--Carolina Saddlebags (*Tamea carolina*): Vermont Valley, Southern Vermont Piedmont



Common Name: **Odonates-Lakes/Ponds Group**
Scientific Name: **Odonates-Lakes/Ponds Group**
Species Group: **Invert**

Distribution by Biophysical Region:

| | | | |
|-------------------------------|-----------|-----------------------------|-----------|
| Champlain Valley | Confident | Southern VT Piedmont | Confident |
| Champlain Hills | Probable | Vermont Valley | Confident |
| Northern Green Mtns | Confident | Southern Green Mtns | Confident |
| Northern VT Piedmont | Confident | Taconic Mtns | Confident |
| Northeastern Highlands | Confident | | |

Distribution by Watershed:

Habitat Description

Habitat Information is based on the following:

Limited Local Knowledge Extensive Local Knowledge Regional Literature General Literature

This group consists of seven species, the habitat requirements of which vary within the general lakes/ponds category. Habitats given for each species refer primarily to reproduction and nymphal requirements; adults of many species require various nearby terrestrial habitats as well. Some dragonflies are known to exhibit "hilltopping" behavior, in which they congregate on tops of hills, which may be fairly distant from egg-laying sites. This would increase the home range requirements for such species.

- New England Bluet (*Enallagma laterale*) Vegetated ponds
- Slender Bluet (*Enallagma traviatum*) Lakes and ponds with vegetation
- Lilypad Forktail (*Ischnura kellicotti*) Ponds with lily pads
- Ringed Emerald (*Somatochlora albicincta*) Cold ponds and lakes
- Lake Emerald (*Somatochlora cingulata*) Shallow cold lakes, sluggish rivers and streams
- Banded Pennant (*Celithemis fasciata*) Vegetated lakes and ponds
- Carolina Saddlebags (*Tamea carolina*) Vegetated lakes and ponds

Habitat Types:

- Open Peatlands
- Marshes and Sedge Meadows
- Wet Shores
- Aquatic: Fluvial
- Aquatic: Lacustrine
- Aquatic: Man-Made Water Bodies



Common Name: **Odonates-Lakes/Ponds Group**
Scientific Name: **Odonates-Lakes/Ponds Group**
Species Group: **Invert**

Current Threats

Habitat Threats:

Conversion of Habitat
Habitat Alteration
Sedimentation
Incompatible Recreation

Description of habitat threat(s): Shoreline development and fill can degrade and eliminate suitable aquatic habitat. Exotic invasive aquatic plants such as Eurasian milfoil may change the habitat available to lake and pond odonates.

Non-Habitat Threats:

Pollution

Description of non-habitat threat(s): Wakes caused by boating can wash over and kill emerging adults.

Research and Monitoring Needs

| Type | Need | Priority | Description |
|------------|--------------------------------|----------|--|
| Research | Habitat Requirements | Low | Define particular habitat requirements of each species within Vermont, utilizing current knowledge of researchers and field investigations. |
| Research | Distribution and Abundance | Medium | 1) Conduct inventories to detect and gather information on new SGCN odonate populations. 2) Obtain baseline distributional and abundance data for all species in group by conducting surveys throughout the state. Efforts should be focused on particular habitats required by each and, where appropriate, on regions of expected occurrence within the state (e.g., a northern peripheral species might be expected in the northern tier counties). Abundance information should be collected at sites of known occurrence. |
| Research | Threats and Their Significance | Medium | Assess the vulnerability of nymphs of each species to habitat perturbations, such as substrate alteration, temperature and water quality shifts, chemical pollution, and changes in vegetation. Investigate the upland habitat needs of the adults and the effects of such impacts as fragmentation and reduction. |
| Monitoring | Population Change | High | Monitor known SGCN odonate populations. Track population trends at distinct locations. This would follow field surveys and assessments to identify populations judged to be large and viable. Focusing on such large populations would offer greater probability of detecting population shifts. Particularly important monitoring sites would include Lily Pond (Windham Co.) and those sites with isolated populations or scattered distributions. |
| Monitoring | Range Shifts | Medium | Monitor particular northern peripheral species (northern Vermont) to detect shifts in range over time. |

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Common Name: **Odonates-Lakes/Ponds Group**
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 Species Group: **Invert**

Species Strategies

| Strategy Type | Strategy Priority | Strategy Description | Performance Measure | Potential Partners | Potential Funding Sources |
|---|--------------------------|--|---|--|--|
| Technical Assistance, Training, Workshops | High | Incorporate odonate SGCN occurrence information into environmental review and technical assistance | Number of sites with odonate SGCN that received conservation benefits to this group | FWD, USFWS, DEC, ANR, VTTrans, NRCS | SWG |
| Compatible Resource Use | High | Develop stewardship program for sites with high priority odonate SGCN | Number of stewardship sites established | FWD, Federation of VT Lakes & Ponds, VCE, DEC, CLF, town Cons Comms | SWG, conservation license plate funds, corporate funding |
| Awareness Raising and Communications | High | Educate public and improve appreciation of vulnerable odonate habitats | Number of participants at events/workshops | FWD, VCE, Federation of VT Lakes & Ponds, town Cons Comms, media outlets | SWG |
| Awareness Raising and Communications | High | Raise awareness of Vermont Shoreland Protection Act with landowners | Number of lakeshore landowners contacted | DEC, FWD, ANR, Federation of VT Lakes and Ponds, media outlets | DEC, ANR |
| Compliance & Enforcement | High | Enforcement of the new (2014) Vermont Shoreland Protection Act | Number of permit requests annually | DEC, ANR | DEC, ANR |
| Easements | High | Acquisition/easement of high priority SGCN odonate lake and pond sites | Number of SGCN odonate sites protected | FWD, VLT, other land trusts | VHCB, SWG, EQIP, USFWS |

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Common Name: **Odonates-Lakes/Ponds Group**
Scientific Name: **Odonates-Lakes/Ponds Group**
Species Group: **Invert**

Bibliography

- Brunelle, P.M. 1999. Distribution of damselflies and dragonflies (Odonata) of Maine, United States. *Northeastern Naturalist* 6(1):35-38.
- Carle, F. L. 1994. Dragonflies and damselflies (Odonata) known to or likely to occur in Vermont. A report to the Nongame and Natural Heritage Program, Vermont Fish & Wildlife Department. 22 pp.
- Carle, F. L. 1997. Odonates of the Green Mountain National Forest A report to the National Forest Service, Manchester Ranger District.
- Carpenter, V.A. 1997. Dragonflies and damselflies of Cape Cod. Edition 2. The Cape Cod Museum of Natural History, Brewster, Massachusetts. 80 pp.
- Dunkle, S.W. 2000. Dragonflies through binoculars: a field guide to dragonflies of North America. Oxford University Press, New York, NY. 266pp.
- Dunkle, S.W. 1990. Damselflies of Florida, Bermuda and the Bahamas. Scientific Publishers Nature Guide # 3.
- Dunkle, S.W. 1989. Dragonflies of the Florida Peninsula, Bermuda and the Bahamas. Scientific Publishers Nature Guide # 1.
- Lam, E. 2004. Damselflies of the Northeast. Biodiversity Books, Forest Hills, N.Y. 96 pp.
- NatureServe. 2004. NatureServe Explorer: an online encyclopedia of life [web application]. Version 4.0. NatureServe, Arlington, VA. Available <http://www.natureserve.org/explorer>.
- Needham, J. G., M. J., Jr., Westfall, and M. L. May. 2000. Dragonflies of North America. Scientific Publishers, Gainesville FL. 940 pp.
- Nikula, B., J.L. Loose, and M.R. Burne. 2003. A field guide to dragonflies and damselflies of Massachusetts. Natural Heritage and Endangered Species Program. Massachusetts Division of Fisheries and Wildlife. Boston, MA.
- Nothnagle, P. 1988. A provisional list of the odonates (dragonflies and damselflies) of Vermont. Technical Report 1. Nongame and Natural Heritage Program, Vermont Fish and Wildlife Department.
- Westfall, M.J. and M.L. May. 1996. Damselflies of North America. Scientific Publishers, Gainesville, Florida.



Common Name: **Odonates-River/Stream Group**
Scientific Name: **Odonates-River/Stream Group**
Species Group: **Invert**

Conservation Assessment

Final Assessment: High Priority

Global Rank:

Global Trend:

State Rank:

State Trend: Unknown

Extirpated in VT? No

Regional SGCN? Yes

Assessment Narrative:

This group consists of 17 species, the habitat requirements of which vary within the general rivers/streams category. Habitats given for each species refer primarily to reproduction and nymphal requirements; adults of many species depend on various nearby terrestrial habitats as well. Riparian vegetation is important to adults as habitat.

