Appendix A: Insects

Rusty-patched Bumble Bee

Bombus affinis

Federal Listing	N/A
State Listing	SGCN
Global Rank	G1
State Rank	S1
Regional Status	

Justification (Reason for Concern in NH)

Bumble bees have been declining seriously, with extensive range reductions in several species (Cameron et al. 2011). Rusty-patched bumble bees are found only in the upper Midwest, where once they occurred all across the east as well. Their range is reduced by 87% (Cameron et al 2011). Declines are due to multiple threats including habitat loss and fragmentation and pesticide use. Changing agricultural practices including extensive monocultures and the increasingly pervasive use of herbicides has removed critical flowering plants that bumble bees use for foraging (Grixti et al. 2009). Lack of breaks in fields and less edge habitat also removes the undisturbed ground needed for nests. Pesticides directly kill or cause impairment in bees (Whitehorn et al. 2012, Hopwood et al. 2012, Thompson 2001). Another emerging threat is diseases carried by commercially produced bumble bees used in crop pollination, particularly the fungus *Nosema bombi* (Cameron et al. 2011, Colla et al. 2006). Cameron et al. (2011) found that American bumble bees had a significantly higher presence of *N. bombi* than were found in stable species such as common eastern or two-spotted bumble bees. Fragmented populations can lead to loss of genetic diversity (Hatfield et al. 2012).

Distribution

Bumble bees can be found statewide in a variety of habitats that support flower production. They are in agricultural settings, backyards, gardens, meadows and forested areas.

Habitat

Bumble bees frequent meadows, crop fields, orchards, gardens and other locations with flowering plants. They also require untilled soil nearby for their underground nests, or unmown ares for nests in tufts of grass.

NH Wildlife Action Plan Habitats

- Grasslands
- Developed Habitats

Distribution Map

Current Species and Habitat Condition in New Hampshire

Unknown. Data from museum collections suggest a major decline but New Hampshire specific data is lacking. The last recorded specimen is from 1997.

Population Management Status

Various NGOs promote pollinator conservation efforts including creating pollinator gardens, reducing pesticide use and promoting pollinator habitat near crops, including orchards (Hatfield 2012). NRCS will provide partial payment for actions on agricultural lands that promote pollinator habitat (USDA 2015). The University of New Hampshire Bee Lab promotes bee conservation and habitat enhancements, in particular nesting habitat.

Regulatory Protection (for explanations, see Appendix I)

- NHFG Permit for collection or possession
- NH NHB Database - current

Quality of Habitat

Bumble bee habitat is mostly privately owned. There is no quantitative measurement of bumble bee habitats. Some landowners are managing their properties to enhance bumble bee and other pollinator habitat.

Habitat Protection Status

Bumble bee habitat is generally not protected. Recent interest in and focus on agricultural land protection may lead to increased habitat protection.

Habitat Management Status

It is unknown how well the recent efforts to protect and enhance bumble bee and other pollinator habitat is working.

Threats to this Species or Habitat in NH

Threat rankings were calculated by groups of taxonomic or habitat experts using a multistep process (details in Chapter 4). Each threat was ranked for these factors: Spatial Extent, Severity, Immediacy, Certainty, and Reversibility (ability to address the threat). These combined scores produced one overall threat score. Only threats that received a "medium" or "high" score have accompanying text in this profile. Threats that have a low spatial extent, are unlikely to occur in the next ten years, or there is uncertainty in the data will be ranked lower due to these factors.

Mortality and species impacts from an offset of plant-pollinator phenology (Threat Rank: High)

Bumblebees depend on nectar-producing flowers for food. They collect both nectar and pollen from these flowers. Climate change has altered the timing of flowering dates (Hayhoe et al 2008) and this may also combine with summer drought (Northeast Climate Impacts Assessment 2007) to decrease the availability of forage in late summer.

Mortality and species impacts from neonicotinoids (Threat Rank: High)

Neonicotinoids are broad spectrum insecticides that are applied both to foliage and to seeds which absorb them into the growing plant. The insecticide accumulates in nectar and pollen, which bumble

bees consume. Bumble bees also may be exposed to direct spray or to residues on plant surfaces (Hopwood et al 2012). Use of neonicotinoids has expanded, with many crops and nursery plants receiving treatment. Nursery plants generally are not labelled as treated, and thus end up in gardens even when the gardener is trying to attract pollinators. Exposure to neonicotinoids causes increased queen mortality, reduced movements in workers and reduced storage of nectar (Scholer and Krischik 2014).