- American Rubyspot (*Hetaerina americana*): Streams and rivers with emergent vegetation
- Blue-fronted Dancer (*Argia apicalis*): Small to large rivers with sand or mud; occasionally ponds and lakes
- River Bluet (*Enallagma anna*): First Vermont record in 2014; rivers
- Rainbow Bluet (*Enallagma antennatum*): Slow streams and big rivers
- Big Bluet (*Enallagma durum*): Discovered in 2005 in southern Vermont; two known sites; slow rivers
- Spine-crowned Clubtail (*Gomphus abbreviatus*): Rivers
- Midland Clubtail (*Gomphus fraternus*): Large rivers
- Rapids Clubtail (*Gomphus quadricolor*): Large streams and rivers
- Skillet Clubtail (*Gomphus ventricosus*): Large rivers; mud or sand bottom
- Cobra Clubtail (*Gomphus vastus*): Large rivers with mud bottom; sometimes large streams and lakes
- Brook Snaketail (*Ophiogomphus aspersus*): Sandy streams
- Riffle Snaketail (*Ophiogomphus carolus*): Rapid, rocky or sandy streams and rivers
- Maine Snaketail (*Ophiogomphus mainensis*): Clear, rocky forested streams
- Rusty Snaketail (*Ophiogomphus rupinsulensis*): Large streams and rivers
- Riverine Clubtail (*Stylurus amnicola*): Big rivers
- Zebra Clubtail (*Stylurus scudderi*): Rivers
- Stygian Shadowdragon (*Neurocordulia yamaskanensis*): Large rivers and lakes; often rocky

Distribution

Biophysical region records for river/stream odonates:

- American Rubyspot (*Hetaerina americana*): Champlain Valley, Southern Vermont Piedmont
- Blue-fronted Dancer (*Argia apicalis*): Champlain Valley, Taconic Mountains, Southern Vermont Piedmont
- River Bluet (*Enallagma anna*): Southern Vermont Piedmont
- Rainbow Bluet (*Enallagma antennatum*): Champlain Valley, Northern Green Mountains, Taconic Mountains, Southern Vermont Piedmont.
- Big Bluet (*Enallagma durum*): Champlain Valley, Taconic Mountains
- Spine-crowned Clubtail (*Gomphus abbreviatus*): Champlain Valley, Taconic Mountains, Southern Vermont Piedmont
- Midland Clubtail (*Gomphus fraternus*): Champlain Valley
- Rapids Clubtail (*Gomphus quadricolor*): Champlain Valley, Champlain Hills, Taconic Mountains, Southern Green Mountains, Southern Vermont Piedmont.
- Skillet Clubtail (*Gomphus ventricosus*): Southern Vermont Piedmont
- Cobra Clubtail (*Gomphus vastus*): Southern Vermont Piedmont
- Brook Snaketail (*Ophiogomphus aspersus*): Northern Highlands, Northern Vermont Piedmont, Northern

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Green Mountains, Champlain Valley, Taconic Mountains, Southern Vermont Piedmont.
--Riffle Snaketail (*Ophiogomphus carolus*): Northern Highlands, Northern Green Mountains, Champlain Valley, Taconic Mountains, Southern Green Mountains, Southern Vermont Piedmont.
--Maine Snaketail (*Ophiogomphus mainensis*): Northern Highlands, Northern Vermont Piedmont, Northern Green Mountains, Southern Green Mountains, Southern Vermont Piedmont.
--Rusty Snaketail (*Ophiogomphus rupinsulensis*): Northern Green Mountains, Taconic Mountains, Southern Vermont Piedmont
--Riverine Clubtail (*Stylurus amnicola*): Southern Vermont Piedmont
--Zebra Clubtail (*Stylurus scudderi*): Northern Highlands, Northern Vermont Piedmont, Northern Green Mountains, Champlain Valley, Taconic Mountains, Vermont Valley, Southern Vermont Piedmont.
--Stygian Shadowdragon (*Neurocordulia yamaskanensis*): Northern Vermont Piedmont, Champlain Valley, Taconic Mountains, Southern Green Mountains, Southern Vermont Piedmont.

Distribution by Biophysical Region:

| | | | |
|-------------------------------|-----------|-----------------------------|-----------|
| Champlain Valley | Confident | Southern VT Piedmont | Confident |
| Champlain Hills | Confident | Vermont Valley | Confident |
| Northern Green Mtns | Confident | Southern Green Mtns | Confident |
| Northern VT Piedmont | Confident | Taconic Mtns | Confident |
| Northeastern Highlands | Confident | | |

Distribution by Watershed:

Habitat Description

Habitat Information is based on the following:

Limited Local Knowledge Extensive Local Knowledge Regional Literature General Literature

This group consists of several species, the habitat requirements of which vary within the general rivers/streams category. Habitats given for each species refer primarily to reproduction and nymphal requirements; adults of many species depend on various nearby terrestrial habitats as well. Riparian vegetation is important to adults as habitat.

- American Rubyspot (*Hetaerina americana*): Streams and rivers with emergent vegetation
- Blue-fronted Dancer (*Argia apicalis*): Small to large rivers with sand or mud; occasionally ponds and lakes
- River Bluet (*Enallagma anna*): Rivers
- Rainbow Bluet (*Enallagma antennatum*): Slow streams and big rivers
- Big Bluet (*Enallagma durum*): Slow rivers
- Spine-crowned Clubtail (*Gomphus abbreviatus*): Rivers
- Midland Clubtail (*Gomphus fraternus*): Big rivers
- Rapids Clubtail (*Gomphus quadricolor*): Large streams and rivers



Common Name: **Odonates-River/Stream Group**
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- Skillet Clubtail (*Gomphus ventricosus*): Large rivers; mud or sand bottom
- Cobra Clubtail (*Gomphus vastus*): Large rivers with mud bottom; sometimes large streams and lakes
- Brook Snaketail (*Ophiogomphus aspersus*): Sandy streams
- Riffle Snaketail (*Ophiogomphus carolus*): Rapid, rocky or sandy streams and rivers
- Maine Snaketail (*Ophiogomphus mainensis*): Clear, rocky forested streams
- Rusty Snaketail (*Ophiogomphus rupinsulensis*): Large streams and rivers
- Riverine Clubtail (*Stylurus amnicola*): Big rivers
- Zebra Clubtail (*Stylurus scudderii*): Rivers
- Stygian Shadowdragon (*Neurocordulia yamaskanensis*): Large rivers and lakes; often rocky.

Habitat Types:

- Aquatic: Fluvial
- Aquatic: Lower CT River
- Aquatic: Large Lake Champlain Tribs Below Falls
- Aquatic: Lacustrine

Current Threats

Habitat Threats:

- Energy Infrastructure and Development
- Habitat Alteration
- Sedimentation
- Incompatible Recreation

Description of habitat threat(s): Bank armoring (riprap) and other disturbance that alters the river bed can kill individuals and permanently reduce habitat suitability. New dam construction alters habitat from riverine to impoundment. Dam operation alters water velocity, water level, and other hydrologic factors.

Non-Habitat Threats:

- Pollution

Description of non-habitat threat(s): Wakes caused by boating can wash over and kill emerging adults.

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Common Name: **Odonates-River/Stream Group**
 Scientific Name: **Odonates-River/Stream Group**
 Species Group: **Invert**

Research and Monitoring Needs

| Type | Need | Priority | Description |
|-------------|--------------------------------|-----------------|--|
| Research | Habitat Requirements | Medium | Define particular habitat requirements of each species within Vermont, utilizing current knowledge of researchers and field investigations. |
| Research | Distribution and Abundance | High | 1) Obtain baseline distributional and abundance data for all species in group by conducting surveys throughout the state. Efforts should be focused on particular habitats required by each and, where appropriate, on regions of expected occurrence within the state (e.g., a northern peripheral species might be expected in the northern tier counties). Abundance information should be collected at sites of known occurrence. 2) Conduct inventories to detect and gather information on new SGCN odonate populations. |
| Research | Threats and Their Significance | Medium | Assess the vulnerability of nymphs of each species to habitat perturbations, such as siltation, temperature and water quality shifts, chemical pollution, hydropower development and operation, and changes in vegetation. Investigate the upland habitat needs of the adults and the effects of such impacts as fragmentation and reduction. |
| Research | Other Research | Medium | Conduct cage study of Hetaerina americana during lampricide treatment of Lewis Creek to provide information on vulnerability of the species to these chemicals. |
| Monitoring | Population Change | High | Monitor known SGCN odonate populations. Track population trends at distinct locations. This would follow field surveys and assessments to identify populations judged to be large and viable. Focusing on such large populations would offer greater probability of detecting population shifts. |

Species Strategies

| Strategy Type | Strategy Priority | Strategy Description | Performance Measure | Potential Partners | Potential Funding Sources |
|---|--------------------------|--|---|--|----------------------------------|
| Technical Assistance, Training, Workshops | High | Incorporate odonate SGCN occurrence information into environmental review and technical assistance | Number of sites with odonate SGCN that received conservation benefits to this group | FWD, USFWS, DEC, ANR, VTrans, NRCS | SWG |
| Awareness Raising and Communications | High | Educate public and improve appreciation of vulnerable odonate habitats | Number of participants at events/workshops | FWD, VCE, watershed groups, VT River Conservancy, TU, town Cons Comms, media outlets | SWG |
| Easements | High | Acquisition/easement of high priority SGCN odonate riverine sites | Number of SGCN odonate sites protected | FWD, TNC, VLT, other land trusts, watershed groups | SWG, EQIP, USFWS |

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Bibliography

- Brunelle, P.M. 1999. Distribution of damselflies and dragonflies (Odonata) of Maine, United States. *Northeastern Naturalist* 6(1):35-38.
- Carle, F. L. 1994. Dragonflies and damselflies (Odonata) known to or likely to occur in Vermont. A report to the Nongame and Natural Heritage Program, Vermont Fish & Wildlife Department. 22 pp.
- Carle, F. L. 1997. Odonates of the Green Mountain National Forest A report to the National Forest Service, Manchester Ranger District.
- Carpenter, V.A. 1997. Dragonflies and damselflies of Cape Cod. Edition 2. The Cape Cod Museum of Natural History, Brewster, Massachusetts. 80 pp.
- Dunkle, S.W. 2000. Dragonflies through binoculars: a field guide to dragonflies of North America. Oxford University Press, New York, NY. 266pp.
- Dunkle, S.W. 1990. Damselflies of Florida, Bermuda and the Bahamas. Scientific Publishers Nature Guide # 3.
- Dunkle, S.W. 1989. Dragonflies of the Florida Peninsula, Bermuda and the Bahamas. Scientific Publishers Nature Guide # 1.
- Lam, E. 2004. Damselflies of the Northeast. Biodiversity Books, Forest Hills, N.Y. 96 pp.
- NatureServe. 2004. NatureServe Explorer: an online encyclopedia of life [web application]. Version 4.0. NatureServe, Arlington, VA. Available <http://www.natureserve.org/explorer>.
- Needham, J. G., M. J., Jr., Westfall, and M. L. May. 2000. Dragonflies of North America. Scientific Publishers, Gainesville FL. 940 pp.
- Nikula, B., J.L. Loose, and M.R. Burne. 2003. A field guide to dragonflies and damselflies of Massachusetts. Natural Heritage and Endangered Species Program. Massachusetts Division of Fisheries and Wildlife. Boston, MA.
- Nothnagle, P. 1988. A provisional list of the odonates (dragonflies and damselflies) of Vermont. Technical Report 1. Nongame and Natural Heritage Program, Vermont Fish and Wildlife Department.
- Westfall, M.J. and M.L. May. 1996. Damselflies of North America. Scientific Publishers, Gainesville, Florida.



Common Name: **Crustaceans Group**
Scientific Name: **Crustaceans Group**
Species Group: **Invert**

Conservation Assessment

Final Assessment: High Priority

Global Rank:

Global Trend:

State Rank:

State Trend: Unknown

Extirpated in VT? No

Regional SGCN? Yes

Assessment Narrative:

This group includes the following three species:

--An amphipod (*Diporeia hoyi*): This deep-water species is rarely collected. It has been reported from Lake Champlain and Lake Memphremagog. It may occur in other deep lakes also. This species is cited as being very sensitive to pollution. It is likely to be one of the first species to disappear when a lake is polluted.

--Taconic Cave amphipod (*Stygobromus borealis*): This state-endangered species is known from only a single cave in Vermont, which is a popular spelunking cave. The status of this population is not known.

--Appalachian Mountain crayfish (*Cambarus bartonii*): This rare crayfish is only found in small cold water streams and is threatened by development (stormwater sedimentation), acid rain, climate change, and introduction of the rusty crayfish (*Orconectes rusticus*).

Distribution

--An amphipod (*Diporeia hoyi*): This species is known in Vermont only from (1) deep water in Lake Champlain from Crown Pt. to Rouses Pt., including Inner Mallets Bay and Missisquoi Bay; and (2) possibly Lake Memphremagog. It may also occur in other large lakes with similar deep water habitat. It was very rare in Lake Champlain 1992-1996 samples.

--Taconic Cave amphipod (*Stygobromus borealis*): This amphipod is known in Vermont only from Morris Cave in Danby; it may also occur in Dorset (Aeolus) Cave in Dorset, but that record is unclear. It has also been reported from MA and NY. It appears to be limited to subterranean drainage systems of karst terrain in the Taconic Mountains. Three single locations comprise the entire global distribution known for this species.

--Appalachian Mountain crayfish (*Cambarus bartonii*): This crayfish is known from the West River, Hudson drainage (Battenkill), and the Champlain Basin. It occurs both in the mountains and in small, valley streams.

Distribution by Biophysical Region:

| | |
|------------------------|----------------------|
| Champlain Valley | Southern VT Piedmont |
| Champlain Hills | Vermont Valley |
| Northern Green Mtns | Southern Green Mtns |
| Northern VT Piedmont | Taconic Mtns |
| Northeastern Highlands | |

Distribution by Watershed:

Known Watersheds

West

Hudson-Hoosic

Probable Watersheds

St. Francois River



Common Name: **Crustaceans Group**
Scientific Name: **Crustaceans Group**
Species Group: **Invert**

Lake Champlain
Lamoille River
Missisquoi River
Otter Creek
Winooski River
Metawee River

Habitat Description

Habitat Information is based on the following:

Limited Local Knowledge Extensive Local Knowledge Regional Literature General Literature

--An amphipod (*Diporeia hoyi*) This is a deep-water species of large lakes, where it undergoes vertical migrations. It has been collected as deep as 900 feet in Lake Superior. It requires cold, deep water with a good oxygen supply. It is likely to be one of the first species to disappear when a lake is polluted.

--Taconic Cave amphipod (*Stygobromus borealis*) In Vermont, this amphipod is found in a cave of marble bedrock with a deep (probably > 9 meters) pool of water with a silt and/or sand bottom. In MA, it was reported from a springhouse.

--Appalachian Mountain crayfish (*Cambarus bartonii*) This rare crayfish is only found in small cold water streams. It occurs both in the mountains and in small, valley streams.

Habitat Types:

Subterranean
Aquatic: Fluvial
Aquatic: Lacustrine
Aquatic: Lake Champlain

Current Threats

Habitat Threats:

Habitat Alteration
Sedimentation
Invasion by Exotic Species
Climate Change

Description of habitat threat(s): *D. hoyi* is limited by shifts in food web dynamics caused by zebra mussels. The invasive quagga mussel is displacing *D. hoyi* in the Great Lakes and could cause similar effects if it reaches Lake Champlain. Spiny waterflea now poses a new threat in Lake Champlain. Long-term deposition of silt is likely altering the benthic habitat this amphipod uses.

--*S. borealis*, due to the nature of its habitat, is vulnerable to hydrologic alterations that may originate away from the occupied site.

--*Cambarus bartonii* is limited by development (stormwater sedimentation), acid rain, climate change, and



Common Name: **Crustaceans Group**
 Scientific Name: **Crustaceans Group**
 Species Group: **Invert**

introduction of the rusty crayfish (*Orconectes rusticus*).

Non-Habitat Threats:

Pollution

Reproductive Traits

Trampling or Direct Impacts

Description of non-habitat threat(s): *D. hoyi* is pollution sensitive, needing clean, cold, well-oxygenated water.

--*S. borealis*, due to the nature of its habitat, is vulnerable to such problems as pollution and nutrient shift. It is also vulnerable to direct loss of individuals, due to the small size and isolated nature of the population. The reproductive capability of this species is likely much more limited than that of surface-water inhabiting amphipods due to limited food supply. This makes rebounding from population losses or poor reproductive years difficult. The threat posed by cave recreation is uncertain.

--*C. bartonii* lives in streams which can be greatly affected by acid rain.

Research and Monitoring Needs

| Type | Need | Priority | Description |
|-------------|--------------------------------|-----------------|--|
| Research | Habitat Requirements | Medium | The habitat requirements for <i>S. borealis</i> needs to be studied and refined. |
| Research | Basic Life History | Medium | The life history of <i>S. borealis</i> is virtually unknown. Study is needed. |
| Research | Distribution and Abundance | High | The distribution and abundance of all three species has not been sufficiently investigated. Further survey work is needed to accurately determine the extent and status of these species in Vermont. |
| Research | Threats and Their Significance | High | The potential impacts of recreational and other human uses of caves supporting <i>S. borealis</i> need to be assessed. The potential for negative impacts due to manipulation or contamination of groundwater feeding these cave streams needs to be determined. The affects of fine sediments on the benthic habitat of <i>D. hoyi</i> should be studied. The effects on food web dynamics caused by zebra mussels and spiny waterflea need to be studied with regard to <i>D. hoyi</i> . |
| Monitoring | Population Change | High | 1) Known <i>S. borealis</i> population should be monitored; methods that do not impact individual amphipods will be required. 2) Monitor known SGCN crustacean populations. |
| Monitoring | Habitat Change | Medium | Water quality and volume in known <i>S. borealis</i> cave stream should be monitored. |

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Common Name: **Crustaceans Group**
 Scientific Name: **Crustaceans Group**
 Species Group: **Invert**

Species Strategies

| Strategy Type | Strategy Priority | Strategy Description | Performance Measure | Potential Partners | Potential Funding Sources |
|----------------------|--------------------------|--|---|---|-----------------------------------|
| Habitat Restoration | High | Protect and restore habitats on which SGCN crustaceans are dependent through pollution abatement, riparian buffers, groundwater protection, etc. | Number of acres of land protected for river buffers, groundwater recharge, etc. | Watershed groups, USFWS, DEC, FWD, LCLT, VLT, TNC | SWG, EQIP, LCLT, VLT, NRCS, USFWS |
| Easements | High | Acquisition/easement of any newly discovered <i>Stygobromus borealis</i> sites | Number of newly discovered sites protected | FWD, USFS, TNC, LCLT, VLT, USFWS | VHCB, SWG, GMNF, EQIP, USFWS |

Bibliography

Bell, R.T. 1971. Handbook of the Malacostraca of Vermont and neighboring regions (crayfish, sowbugs and their relatives). Published by author. Burlington, VT. 65 pp.