Mortality and species impacts from agricultural pesticide use (Threat Rank: High)

Insecticides are used regularly in agricultural production to control crop pests, but most insecticides are designed to kill all types of insects. During spraying of insecticides the chemical can drift outside of crop lands and affect habitat acres away. In addition, insecticides are often used in gardens. Spring applications of pesticides cause the largest declines in bumble bee populations as queens or just a few new workers are foraging at that time. The use of Integrated Pest Management (IPM), which targets treatment to actual pest outbreaks, has decreased in agricultural production, so more insecticides are being used prophylactically, meaning a greater amount of insecticides are being used.

Habitat conversion due to development (loss of nesting habitat, soils) (Threat Rank: Medium)

Development, especially when it occurs on agricultural land, removes essential nesting and foraging habitat.

Species impacts from range shifting of native species (Threat Rank: Medium)

As climate change shifts temperature ranges, precipitation patterns, and other factors, the geographic ranges of bumble bees will also shift (Kerr et al 2015). This will be compounded by the effects of disease, altered phenology and continued decline in wildflowers (Goulson et al 2015).

List of Lower Ranking Threats:

Disturbance from introduced or invasive animals (bee species)

Mortality and species impacts from pathogens (introduced and *Apis* spill-over)

Habitat degradation due to gardening practices that result in nest and forage loss

Habitat degradation from forestry practices

Habitat degradation due to agricultural practices causing loss of foraging and nesting components

Actions to benefit this Species or Habitat in NH

Conserve farmland.

Primary Threat Addressed: Habitat conversion due to development (loss of nesting habitat, soils)

Specific Threat (IUCN Threat Levels): Residential & commercial development

Objective:
Conserve farmland that is managed to protect pollinators through a variety of practices including

reduced chemical use and encouragement of foraging areas.

General Strategy:
Encourage land trusts and their funders to identify and put under permanent protection farm lands where the landowners agree to farm organically, or nearly so, and to provide untilled and unmown areas for nesting and foraging habitat.

Political Location:
Statewide

Watershed Location:
Statewide

Promote practices that enhance bumble bee and other pollinator habitat.

Primary Threat Addressed: Habitat degradation due to agricultural practices causing loss of foraging and nesting components

Specific Threat (IUCN Threat Levels): Agriculture & aquaculture

Objective:
Provide technical assistance to organizations that provide education, technical assistance and funding to farmers, landowners and landscapers on practices that enhance habitat for pollinators.

General Strategy:
Encourage NRCS to fund practices that enhance habitat for pollinators. Work with the NH Department of Agriculture and UNH Cooperative Extension to promote farming practices that enhance pollinator habitat. Work with the UNH Bee Lab to promote native pollinators including providing nesting habitat. Add information on the NHFG website or Taking Action for Wildlife website on pollinator friendly practices such as leaving grassy areas in orchards unmowed, providing unmowed areas at the edges of crop fields, putting in hedgerows and reducing chemical use. Include the creation and management of natural meadows. Encourage the UNH Cooperative Extension's Master Gardeners Program to promote gardening practices that enhance pollinator habitat. Work with others who provide education to landscapers on promoting pollinator habitat in gardens (in both private and commercial settings).

Political Location:
Statewide

Watershed Location:
Statewide

Promote organic practices and integrated pest management (IPM)

Primary Threat Addressed: Mortality and species impacts from agricultural pesticide use

Specific Threat (IUCN Threat Levels): Pollution / Agricultural & forestry effluents / Herbicides & pesticides

Objective:
Provide technical assistance to organizations that provide education, technical assistance and funding to farmers and homeowners on organic growing practices and IPM.

General Strategy:
Work with the Northeast Organic Farmers Association, UNH Cooperative Extension, NRCS, nursery

stock growers, garden centers, garden clubs, landscapers and others to educate farmers, homeowners and commercial landscapers on using IPM and organic practices.

Political Location:
Statewide

Watershed Location:
Statewide

Monitor Bumblebees

Objective:
Develop and implement a monitoring program for bumblebees.

General Strategy:
Develop a monitoring program for bumble bees in partnership with a university program such as the UNH Bee Lab. Work with other states to ensure the program is consistent with other monitoring programs. Consider developing this as a citizen science project. Begin to implement the program.

Political Location:
Statewide

Watershed Location:
Statewide

References, Data Sources and Authors

Data Sources
Data on bumble bee distribution comes for the published literature and a database of museum specimens provided by Dr. Leif Richardson. Data on habitat, nationwide population declines and threats come from the scientific literature.