Biomonitoring Database 2005. Vermont Department of Environmental Conservation. Biomonitoring Section.

Bousfield, E.L. 1973. Shallow-water gammaridean Amphipoda of New England. Cornell University Press, Ithaca, NY. 312pp.

Dermott, R. 2001. Sudden disappearance of the amphipod *Diporeia* from eastern Lake Ontario, 1993-1995. J. Great Lakes Res. 27: 423-433.

NatureServe. 2004. NatureServe Explorer: an online encyclopedia of life [web application]. Version 4.0. NatureServe, Arlington, VA. Available <http://www.natureserve.org/explorer>.

Smith, D.G. 1995. Keys to the freshwater macroinvertebrates of Massachusetts, Second Ed. Privately published. Douglas G. Smith, 30 Montague Road, Sunderland. MA. 243pp.

Nalepa, T. F.; D.L. Fanslow, and G. Messick. 2005. Characteristics and potential causes of declining *Diporeia* spp. populations in southern Lake Michigan and Saginaw Bay, Lake Huron. Page 157-188. Publications, Agencies and Staff of the U.S. Department of Commerce. Paper 414.

Smith, D.G. 2001. Pennak's freshwater invertebrates of the United States: Porifera to Crustacea. 4th Ed. John Wiley & Sons. 638pp.

The Amphipod Homepage. [Http://www.imv.uit.no/amphipod/index.html](http://www.imv.uit.no/amphipod/index.html).



Common Name: **Freshwater Mussels Group**
Scientific Name: **Freshwater Mussels Group**
Species Group: **Invert**

Conservation Assessment

Final Assessment: High Priority

Global Rank:

Global Trend:

State Rank:

State Trend: Declining

Extirpated in VT? No

Regional SGCN? Yes

Assessment Narrative:

This group includes 13 species. Seven are state-endangered species and three state-threatened species. One is also federally endangered. Two of the three remaining species are each known from only a single short stretch of river. Freshwater mussels are recognized as one of the most endangered groups in the state.

- Eastern pearlshell (*Margaritifera margaritifera*): State threatened. Regional SGCN*
- Dwarf wedgemussel (*Alasmidonta heterodon*): State and federal endangered. Regional SGCN*
- Brook floater (*Alasmidonta varicosa*): State threatened. Only one population, occupying only one river stretch. Regional SGCN*
- Elktoe (*Alasmidonta marginata*): Very rare. Occupies a single short river stretch. Regional SGCN*
- Alewife floater (*Anodonta implicata*): Rare. Occupies a single river stretch. Regional SGCN*
- Cylindrical papershell (*Anodontoidea ferussacianus*): State endangered. Regional SGCN*
- Pocketbook (*Lampsilis ovata*): State endangered. Regional SGCN*
- Fluted-shell (*Lasmigona costata*): State endangered.
- Creek heelsplitter (*Lasmigona compressa*): Rare. Regional SGCN*
- Fragile papershell (*Leptodea fragilis*): State endangered. Regional SGCN*
- Black sandshell (*Ligumia recta*): State endangered. Probably most endangered Vermont mussel. Regional SGCN*
- Pink heelsplitter (*Potamilus alatus*): State endangered
- Giant floater (*Pyganodon grandis*): State threatened

*Regional Species of Greatest Conservation Need (RSGCN) among the 13 Northeastern states

Distribution

Eastern pearlshell (*Margaritifera margaritifera*): Reported from the upper Winooski River and Lewis Creek systems of the Champlain basin, and the Passumpsic River, West River, and Nulhegan River systems of the Connecticut River basin.

--Dwarf wedgemussel (*Alasmidonta heterodon*): Connecticut River mainstem, and slightly upstream into some large tributaries. Historically found from Bloomfield to Brattleboro. More recently known from Hartland to Springfield, and from Guildhall to Lunenburg.

--Brook floater (*Alasmidonta varicosa*): Known only from West River (Connecticut River tributary). One historic report from the Connecticut River mainstem.

--Elktoe (*Alasmidonta marginata*): Known only from a short stretch (~ 5 miles) of the Lamoille River.

--Alewife floater (*Anodonta implicata*): Occurs in Connecticut River downstream of Bellows Falls.

--Cylindrical papershell (*Anodontoidea ferussacianus*): Known from Missisquoi, Lamoille, and Poultney river systems, and also Stone Bridge Brook (Milton). May occur in other Lake Champlain rivers and the main lake itself. One historic report from the Clyde River.



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--Pocketbook (*Lampsilis ovata*): Champlain basin species; reported from Lake Champlain, Missisquoi River, Lamoille River, Winooski River, LaPlatte River, Lewis Creek, Otter Creek, and Poultney River. Only found below principal fall line.

--Fluted-shell (*Lasmigona costata*): Champlain basin species; reported from Lamoille River, Winooski River, Otter Creek, Lewis Creek, and Poultney River. Historically in the Missisquoi River (shells collected), but no live specimens have been observed. Observed above the principal fall line only in Otter and Lewis creeks.

--Creek heelsplitter (*Lasmigona compressa*): Reported from several small to large tributaries to Lake Champlain. Primarily a headwater to medium-sized creek species, but does occur in larger habitats (e.g., below fall line in Winooski River). One record is from outside the Champlain basin, the Coaticook River.

--Fragile papershell (*Leptodea fragilis*): Lake Champlain basin only; reported from Lake Champlain, Missisquoi River, Lamoille River, Winooski River, Poultney River, and Otter Creek system. Only found below principal fall line.

--Black sandshell (*Ligumia recta*): Champlain basin species; reported from Missisquoi River, Otter Creek, Poultney River, and Hospital Creek, and shallow areas in Lake Champlain near the mouths of these rivers. Appears extirpated from Hospital Creek; most recent survey did not find it in Otter Creek. Only found below principal fall line.

--Pink heelsplitter (*Potamilus alatus*): Champlain basin species; reported from Lake Champlain, Missisquoi River, Lamoille River, Winooski River, Otter Creek, Lewis Creek, Hospital Creek, and Poultney River. Only found below principal fall line.

--Giant floater (*Pyganodon grandis*): Champlain basin species; reported in Lake Champlain, Missisquoi River, Lamoille River, Winooski River, East Creek, Poultney River, and Otter Creek system. Reported from above the principal fall line only in Otter Creek and Lamoille River. A high elevation pond population in Chittenden Co. is believed to be the result of an unintentional stocking.

Distribution by Biophysical Region:

| | |
|-------------------------------|-----------------------------|
| Champlain Valley | Southern VT Piedmont |
| Champlain Hills | Vermont Valley |
| Northern Green Mtns | Southern Green Mtns |
| Northern VT Piedmont | Taconic Mtns |
| Northeastern Highlands | |

Distribution by Watershed:

| | |
|---------------------------|----------------------------|
| Known Watersheds | Probable Watersheds |
| Metawee River | St. Francois River |
| Waits | Middle Connecticut |
| Upper Connecticut-Mascoma | West |
| Black-Ottawaquechee | |
| Lake Champlain | |
| Lamoille River | |



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Missisquoi River
Otter Creek
Passumpsic
Upper Connecticut
Winooski River

Habitat Description

Habitat Information is based on the following:

Limited Local Knowledge Extensive Local Knowledge Regional Literature General Literature

--Eastern pearlshell (*Margaritifera margaritifera*) This is a coldwater species, found in streams that support trout populations. It inhabits firm sand substrates, often amidst gravel and cobbles, and occasionally tightly packed cobbles and gravel. Salmonids are the fish hosts.

--Dwarf wedgemussel (*Alasmidonta heterodon*) A large river species, this mussel is found in stable mud, silty sand, sand, or gravel where the current is sufficient to keep the substrate free of surficial silt. Fish hosts may include the tessellated darter and slimy sculpin.

--Elktoe (*Alasmidonta marginata*) This is a mussel of medium-sized rivers, where it occupies riffles or rapids on stable gravel or rocky bottoms. It burrows securely into the sand-filled spaces between stones.

--Brook floater (*Alasmidonta varicosa*) This mussel occupies small rivers, where it is found in broad and shallow pools, runs, and glides, in sand and gravel substrates, often among or near cobble and boulder. Mussel beds usually support some submerged aquatic plants.

--Pocketbook (*Lampsilis ovata*) This relatively mobile mussel is found primarily in stretches of larger rivers from Lake Champlain to the first major waterfall. It also can be found in shallow areas of the main lake near deltas of these rivers. Mussels occupy firmly packed sand, sand and gravel, or silty sand.

--Fluted-shell (*Lasmigona costata*) This mussel is found primarily in medium-sized creeks to larger rivers from Lake Champlain to the first major waterfall, but also occurs above this fall line in some streams. It inhabits a variety of substrates, including mud, sand, gravel, and aggregates of cobble, gravel, and sand.

--Creek heelsplitter (*Lasmigona compressa*) This is a mussel of small creeks to small rivers, but occurs in small numbers in large river sections above Lake Champlain as well. It is found in gravel, sand, or mud.

--Pink heelsplitter (*Potamilus alatus*) This mussel occurs in large rivers only between Lake Champlain and the first major waterfall. It also occupies areas of Lake Champlain near the deltas of these rivers. It is found in clay, clayey silt, sand, gravel and sand, or mixtures of cobble, sand, and silt. Pink heelsplitters usually bury themselves nearly completely into the substrate, their shape anchoring them securely in place.

--Fragile papershell (*Leptodea fragilis*) This mussel occurs in large rivers only between Lake Champlain and the first major waterfall. It also occupies areas of Lake Champlain near the deltas of these rivers. It is found in sand, clayey silt, silty sand, or gravel and sand. Fragile papershells usually bury themselves nearly completely into the substrate, their shape anchoring them securely in place.

--Black sandshell (*Ligumia recta*) This mussel occurs only in large rivers between Lake Champlain and the first major waterfall. Substrates include sand, sand and gravel, and mud.



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--Giant floater (*Pyganodon grandis*) A relatively mobile species of large rivers and lakes, it is found in sand, sand and gravel, silty sand, and clay.

--Cylindrical papershell (*Anodontoidea ferussacianus*) This mussel is found in creeks and rivers, but likely occupies shallow lake habitat as well (Lake Champlain). Substrates include silt and silty sand in slow currents. It is known from both above and below the first waterfall upstream of Lake Champlain.

--Alewife floater (*Anodonta implicata*) This is a riverine mussel in Vermont found in slow to fast waters. It occurs in a variety of substrates, including sand, sand and gravel, and silt.

POTENTIAL FISH HOSTS REPORTED*:

--Eastern pearlshell: Rainbow trout, Atlantic salmon, brook trout, brown trout

--Dwarf wedgemussel: tessellated darter, slimy sculpin, banded killifish, Atlantic salmon

--Elktoe: white sucker, shorthead redhorse, rock bass

--Brook floater: slimy sculpin, longnose dace, blacknose dace, golden shiner, pumpkinseed, yellow perch, tessellated darter

--Pocketbook: smallmouth bass, white crappie, largemouth bass, bluegill, sauger, yellow perch

--Fluted-shell: common carp, spotfin shiner, longnose dace, creek chub, slimy sculpin, black crappie, yellow perch, bowfin, northern pike, bluegill, pumpkinseed, largemouth bass, walleye

--Creek heelsplitter: slimy sculpin, black crappie, spotfin shiner, yellow perch, yellow bullhead, brook stickleback, brassy minnow, bluegill, smallmouth bass, emerald shiner, mimic shiner, longnose dace, creek chub, bluntnose minnow

--Pink heelsplitter: freshwater drum

--Fragile papershell: freshwater drum

--Black sandshell: sauger, banded killifish, rosyface shiner, bluegill, redbreast sunfish, pumpkinseed, rock bass, American eel, common carp, white perch, white crappie, black crappie, largemouth bass, yellow perch, walleye

--Giant floater: banded killifish, blackchin shiner, blacknose shiner, black crappie, blacknose dace, bluegill, bluntnose minnow, brook silverside, common carp, brook stickleback, common shiner, creek chub, freshwater drum, gizzard shad, golden shiner, largemouth bass, longnose gar, pearl dace, pumpkinseed, rock bass, white crappie, white sucker, yellow bullhead, yellow perch

--Cylindrical papershell: spotfin shiner, black crappie; possibly sea lamprey, mottled sculpin, brook stickleback, white sucker, common shiner, blacknose shiner, bluntnose minnow, fathead minnow, bluegill, largemouth bass

--Alewife floater: American shad, alewife, blueback herring, white sucker, pumpkinseed, white perch

*Primarily from lab studies; this list does not indicate that fish hosts have been demonstrated in natural



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environment.

Habitat Types:

Aquatic: Fluvial
Aquatic: Lower CT River
Aquatic: Large Lake Champlain Tribs Below Falls
Aquatic: Lake Champlain
Aquatic: Man-Made Water Bodies

Current Threats

Habitat Threats:

Conversion of Habitat
Habitat Alteration
Sedimentation
Habitat Fragmentation
Invasion by Exotic Species

Description of habitat threat(s): --Zebra mussels are decimating Lake Champlain mussel populations, and are found in the lower portions of some of the lake's tributaries.
--Asiatic clams now occur in Lake George, which is upstream of Lake Champlain; these pose a future threat to Vermont's mussels.
--Bridge construction and road-related river bank stabilization have been common direct impacts
Streambank erosion and stormwater runoff can cover mussel habitat in intolerable levels of sediment.
--Dams have been responsible for large losses of habitat, particularly with the Connecticut River. Dams have converted river habitat to reservoirs, altered and degraded downstream habitats, and created barriers to movement. Hydropower dams create unnatural frequency of water level and velocity changes.

Non-Habitat Threats:

Genetics
Pollution
Harvest or Collection
Reproductive Traits
Trampling or Direct Impacts
Predation or Herbivory

Description of non-habitat threat(s): --Loss of specific fish hosts can result in reduced/eliminated reproductive success.
--Low local mussel abundance can reduce success rate of external fertilization.
--Muskrats are mussel predators and can decimate local populations when their numbers are too high or when a mussel species is particularly vulnerable.
--Low mussel densities can have genetic consequences.
--Mussels have been shown to be sensitive to a variety of pesticides and other anthropogenic chemicals.
--Wastewater effluents, stormwater runoff, and agricultural runoff can carry these pollutants into rivers



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where mussels reside.

--Use of mussels as bait by anglers has been problematic in some other states. This has not been investigated in Vermont.

--Damage to/death of mussels due to trampling by stream users may occur regularly, but has not been investigated. Thin-shelled species are often found dead due to breakage.

--Fisheries sampling also has the potential of affecting young and adult mussels, where equipment is in contact with the substrate.



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Research and Monitoring Needs

| <i>Type</i> | <i>Need</i> | <i>Priority</i> | <i>Description</i> |
|-------------|--------------------------------|-----------------|--|
| Research | Habitat Requirements | High | Define particular habitat requirements of each species within Vermont, utilizing field investigations and knowledge of researchers. |
| Research | Basic Life History | High | Determine host fish requirements for each mussel species. This needs to be specific to Vermont populations. |
| Research | Distribution and Abundance | High | 1) Obtain baseline information on distribution and abundance of each mussel species. This should include all existing information sources. 2) Conduct inventories of rivers and appropriate lake habitat to detect and gather information on SGCN mussel populations. |
| Research | Threats and Their Significance | High | 1) Assess limiting factors and their potential impacts to the aquatic habitats of each mussel species. Assessment should be on a watershed scale, including upland sources of potential limiting factors. 2) Research is needed on how to protect native mussel populations that are being impacted by zebra mussels, and also those populations that are vulnerable to further zebra mussel colonization. 3) Determine how dams affect mussel populations, their habitats, and life history requirements. 4) Investigate impacts of Missouri trawl (fisheries sampling) operation on young-of-year and older juvenile SGCN mussels. |
| Research | Population Genetics | High | 1) Certain species (e.g., black sandshell, elktoe, brook floater) are highly isolated from nearest populations. Genetic comparisons with other populations will be needed before reintroduction options can be evaluated. 2) Determine genetic constraints that may be hampering the recovery of isolated SGCN mussel populations (particularly black sandshell and elktoe). |
| Research | Taxonomy | Medium | There is uncertainty about the species assignment of <i>Lampsilis ovata</i> . Vermont populations may be <i>L. cardium</i> , or more than one species could be here. This needs to be determined. |
| Research | Other Research | High | Investigate the potential benefits and risks of dam removal to SGCN mussel populations. |
| Monitoring | Population Change | High | Monitor known SGCN mussel populations. Track population trends at distinct locations. This would follow field surveys and assessments to identify appropriate populations for monitoring. Focusing on large populations would offer greater probability of detecting population shifts. Areas of habitat where species have disappeared need to be tracked. |
| Monitoring | Habitat Change | High | Changes to habitat due to specific threats (e.g., hydrodams) need to be monitored. |
| Monitoring | Monitor Threats | High | Zebra mussel detection and monitoring is needed in watersheds that support SGCN mussels. Occupied rivers and boating lakes that occur upstream need to be monitored. The effects of dams on downstream habitat needs to be monitored, including de-watering, temperature regime, and silt releases. |