Data Quality
There have been few surveys of bumble bees in NH, so the quality of information for NH must be extrapolated from regional or national studies.

2015 Authors:
Emily Preston, NHFG

2005 Authors:

Literature

Cameron, S. A., J. D. Lozier, J. P. Strange, J. B. Koch, N. Cordes, L. F. Solter, and T. L. Griswold. 2011. Patterns of widespread decline in North American bumble bees. PNAS 108 (2) 662-667. doi:10.1073/pnas.1014743108.

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Kerr, J. T., A. Pindar, P. Galpern, L. Packer, S. G. Potts, S. M. Roberts, P. Rasmont, O. Schweiger, S. R. Colla, L. L. Richardson, D. L. Wagner, L. F. Gall, D. S. Sikes, and A. Pantoja. 2015. Climate change impacts on bumblebees converge across continents. Science 349 (6244), 177-180. [DOI:10.1126/science.aaa7031]

Klemens, E., & Volkmar, W. 2006. Increased density of honeybee colonies affects foraging bumblebees. Apidologie, 37, 517-532.

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Osborne, J. L., Martin, A. P., Shortall, C. R., Todd, A. D., Goulson, D., Knight, M. E., Hale R. J. & Sanderson, R. A. 2008. Quantifying and comparing bumblebee nest densities in gardens and countryside habitats. Journal of Applied Ecology, 45(3),

Scholer, J., & Krischik, V. 2014. Chronic exposure of imidacloprid and clothianidin reduce queen survival, foraging, and nectar storing in colonies of *Bombus impatiens*. PloS one, 9(3), e91573.

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Yellow Bumble Bee

Bombus fervidus

Federal Listing	N/A
State Listing	SGCN
Global Rank	
State Rank	S1S2
Regional Status	

Justification (Reason for Concern in NH)

Bumble bees have been declining seriously, with extensive range reductions in several species (Cameron et al. 2011). Yellow Bumble bees have not been studied at a regional or national scale, but were found to have decreased significantly in Ontario (Colla and Packer 2008), and are listed as S1 in New York and S1S2 in Vermont. Declines are due to multiple threats including habitat loss and fragmentation and pesticide use. Changing agricultural practices including extensive monocultures and the increasingly pervasive use of herbicides has removed critical flowering plants that bumble bees use for foraging (Grixti et al. 2009). Lack of breaks in fields and less edge habitat also removes the undisturbed ground needed for nests. Pesticides directly kill or cause impairment in bees (Whitehorn et al. 2012, Hopwood et al. 2012, Thompson 2001). Another emerging threat is diseases carried by commercially produced bumble bees used in crop pollination, particularly the fungus *Nosema bombi* (Cameron et al. 2011, Colla et al. 2006). Cameron et al (2011) found that American bumble bees had a significantly higher presence of *N. bombi* than were found in stable species such as common eastern or two-spotted bumble bees. Fragmented populations can lead to loss of genetic diversity (Hatfield et al. 2012).

Distribution

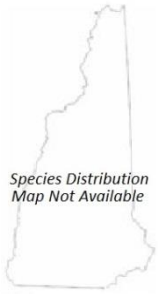
Bumble bees can be found statewide in a variety of habitats that support flower production. They are in agricultural settings, backyards, gardens, meadows and forested areas.

Habitat

Bumble bees frequent meadows, crop fields, orchards, gardens and other locations with flowering plants. They also require untilled soil nearby for their underground nests.

NH Wildlife Action Plan Habitats

- Grasslands
- Developed Habitats



Distribution Map

Current Species and Habitat Condition in New Hampshire

Unknown. Data from museum collections suggest a major decline but New Hampshire specific data is lacking. The last recorded specimen is from 1997.

Population Management Status

Various NGOs promote pollinator conservation efforts including creating pollinator gardens, reducing pesticide use and promoting pollinator habitat near crops, including orchards (Hatfield 2012). NRCS will provide partial payment for actions on agricultural lands that promote pollinator habitat (USDA 2015). The University of New Hampshire Bee Lab promotes bee conservation and habitat enhancements, in particular nesting habitat.

Regulatory Protection (for explanations, see Appendix I)

- NHFG Permit for collection or possession
- NH NHB Database - current

Quality of Habitat

Bumble bee habitat is mostly privately owned. There is no quantitative measurement of bumble bee habitats. Some landowners are managing their properties to enhance bumble bee and other pollinator habitat.

Habitat Protection Status

Bumble bee habitat is generally not protected. Recent interest in and focus on agricultural land protection may lead to increased habitat protection.