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Species Strategies

| Strategy Type | Strategy Priority | Strategy Description | Performance Measure | Potential Partners | Potential Funding Sources |
|---------------------------------------|--------------------------|--|--|--|--|
| Species Restoration | High | Investigate possibility of developing a freshwater mussel propagation facility for population reintroduction and enhancement. Such a facility could provide research opportunities as well. | Completion of design and plans for a mussel propagation facility | FWD, USFWS, UVM, other Northeast states | FWD, SWG, Endangered Species Section 6, PR |
| Habitat Restoration | High | Reduce the use of riprap in aquatic habitat as a method of bank stabilization. | Track change in annual number of stream feet impacted by new riprap projects. | FWD, DEC, ANR, NRCS, FEMA, VTrans, FHWA | PR, DJ, NRCS |
| Natural Processes Restoration | High | Work with regulators and dam operators/owners to reduce the impacts of dam operations on SGCN mussel populations. FERC re-licensing should require run-of-river flows. | Number of operating dams on SGCN mussel rivers that modify operations to run-of-river flows through FERC re-licensing or other negotiations. | FWD, DEC, ANR, FERC, dam operators/owners, USACOE, towns, VNRC | PR, DJ, DEC, USFWS, Hydro funds |
| Invasive Species Control & Prevention | High | Prevent the introduction and spread of zebra mussels. | Monitor sites of potential occurrence | LCBP, DEC, Towns, FWD, USFWS | VT Watershed Grants, LCBP, DEC |
| Species Restoration | High | Remove muskrats and potentially other predators where local mussel populations are vulnerable and are likely to be impacted by predation. | Continued surveillance to determine whether muskrats are impacting critical areas. | FWD, Wildlife Services (USDA), TNC, local trappers, USFWS | FWD, SWG, Endangered Species Section 6, PR |
| Easements | Medium | Acquire conservation easements for the protection of necessary SGCN mussel habitats and maintenance or restoration of ecological functions. | Number of riparian habitat acres acquired/enrolled | LCLT, VLT, FWD, ANR, TNC, NRCS, USFWS | LCLT, VLT, TNC, SWG, NRCS, PR, DJ |
| Alliance Development | High | Enhance coordination between government agencies and partners to ensure consistency in respective program implementation and increased sensitivity to SGCN mussel requirements and problems. | Number of mussel-pertinent permit and project notifications that bridge between agencies/organizations annually. | ANR, USFWS, COE, FEMA, FHWA, NRCS, Wildlife Services, VTrans, others | PR, SWG |

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| | | | | | |
|---------------------|------|---|---|--|----------------------|
| Habitat Restoration | High | Protect and restore habitats on which SGCN mussels are dependent through pollution abatement, riparian buffers, flow regulation, etc. | Number of acres of riparian habitat protected and/or restored | LCLT, VLT, Watershed groups, USFWS, DEC, FWD | SWG, LCLT, VLT, NRCS |
|---------------------|------|---|---|--|----------------------|

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Bibliography

- Bauer, G. 1983. Age structure, age specific mortality rates and population trend of the freshwater pearl mussel (*Margaritifera margaritifera*) in North Bavaria. - *Archiv fuer Hydrobiologie* 98:523-532.
- Bauer, G. 1987. Reproductive strategy of the freshwater pearl mussel *Margaritifera margaritifera*. *Journal of Animal Ecology* 56: 691-704.
- Bauer, G. 1988. Threats to the freshwater pearl mussel *Margaritifera margaritifera* L. in central Europe. *Biological Conservation* 45: 239-253.
- Baxter, R. M. 1977. Environmental effects of dams and impoundments. *Annual Review of Ecology and Systematics* 8: 255-283.
- Bogan, A.E. 1993. Freshwater bivalve extinctions (Mollusca: Unionoida): a search for causes. *American Zoologist* 33: 599-609.
- Bogan, A.E. 1996. Decline and decimation: the extirpation of the unionid freshwater bivalves of North America. *Journal of Shellfish Research* 15(2): 484.
- Fichtel, C., and D.G. Smith. 1995. *The Freshwater Mussels of Vermont*. Leahy Press, Montpelier, VT.
- Nedeau, E.J., M.A. McCollough, and B.I. Swartz. 2000. *The Freshwater Mussels of Maine*. Maine Department of Inland Fisheries and Wildlife, Augusta, ME.
- Nedeau E.J. (2008) *Freshwater Mussels and the Connecticut River Watershed*. Connecticut River Watershed Council, Greenfield, MA.
- Clarke, A. H. 1981. *The Freshwater Molluscs of Canada*. National Museum of Natural Science. Ottawa, ON.
- Strayer, D. L., and Jirka, K. J. 1997. *The Pearly Mussels of New York State*. University of the State of New York, State Education Department. 113p.
- Brim Box, J. and J. Mossa. 1999. Sediment, land use and freshwater mussels: prospects and problems. *Journal of the North American Benthological Society* 18:99-117.
- Clarke, A. H. 1981. *The freshwater molluscs of Canada*. National Museum of Natural Sciences/National Museums of Canada, Ottawa, Canada. 446 pp.
- Cope, W. G., and D. L. Waller. 1995. Evaluation of freshwater mussel relocation as a conservation and management strategy. *Regulated Rivers: Research & Management*. 11(2): 147-155.
- Cummings, K. S., and C. A. Mayer. 1992. *Field guide to freshwater mussels of the Midwest*. Illinois Natural History Survey, Manual 5. Champaign, IL. 194 pp.
- Di Maio, J. and L. D. Corkum. 1995. Relationship between the spatial distribution of freshwater mussels (*Bivalvia: Unionidae*) and the hydrological variability of rivers. *Canadian Journal of Zoology* 73: 663-671.
- Dunn, H. L. and B. E. Sietman. 1997. Guidelines used in four geographically diverse unionid relocations. Pages 176-183 in Cummings, K. S., A. C. Buchanan, C. A. Mayer, and T. J. Naimo (eds.). *Conservation and management of freshwater mussels II: initiatives for the future*. Proceedings of a Upper Mississippi River Conservation Committee symposium, 16-18 October 1995, St. Louis, Missouri. Upper Mississippi River Conservation Committee, Rock Island, Illinois.
- Fichtel, C., and D. G. Smith. 1995. *The freshwater mussels of Vermont*. Nongame & Natural Heritage Program, Vermont Fish and Wildlife Department. 54 pp.
- Goudreau, S.E., R.J. Neves and R.J. Sheehan. 1993. Effects of wastewater treatment plant effluents on freshwater mollusks in the upper Clinch River, Virginia, USA. *Hydrobiologia* 252: 211-230.
- Haag, W. R. and M. L. Warren. 1998. Role of ecological factors and reproductive strategies in structuring freshwater mussel communities. *Canadian Journal of Fisheries and Aquatic Sciences* 55: 297-306.
- Hallac, D. E. 1999. Conservation of unionid mussels threatened by zebra mussels (*Dreissena polymorpha*) in Lake Champlain, VT: and examination of species vulnerability, conservation strategies, and causal mechanisms of stress. M.S. Thesis, UCM. 110 pp.

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Johnson, R.I. 1980. Zoogeography of North American Unionacea (Mollusca: Bivalvia) north of the maximum Pleistocene glaciation. *Bulletin of the Museum of Comparative Zoology* 149(2): 77-189.

Jokela, J. and Mutikainen, P. Effect of size-dependent muskrat (*Ondatra zibethica*) predation on spatial distribution of a freshwater clam, *Anodonta piscinalis* Nilss. (Unionidae, Bivalvia). *Canadian Journal of Zoology* 73: 1085-1094.

Keller, A.E., and M. Lydy. 1997. Biomonitoring and the hazards of contaminants to freshwater mollusks. Unpublished report in: *Freshwater mollusks as indicators of water quality: a workshop*. U.S. Geological Survey Biological Resources Division and National Water Quality Assessment Program. 55 pp.

Lewis, J.B., and P.N. Riebel. 1984. The effect of substrate on burrowing in freshwater mussels (Unionidae). *Canadian Journal of Zoology* 62: 2023-2025.

Ligon, F. K., W. E. Dietrich, and W. J. Trush. 1995. Downstream ecological effects of dams: a geomorphic perspective. *Bioscience* 45 (3): 183-192.

Michaelson, D. and R. J. Neves. 1995. Life history and habitat of the endangered dwarf wedgemussel *Alasmidonta heterodon* (Bivalvia: Unionidae). *Journal of the North American Benthological Society* 14:324-340.

Mills, E. L., G. Rosenberg, A. P. Spidle, M. Ludyanskiy, Y. Pligin, and B. May. 1996. A review of the biology and ecology of the quagga mussel (*Dreissena bugensis*), a second species of freshwater dreissenid introduced to North America. *American Zoologist* 36: 271-286.

National Native Mussel Conservation Committee. 1998. National strategy for the conservation of native freshwater mussels. *Journal of Shellfish Research* 17: 1419-1428.

NatureServe. 2004. NatureServe Explorer: an online encyclopedia of life [web application]. Version 4.0. NatureServe, Arlington, VA. Available <http://www.natureserve.org/explorer>.

Neves, R. J., and M. C. Odum. 1989. Muskrat predation on endangered freshwater mussels in Virginia. *Journal of Wildlife Management* 53(4): 939-940.

Nedeau, E. J., M. A. McCollough, and B. I. Swartz. 2000. The freshwater mussels of Maine. Maine Department of Inland Fisheries and Wildlife. 118 pp.

Nedeau, E. J., and J. Victoria. 2003. A field guide to the freshwater mussels of Connecticut. Connecticut Department of Environmental Protection. 32 pp.

Richter, B.D., D.P. Braun, M. A. Mendelson, and L.L. Master. 1997. Threats to imperiled freshwater fauna. *Conservation Biology* 11:1081-1093.

Schloesser, D.W., T.F. Nalepa, and G.L. Mackie. 1996. Zebra mussel infestation of unionid bivalves (Unionidae) in North America. *American Zoologist* 36: 300-310.

Smith, D. G. 1985. Recent range expansion of the freshwater mussel *Anodonta implicata* and its relationship to clupeid fish restoration in the Connecticut River system. *Freshwater Invertebrate Biology* 4: 105-108.

Strand, M., and R. W. Merritt. 1999. Impacts of livestock grazing activities on stream insect communities and the riverine environment. *American Entomologist* 45(1): 13-29.

Strayer, D. L. 1999. Use of flow refuges by unionid mussels in rivers. *Journal of the North American Benthological Society* 18:468-476.

Strayer, D., and K. Jirka. 1997. The pearly mussels of New York State. New York State Museum, Memoir 26. 113 pp.

Watters, G. T. 1994. An annotated bibliography of the reproduction and propagation of the Unionoidea. (primarily of North America). Ohio Biological Survey Miscellaneous Contribution No. 1. vi+ 158pp.

Watters, G. T. 1996. Small dams as barriers to freshwater mussels (Bivalvia, Unionoidea) and their hosts. *Biological Conservation* 78: 79-85.

Williams, J. D., M. L. Warren, K. S. Cummings, J. L. Harris, and R. J. Neves. 1993. Conservation status of freshwater mussels of

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the United States and Canada. Fisheries 18: 6-22.

Yeager, B.L. 1994. Impacts of reservoirs on the aquatic environment of regulated rivers. Tennessee Valley Authority, Water Resources, Aquatic Biology Department, TVA/WR/AB-93/1, Norris, Tennessee.



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Conservation Assessment

Final Assessment: High Priority

Global Rank:

Global Trend:

State Rank:

State Trend: Declining

Extirpated in VT?

Regional SGCN?

Assessment Narrative:

A diverse group of 15 snail species whose general status ranges from extirpated to declining to rare. Much work is needed to refine status assessment. This group includes

--Fringed valvata (*Valvata lewisi*): Recorded from four locations in VT: St Catherine, and associated Little Pond, Lake Salem and Berlin Pond. Possibly occurs elsewhere. Only found in low numbers throughout range.

--Mossy valvata (*Valvata sincera*): Only found at four locations in VT: three in Lake Champlain, and Flag pond.

--Squat duskysnail (*Lyogyrus granum*): Only three locations: Lake St Catherine, Connecticut River, Lake Fairlee. An East Coast species.

--Pupa duskysnail (*Lyogyrus pupoideus*): Only six collections, all in Lake Champlain, may be susceptible to zebra mussel colonization.

--Canadian duskysnail (*Lyogyrus walkeri*): Only known from Lake St. Catherine.

--Buffalo pebblesnail (*Gillia altilis*): 12 locations in: Lake Champlain, Missisquoi River, Connecticut River, Crystal Lake, Indian Brook Reservoir, Hinkum Pond. Atlantic drainage species.

--Boreal marstonia (*Marstonia lustrica*): Found in Lake Champlain, Laplatte River and Joes Pond. Uncommon in northern part of range; more common southward. Reported as abundant at some Massachusetts sites.

--Liver elimia (*Goniobasis livescens*): Eleven sites, all in Lake Champlain. May be vulnerable to invasives such as *Bithynia tentaculata*, zebra mussel.

--Sharp hornsail (*Pleurocera acuta*): No recent occurrences from Vermont; may be extirpated. Reported historically from VT, QE, and NY in literature.

--Spindle lymnaea (*Acella haldemani*): Only known from one lake in VT: Beebee Pond, a lake periodically chemically treated and managed for invasive Eurasian Milfoil. Limited and localized in distribution. Appears to be greatly reduced from historical range. Often only one location is reported for a lake, but it is easily overlooked. Reproduction may be a limiting factor.

--Dusky ancyloid (*Laevapex fuscus*): Reproductive traits may be a limiting factor (low colonization rate).

--Mammoth lymnaea (*Bulimnaea megasoma*): Reported from Lake Champlain and its tributaries in 19th century literature; no recent records. May be extirpated; only VT historic record, a small stream in Burlington area, has since been filled in.

--Country fossaria (*Fossaria rustica*): Only found in two streams in Champlain Valley: Little Otter and Lewis creeks. Locations have been resampled since 1997 and not found.

--Star gyro (*Gyraulus crista*): Limited distribution in VT. Found in seven rivers: White River, Calendar Brook tributary, East Branch Passumpsic River, Ranch Brook, Sunny Brook, East Creek-South Fork, Morehouse Brook. Holarctic (northern): distribution. Rare in NY.

--Thicklip rams-horn (*Planorbula armigera*): Found at four locations; three of these are in urban or agricultural watersheds with degraded water quality.

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Distribution

- Fringed valvata (*Valvata lewisi*): Recorded from four locations: St Catherine, and associated Little Pond, Lake Salem and Berlin Pond. Possibly occurs elsewhere.
- Mossy valvata (*Valvata sincera*): Recorded at four locations: three in Lake Champlain, and Flag pond.
- Squat dusksnail (*Lyogyrus granum*): Three locations: Lake St Catherine, Connecticut River, Lake Fairlee.
- Pupa dusksnail (*Lyogyrus pupoideus*): Only six collections, all in Lake Champlain.
- Canadian dusksnail (*Lyogyrus walkeri*): Only known from Lake St. Catherine.
- Buffalo pebblesnail (*Gillia altilis*): 12 locations in: Lake Champlain, Missisquoi River, Connecticut River, Crystal Lake, Indian Brook Reservoir, Hinkum Pond.
- Boreal marstonia (*Marstonia lustrica*): Found in Lake Champlain, Laplatte River and Joes Pond.
- Liver elimia (*Goniobasis livescens*): Eleven sites, all in Lake Champlain.
- Sharp hornsnail (*Pleurocera acuta*): No recent occurrences from Vermont; may be extirpated. Reported historically from VT, QE, and NY in literature.
- Spindle lymnaea (*Acella haldemani*): Only known from one lake in VT: Beebee Pond.
- Dusky ancyliid (*Laevapex fuscus*): Known from two locations: Colchester Pond and Jones Mill Pond.
- Mammoth lymnaea (*Bulimnaea megasoma*): Reported from Lake Champlain and its tributaries in 19th century literature; no recent records. May be extirpated; only VT historic record, a small stream in Burlington area, has since been filled in.
- Country fossaria (*Fossaria rustica*): Only found in two streams in Champlain Valley: Little Otter and Lewis creeks. Locations have been resampled since 1997 and not found.
- Star gyro (*Gyraulus crista*): Limited distribution in VT. Found in seven rivers: White River, Calendar Brook tributary, East Branch Passumpsic River, Ranch Brook, Sunny Brook, East Creek-South Fork, Morehouse Brook.
- Thicklip rams-horn (*Planorbula armigera*): Found at four locations: Jewett Brook, Indian Brook, Pleasant Brook, and Leicester Sedge Marsh.

Distribution by Biophysical Region:

| | |
|-------------------------------|-----------------------------|
| Champlain Valley | Southern VT Piedmont |
| Champlain Hills | Vermont Valley |
| Northern Green Mtns | Southern Green Mtns |
| Northern VT Piedmont | Taconic Mtns |
| Northeastern Highlands | |

Distribution by Watershed:



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Known Watersheds

Middle Connecticut
Waits
West
Black - Ottauquechee
Upper Connecticut - Mascoma
Lake Champlain
Lamoille River
Missisquoi River
Otter Creek
Passumpsic
St. Francois River
Upper Connecticut
White
Winooski River
Metawee River

Probable Watersheds

Deerfield
Hudson-Hoosic

Habitat Description

Habitat Information is based on the following:

Limited Local Knowledge Extensive Local Knowledge Regional Literature General Literature

--Boreal marstonia (*Marstonia lustrica*) Found in well-buffered lakes and streams.

--Liver elimia (*Goniobasis livescens*) Grazes in shallow water on stones and gravel in lakes and clear rapid streams. In lakes, it burrows into the sand and feeds on algae and bacteria; this is not as good a food source as it is for other pulmonate snails.

--Sharp hornsnail (*Pleurocera acuta*) Found in a variety of habitats. In lakes, found on boulders on exposed shores or in mud and sand. In rivers, found on stones in rapid current. Snails remain in shallow water up to 1 m deep, where they burrow under the sand and layers of decaying leaves and other organic matter.