Habitat Management Status

It is unknown how well the recent efforts to protect and enhance bumble bee and other pollinator habitat is working.

Threats to this Species or Habitat in NH

Threat rankings were calculated by groups of taxonomic or habitat experts using a multistep process (details in Chapter 4). Each threat was ranked for these factors: Spatial Extent, Severity, Immediacy, Certainty, and Reversibility (ability to address the threat). These combined scores produced one overall threat score. Only threats that received a "medium" or "high" score have accompanying text in this profile. Threats that have a low spatial extent, are unlikely to occur in the next ten years, or there is uncertainty in the data will be ranked lower due to these factors.

Mortality and species impacts from an offset of plant-pollinator phenology (Threat Rank: High)

Bumblebees depend on nectar-producing flowers for food. They collect both nectar and pollen from these flowers. Climate change has altered the timing of flowering dates (Hayhoe et al 2008) and this may also combine with summer drought (Northeast Climate Impacts Assessment 2007) to decrease the availability of forage in late summer.

Mortality and species impacts from neonicotinoids (Threat Rank: High)

Neonicotinoids are broad spectrum insecticides that are applied both to foliage and to seeds which

absorb them into the growing plant. The insecticide accumulates in nectar and pollen, which bumble bees consume. Bumble bees also may be exposed to direct spray or to residues on plant surfaces (Hopwood et al 2012). Use of neonicotinoids has expanded, with many crops and nursery plants receiving treatment. Nursery plants generally are not labelled as treated, and thus end up in gardens even when the gardener is trying to attract pollinators. Exposure to neonicotinoids causes increased queen mortality, reduced movements in workers and reduced storage of nectar (Scholer and Krischik 2014).

Mortality and species impacts from agricultural pesticide use (Threat Rank: High)

Insecticides are used regularly in agricultural production to control crop pests, but most insecticides are designed to kill all types of insects. During spraying of insecticides the chemical can drift outside of crop lands and affect habitat acres away. In addition, insecticides are often used in gardens. Spring applications of pesticides cause the largest declines in bumble bee populations as queens or just a few new workers are foraging at that time. The use of Integrated Pest Management (IPM), which targets treatment to actual pest outbreaks, has decreased in agricultural production, so more insecticides are being used prophylactically, meaning a greater amount of insecticides are being used.

Habitat conversion due to development (loss of nesting habitat, soils) (Threat Rank: Medium)

Development, especially when it occurs on agricultural land, removes essential nesting and foraging habitat.

Species impacts from range shifting of native species (Threat Rank: Medium)

As climate change shifts temperature ranges, precipitation patterns, and other factors, the geographic ranges of bumble bees will also shift (Kerr et al 2015). This will be compounded by the effects of disease, altered phenology and continued decline in wildflowers (Goulson et al 2015).

List of Lower Ranking Threats:

Disturbance from introduced or invasive animals (bee species)

Mortality and species impacts from pathogens (introduced and *Apis* spill-over)

Habitat degradation due to gardening practices that result in nest and forage loss

Habitat degradation from forestry practices

Habitat degradation due to agricultural practices causing loss of foraging and nesting components

Actions to benefit this Species or Habitat in NH

Conserve farmland.

Primary Threat Addressed: Habitat conversion due to development (loss of nesting habitat, soils)

Specific Threat (IUCN Threat Levels): Residential & commercial development

Objective:
Conserve farmland that is managed to protect pollinators through a variety of practices including reduced chemical use and encouragement of foraging areas.

General Strategy:
Encourage land trusts and their funders to identify and put under permanent protection farm lands where the landowners agree to farm organically, or nearly so, and to provide untilled and unmown areas for nesting and foraging habitat.

Political Location:
Statewide

Watershed Location:
Statewide

Promote practices that enhance bumble bee and other pollinator habitat.

Primary Threat Addressed: Habitat degradation due to agricultural practices causing loss of foraging and nesting components

Specific Threat (IUCN Threat Levels): Agriculture & aquaculture

Objective:
Provide technical assistance to organizations that provide education, technical assistance and funding to farmers, landowners and landscapers on practices that enhance habitat for pollinators.

General Strategy:
Encourage NRCS to fund practices that enhance habitat for pollinators. Work with the NH Department of Agriculture and UNH Cooperative Extension to promote farming practices that enhance pollinator habitat. Work with the UNH Bee Lab to promote native pollinators including providing nesting habitat. Add information on the NHFG website or Taking Action for Wildlife website on pollinator friendly practices such as leaving grassy areas in orchards unmowed, providing unmowed areas at the edges of crop fields, putting in hedgerows and reducing chemical use. Include the creation and management of natural meadows. Encourage the UNH Cooperative Extension's Master Gardeners Program to promote gardening practices that enhance pollinator habitat. Work with others who provide education to landscapers on promoting pollinator habitat in gardens (in both private and commercial settings).

Political Location:
Statewide

Watershed Location:
Statewide

Promote organic practices and integrated pest management (IPM)

Primary Threat Addressed: Mortality and species impacts from agricultural pesticide use

Specific Threat (IUCN Threat Levels): Pollution / Agricultural & forestry effluents / Herbicides & pesticides

Objective:
Provide technical assistance to organizations that provide education, technical assistance and funding to farmers and homeowners on organic growing practices and IPM.

General Strategy:
Work with the Northeast Organic Farmers Association, UNH Cooperative Extension, NRCS, nursery stock growers, garden centers, garden clubs, landscapers and others to educate farmers, homeowners and commercial landscapers on using IPM and organic practices.

Political Location:
Statewide

Watershed Location:
Statewide

Monitor Bumblebees

Objective:
Develop and implement a monitoring program for bumblebees.

General Strategy:
Develop a monitoring program for bumble bees in partnership with a university program such as the UNH Bee Lab. Work with other states to ensure the program is consistent with other monitoring programs. Consider developing this as a citizen science project. Begin to implement the program.

Political Location:
Statewide

Watershed Location:
Statewide

References, Data Sources and Authors

Data Sources
Data on bumble bee distribution comes for the published literature and a database of museum specimens provided by Dr. Leif Richardson. Data on habitat, nationwide population declines and threats come from the scientific literature.

Data Quality
There have been few surveys of bumble bees in NH, so the quality of information for NH must be extrapolated from regional or national studies.

2015 Authors:
Emily Preston, NHFG

2005 Authors:

Literature

Cameron, S. A., J. D. Lozier, J. P. Strange, J. B. Koch, N. Cordes, L. F. Solter, and T. L. Griswold. 2011. Patterns of widespread decline in North American bumble bees. PNAS 108 (2) 662-667. doi:10.1073/pnas.1014743108.

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Grixti, J. C., Wong, L. T., Cameron, S. A., & Favret, C. 2009. Decline of bumble bees (*Bombus*) in the North American Midwest. Biological Conservation, 142(1), 75-84.

Hatfield, R., Jepsen, S., Mader, E., Black, S. H., & Shepherd, M. 2012. Conserving Bumble Bees. Guidelines for Creating and Managing Habitat for America's Declining Pollinators. The Xerces Society for Invertebrate Conservation, USA. 32pp.

Hayhoe, K., C. Wake, B. Anderson, X. Ling, E. Maurer, J. Zhu, J. Bradbury, a. DeGaetane, A.M. Stoner, D. Wuebbles. 2008. Regional climate change projections of the Northeastern USA. Mitigation and Adaptation Strategies for Global Change

Hopwood, J., Vaughan, M., Shepherd, M., Biddinger, D., Mader, E., Black, S. H., & Mazzacano, C. 2012. Are Neonicotinoids Killing Bees?. A review of research into the effects of neonicotinoid insecticides on bees, with recommendations

Kerr, J. T., A. Pindar, P. Galpern, L. Packer, S. G. Potts, S. M. Roberts, P. Rasmont, O. Schweiger, S. R. Colla, L. L. Richardson, D. L. Wagner, L. F. Gall, D. S. Sikes, and A. Pantoja. 2015. Climate change impacts on bumblebees converge across continents. Science 349 (6244), 177-180. [DOI:10.1126/science.aaa7031]

Klemens, E., & Volkmar, W. 2006. Increased density of honeybee colonies affects foraging bumblebees. Apidologie, 37, 517-532.

Northeast Climate Impacts Assessment. 2007. Confronting Change in US Northeast: New Hampshire. Union of Concerned Scientists. Cambridge MA. 6pp.

Osborne, J. L., Martin, A. P., Shortall, C. R., Todd, A. D., Goulson, D., Knight, M. E., Hale R. J. & Sanderson, R. A. 2008. Quantifying and comparing bumblebee nest densities in gardens and countryside habitats. Journal of Applied Ecology, 45(3),

Scholer, J., & Krischik, V. 2014. Chronic exposure of imidacloprid and clothianidin reduce queen survival, foraging, and nectar storing in colonies of *Bombus impatiens*. PloS one, 9(3), e91573.