--Spindle lymnaea (*Acella haldemani*) Found on submerged logs, silt, sand, and mud; up to 2 m deep. Often is attached to leaves and stems of aquatic pondweed and other submerged vegetation. Reported to favor eutrophic lakes and ponds. Young don't travel far from where they hatched, leading to a clumped distribution.

--Mammoth lymnaea (*Bulimnaea megasoma*) Found in ponds, large and small lakes, and quiet embayment of rivers.

--Country fossaria (*Fossaria rustica*) Occupies rivers and streams, lakes, ponds, and occasionally ditches and canals. Can be in damp mud flats and bodies of water with fluctuations in water level.

--Star gyro (*Gyraulus crista*) Found in dense aquatic vegetation, water-logged wood, and rotting terrestrial leaves (in water).

--Fringed valvata (*Valvata lewisi*) A pool/pond/lake species. Found particularly on sand, but also mud and aquatic vegetation down to 7 m.

--Mossy valvata (*Valvata sincera*) Generally limited to oligotrophic and mesotrophic situations, but occasionally in eutrophic waters. Associated with submerged aquatic vegetation. In MA, however, it is reported as requiring deep lakes with a pH of 7.6 or greater, where it is often associated with rooted vegetation.

--Squat dusksnail (*Lyogyrus granum*) Found on organic debris and vegetation in standing waters of larger lakes and ponds, oxbows, and major rivers. Highly tolerant of acidic conditions, but limited tolerance to sodium (e.g., road salt).



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- Canadian dusksnail (*Lyogyrus walkeri*) Found in sluggish streams and quiet ponds where dead plants accumulate. Occupies lentic waters, ranging from oligotrophic to marl ponds.
- Buffalo pebblesnail (*Gillia altilis*) Large lakes and rivers. In Hudson River, it is found on mud and aquatic plants in the shallows.
- Pupa dusksnail (*Lyogyrus pupoideus*) Occurs in small to large ponds and large rivers. Found on organic debris and aquatic plants. Hybridization with *A. grana* reported.
- Dusky ancylid (*Laevapex fuscus*) Most commonly found in still waters, such as impoundments, back waters, and ponds; occasionally in temporary waters. Generally absent from mountainous regions. Absent from low diversity habitats and tends to have low colonization rates, but will compete well.
- Thicklip rams-horn (*Planorbula armigera*) Most likely to be found in slow streams, wetlands, temporary ponds, and ditches.

Habitat Types:

- Seeps and Pools
- Wet Shores
- Aquatic: Fluvial
- Aquatic: Lower CT River
- Aquatic: Large Lake Champlain Tribs Below Falls
- Aquatic: Lacustrine
- Aquatic: Lake Champlain
- Aquatic: Man-Made Water Bodies

Current Threats

Habitat Threats:

- Conversion of Habitat
- Energy Infrastructure and Development
- Habitat Alteration
- Sedimentation
- Habitat Fragmentation
- Impacts of Roads or Transportation Systems
- Invasion by Exotic Species
- Climate Change

- Description of habitat threat(s):** --Sedimentation and chloride from road and impervious surface runoff.
- Lake/reservoir water level manipulation may be a problem to snails.
 - Acidification (acid rain) may be a problem for species sensitive to low pH, low calcium.
 - Copper sulfate used for treating waters for algae and swimmers itch is a risk to snails (it is a molluscicide).
 - Baylicide, used to reduce sea lamprey populations, is a molluscicide.
 - Nuisance aquatic plant management can impact snails by removing snails and habitat (plants) and covering lake bottoms.
 - Goniobasis livescens* is at risk to invasive *Bithynia tentaculata*.
 - Lake species vulnerable to zebra mussels.



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Non-Habitat Threats:

Competition

Pollution

Reproductive Traits

- Description of non-habitat threat(s):**
- Valvata lewisi - only found in very low densities throughout range; this may limit long-term viability of local populations.
 - Valvata sincera - low reproductive rate. Only a few eggs (4-12) produced per individual.
 - Lyogyrus granum - low tolerance to sodium (e.g., road salt). This may impact populations anywhere they are found (particularly in rivers).
 - Lyogyrus pupoideus - reported to hybridize with Amnicola grana. This could jeopardize both species where they co-occur.
 - Goniobasis livescens - Likely being impacted by the exotic Bithnia tinticulata (snail) in Lake Champlain. Region mollusc expert Dr. Doug Smith (Umass) believes it will become extirpated from the lake for this reason.
 - Acella haldemani - Apparently greatly reduced in distribution and abundance from historical range for unknown reasons. The young don't travel far from where the hatch, which creates limited ability to disperse and colonize/recolonize other habitat patches.
 - Bulimnaea megasoma - may have been extirpated due to unknown causes.
 - Laevapex fuscus - reproductive traits may be a limiting factor (low colonization rate).
-
- Copper sulfate used for treating waters for algae and swimmers itch is a risk to snails (it is a molluscicide).
 - Baylicide, used to reduce sea lamprey populations, is a molluscicide.
 - Nuisance aquatic plant management can impact snails by removing snails and habitat (plants) and covering lake bottoms.
 - Fisheries reclamation in lakes (rotenone) is known to impact snail communities.

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Research and Monitoring Needs

| Type | Need | Priority | Description |
|-------------|--------------------------------|-----------------|---|
| Research | Habitat Requirements | High | Define particular habitat requirements of each species within Vermont, utilizing current knowledge of researchers and field investigations. |
| Research | Distribution and Abundance | High | 1) Obtain baseline distributional and abundance data for all species in group by conducting surveys throughout the state. Abundance information should be collected at sites of known occurrence. 2) Conduct inventories to detect and gather information on new SGCN snail populations. |
| Research | Threats and Their Significance | High | Assess potential and existing impacts of limiting factors to habitat and individual species. Such limiting factors as habitat loss and degradation, exotic invasive snails, and use of pesticides should be examined. |
| Research | Population Genetics | High | Investigate genetic relationships of isolated populations to their larger population strongholds; potentially addressing taxonomic uncertainties. |
| Research | Taxonomy | Medium | Taxonomic questions regarding <i>Fossaria rustica</i> need to be resolved. |
| Monitoring | Population Change | Medium | 1) Monitor known SGCN snail populations. 2) Population monitoring could be employed to track population trends at distinct locations. This would follow field surveys and assessments to identify populations judged to be large and viable. Focusing on such large populations would offer greater probability of detecting population shifts. Monitoring populations subjected to specific environmental perturbations should also be considered. |
| Monitoring | Habitat Change | High | Changes to habitat due to specific threats (e.g., dam removal) need to be monitored. |
| Monitoring | Monitor Threats | High | Number of waterbodies and areas chemically treated to control snails and algae needs to be tracked and used to assess the significance of this limiting factor to SGCN snails. |
| Monitoring | Other Monitoring Needs | High | Changes to populations due to specific threats (e.g., dam removal) need to be monitored. |

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Species Strategies

| Strategy Type | Strategy Priority | Strategy Description | Performance Measure | Potential Partners | Potential Funding Sources |
|---|--------------------------|--|--|--|----------------------------------|
| Technical Assistance, Training, Learning Networks | High | Work to reduce the problem and impacts of acidification on aquatic habitat | | DEC, other state regulators, legislators, governor | |
| Alliance Development | Medium | Enhance coordination between government agencies and partners to ensure consistency in respective program implementation and increased sensitivity to SGCN snail requirements and threats. | | ANR, USFWS | |
| Invasive Species Control & Prevention | High | Prevent the introduction and spread of invasive exotic species (particularly snails) | | FWD, DEC, LCBP, USFWS | |
| Habitat Restoration | High | Protect and restore habitats on which SGCN snails are dependent through pollution abatement, riparian buffers, etc. | Number of acres of riparian and lakeshore natural vegetation protected and/or restored. Number of acres of lake habitat restored/protected | LCLT, VLT, Watershed groups, USFWS, DEC, FWD | SWG, LCLT, VLT, NRCS |
| Compatible Resource Use | High | Reduce the use of algicides, molluscicides, and other pesticides in waters where it may impact SGCN snails | Sustained reduction in the number of annual requests for use of pesticides in SGCN waters | FWD, DEC, ANR, lake associations, private landowners | |

Bibliography

Vermont Department of Environmental Conservation, Biomonitoring Database 2014

Burch, J.B. 1982. Freshwater snails (Mollusca: Gastropoda) of North America. United States Environmental Protection Agency. Environmental Monitoring and Support Laboratory. EPA-600/3-82-026. 294pp.

Clarke, A. H. 1981. The freshwater molluscs of Canada. National Museum of Natural Sciences, National Museums of Canada, Ottawa, Canada. 446 pp.

Jokinen, E.H. 1983. The freshwater snails of Connecticut. State Geological and Natural History Survey of Connecticut. Survey Bull. 109. 83pp.

Jokinen, E. 1992. The freshwater snails (Mollusca: Gastropoda) of New York State. New York State Museum Bulletin 482, 1-112.

NatureServe. 2004. NatureServe Explorer: an online encyclopedia of life [web application]. Version 4.0. NatureServe, Arlington, VA. Available <http://www.natureserve.org/explorer>.