Thompson, H. M. 2001. Assessing the exposure and toxicity of pesticides to bumblebees (Bombus sp.). Apidologie, 32(4), 305-321.

US Department Of Agriculture. 2015. Using 2014 Farm Bill Programs for Pollinator Conservation. Biology Technical Note No. 78, 2nd Ed. 18pp.

Whitehorn, P, R., S, O'Connor, F, L. Wackers, and D, Goulson. 2012. Neonicotinoid Pesticide Reduces Bumble Bee Colony Growth and Queen Production. Science: 336 (6079), 351-352. DOI:10.1126/science.1215025

American Bumble Bee

Bombus pensylvanicus

Federal Listing	N/A
State Listing	SGCN
Global Rank	
State Rank	S1
Regional Status	

Justification (Reason for Concern in NH)

Bumble bees have been declining seriously, with extensive range reductions in several species (Cameron et al. 2011). American bumble bees are missing from their northern and eastern ranges, occurring only in the south and western Midwest, with a range reduction of 23% (Cameron et al. 2011). Declines are due to multiple threats including habitat loss and fragmentation and pesticide use. Changing agricultural practices including extensive monocultures and the increasingly pervasive use of herbicides has removed critical flowering plants that bumble bees use for foraging (Grixti et al. 2009). Lack of breaks in fields and less edge habitat also removes the undisturbed ground needed for nests. Pesticides directly kill or cause impairment in bees (Whitehorn et al. 2012, Hopwood et al. 2012, Thompson 2001). Another emerging threat is diseases carried by commercially produced bumble bees used in crop pollination, particularly the fungus Nosema bombi (Cameron et al. 2011, Colla et al. 2006). Cameron et al (2011) found that American bumble bees had a significantly higher presence of N. bombi than were found in stable species such as common eastern or two-spotted bumble bees. Fragmented populations can lead to loss of genetic diversity (Hatfield et al. 2012).

Distribution

Bumble bees can be found statewide in a variety of habitats that support flower production. They are in agricultural settings, backyards, gardens, meadows and forested areas.

Habitat

Bumble bees frequent meadows, crop fields, orchards, gardens and other locations with flowering plants. They also require untilled soil nearby for their underground nests.

NH Wildlife Action Plan Habitats

- Grasslands
- Developed Habitats
- Shrublands

Distribution Map

Current Species and Habitat Condition in New Hampshire

Unknown. Data from museum collections suggest a major decline but New Hampshire specific data is lacking. The last recorded specimen is from 1997.

Population Management Status

Various NGOs promote pollinator conservation efforts including creating pollinator gardens, reducing pesticide use and promoting pollinator habitat near crops, including orchards (Hatfield 2012). NRCS will provide partial payment for actions on agricultural lands that promote pollinator habitat (USDA 2015). The University of New Hampshire Bee Lab promotes bee conservation and habitat enhancements, in particular nesting habitat.

Regulatory Protection (for explanations, see Appendix I)

- NHFG Permit for collection or possession
- NH NHB Database - current

Quality of Habitat

Bumble bee habitat is mostly privately owned. There is no quantitative measurement of bumble bee habitats. Some landowners are managing their properties to enhance bumble bee and other pollinator habitat.

Habitat Protection Status

Bumble bee habitat is generally not protected. Recent interest in and focus on agricultural land protection may lead to increased habitat protection.

Habitat Management Status

It is unknown how well the recent efforts to protect and enhance bumble bee and other pollinator habitat is working.

Threats to this Species or Habitat in NH

Threat rankings were calculated by groups of taxonomic or habitat experts using a multistep process (details in Chapter 4). Each threat was ranked for these factors: Spatial Extent, Severity, Immediacy, Certainty, and Reversibility (ability to address the threat). These combined scores produced one overall threat score. Only threats that received a "medium" or "high" score have accompanying text in this profile. Threats that have a low spatial extent, are unlikely to occur in the next ten years, or there is uncertainty in the data will be ranked lower due to these factors.

Mortality and species impacts from an offset of plant-pollinator phenology (Threat Rank: High)

Bumblebees depend on nectar-producing flowers for food. They collect both nectar and pollen from these flowers. Climate change has altered the timing of flowering dates (Hayhoe et al 2008) and this may also combine with summer drought (Northeast Climate Impacts Assessment 2007) to decrease the availability of forage in late summer.

Mortality and species impacts from neonicotinoids (Threat Rank: High)

Neonicotinoids are broad spectrum insecticides that are applied both to foliage and to seeds which absorb them into the growing plant. The insecticide accumulates in nectar and pollen, which bumble

bees consume. Bumble bees also may be exposed to direct spray or to residues on plant surfaces (Hopwood et al 2012). Use of neonicotinoids has expanded, with many crops and nursery plants receiving treatment. Nursery plants generally are not labelled as treated, and thus end up in gardens even when the gardener is trying to attract pollinators. Exposure to neonicotinoids causes increased queen mortality, reduced movements in workers and reduced storage of nectar (Scholer and Krischik 2014).

Mortality and species impacts from agricultural pesticide use (Threat Rank: High)

Insecticides are used regularly in agricultural production to control crop pests, but most insecticides are designed to kill all types of insects. During spraying of insecticides the chemical can drift outside of crop lands and affect habitat acres away. In addition, insecticides are often used in gardens. Spring applications of pesticides cause the largest declines in bumble bee populations as queens or just a few new workers are foraging at that time. The use of Integrated Pest Management (IPM), which targets treatment to actual pest outbreaks, has decreased in agricultural production, so more insecticides are being used prophylactically, meaning a greater amount of insecticides are being used.

Habitat conversion due to development (loss of nesting habitat, soils) (Threat Rank: Medium)

Development, especially when it occurs on agricultural land, removes essential nesting and foraging habitat.

Species impacts from range shifting of native species (Threat Rank: Medium)

As climate change shifts temperature ranges, precipitation patterns, and other factors, the geographic ranges of bumble bees will also shift (Kerr et al 2015). This will be compounded by the effects of disease, altered phenology and continued decline in wildflowers (Goulson et al 2015).

List of Lower Ranking Threats:

Disturbance from introduced or invasive animals (bee species)

Mortality and species impacts from pathogens (introduced and *Apis* spill-over)

Habitat degradation due to gardening practices that result in nest and forage loss

Habitat degradation from forestry practices

Habitat degradation due to agricultural practices causing loss of foraging and nesting components

Actions to benefit this Species or Habitat in NH

Conserve farmland.

Primary Threat Addressed: Habitat conversion due to development (loss of nesting habitat, soils)

Specific Threat (IUCN Threat Levels): Residential & commercial development

Objective:
Conserve farmland that is managed to protect pollinators through a variety of practices including

reduced chemical use and encouragement of foraging areas.

General Strategy:
Encourage land trusts and their funders to identify and put under permanent protection farm lands where the landowners agree to farm organically, or nearly so, and to provide untilled and unmown areas for nesting and foraging habitat.

Political Location:
Statewide

Watershed Location:
Statewide

Promote practices that enhance bumble bee and other pollinator habitat.

Primary Threat Addressed: Habitat degradation due to agricultural practices causing loss of foraging and nesting components

Specific Threat (IUCN Threat Levels): Agriculture & aquaculture

Objective:
Provide technical assistance to organizations that provide education, technical assistance and funding to farmers, landowners and landscapers on practices that enhance habitat for pollinators.

General Strategy:
Encourage NRCS to fund practices that enhance habitat for pollinators. Work with the NH Department of Agriculture and UNH Cooperative Extension to promote farming practices that enhance pollinator habitat. Work with the UNH Bee Lab to promote native pollinators including providing nesting habitat. Add information on the NHFG website or Taking Action for Wildlife website on pollinator friendly practices such as leaving grassy areas in orchards unmowed, providing unmowed areas at the edges of crop fields, putting in hedgerows and reducing chemical use. Include the creation and management of natural meadows. Encourage the UNH Cooperative Extension's Master Gardeners Program to promote gardening practices that enhance pollinator habitat. Work with others who provide education to landscapers on promoting pollinator habitat in gardens (in both private and commercial settings).

Political Location:
Statewide

Watershed Location:
Statewide

Promote organic practices and integrated pest management (IPM)

Primary Threat Addressed: Mortality and species impacts from agricultural pesticide use

Specific Threat (IUCN Threat Levels): Pollution / Agricultural & forestry effluents / Herbicides & pesticides

Objective:
Provide technical assistance to organizations that provide education, technical assistance and funding to farmers and homeowners on organic growing practices and IPM.

General Strategy:
Work with the Northeast Organic Farmers Association, UNH Cooperative Extension, NRCS, nursery

stock growers, garden centers, garden clubs, landscapers and others to educate farmers, homeowners and commercial landscapers on using IPM and organic practices.

Political Location:
Statewide

Watershed Location:
Statewide

Monitor Bumblebees

Objective:
Develop and implement a monitoring program for bumblebees.

General Strategy:
Develop a monitoring program for bumble bees in partnership with a university program such as the UNH Bee Lab. Work with other states to ensure the program is consistent with other monitoring programs. Consider developing this as a citizen science project. Begin to implement the program.

Political Location:
Statewide

Watershed Location:
Statewide

References, Data Sources and Authors

Data Sources
Data on bumble bee distribution comes for the published literature and a database of museum specimens provided by Dr. Leif Richardson. Data on habitat, nationwide population declines and threats come from the scientific literature.

Data Quality
There have been few surveys of bumble bees in NH, so the quality of information for NH must be extrapolated from regional or national studies.

2015 Authors:
Emily Preston, NHFG

2005 Authors:

Literature

Cameron, S. A., J. D. Lozier, J. P. Strange, J. B. Koch, N. Cordes, L. F. Solter, and T. L. Griswold. 2011. Patterns of widespread decline in North American bumble bees. PNAS 108 (2) 662-667. doi:10.1073/pnas.1014743108.

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Goulson, D., Nicholls, E., Botías, C., & Rotheray, E. L. 2015. Bee declines driven by combined stress from parasites, pesticides, and lack of flowers. Science, 347(6229), 1255957.

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Grixti, J. C., Wong, L. T., Cameron, S. A., & Favret, C. 2009. Decline of bumble bees (*Bombus*) in the North American Midwest. Biological Conservation, 142(1), 75-84.

Hatfield, R., Jepsen, S., Mader, E., Black, S. H., & Shepherd, M. 2012. Conserving Bumble Bees. Guidelines for Creating and Managing Habitat for America's Declining Pollinators. The Xerces Society for Invertebrate Conservation, USA. 32pp.

Hayhoe, K., C. Wake, B. Anderson, X. Ling, E. Maurer, J. Zhu, J. Bradbury, a. DeGaetane, A.M. Stoner, D. Wuebbles. 2008. Regional climate change projections of the Northeastern USA. Mitigation and Adaptation Strategies for Global Change

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Kerr, J. T., A. Pindar, P. Galpern, L. Packer, S. G. Potts, S. M. Roberts, P. Rasmont, O. Schweiger, S. R. Colla, L. L. Richardson, D. L. Wagner, L. F. Gall, D. S. Sikes, and A. Pantoja. 2015. Climate change impacts on bumblebees converge across continents. Science 349 (6244), 177-180. [DOI:10.1126/science.aaa7031]

Klemens, E., & Volkmar, W. 2006. Increased density of honeybee colonies affects foraging bumblebees. Apidologie, 37, 517-532.

Northeast Climate Impacts Assessment. 2007. Confronting Change in US Northeast: New Hampshire. Union of Concerned Scientists. Cambridge MA. 6pp.

Osborne, J. L., Martin, A. P., Shortall, C. R., Todd, A. D., Goulson, D., Knight, M. E., Hale R. J. & Sanderson, R. A. 2008. Quantifying and comparing bumblebee nest densities in gardens and countryside habitats. Journal of Applied Ecology, 45(3),

Scholer, J., & Krischik, V. 2014. Chronic exposure of imidacloprid and clothianidin reduce queen survival, foraging, and nectar storing in colonies of *Bombus impatiens*. PloS one, 9(3), e91573.

Thompson, H. M. 2001. Assessing the exposure and toxicity of pesticides to bumblebees (*Bombus sp*.). Apidologie, 32(4), 305-321.

US Department Of Agriculture. 2015. Using 2014 Farm Bill Programs for Pollinator Conservation. Biology Technical Note No. 78, 2nd Ed. 18pp.

Whitehorn, P, R., S, O'Connor, F, L. Wackers, and D, Goulson. 2012. Neonicotinoid Pesticide Reduces Bumble Bee Colony Growth and Queen Production. Science: 336 (6079), 351-352. DOI:10.1126/science.1215025

Yellowbanded Bumble Bee

Bombus terricola

Federal Listing	N/A
State Listing	SGCN
Global Rank	
State Rank	S2
Regional Status	

Justification (Reason for Concern in NH)

Bumble bees have been declining seriously, with extensive range reductions in several species (Cameron et al. 2011). Yellowbanded bumble bees are still found in the northeast and higher elevations but their range has shrunk by 31% (Cameron et al. 2011). Declines are due to multiple threats including habitat loss and fragmentation and pesticide use. Changing agricultural practices including extensive monocultures and the increasingly pervasive use of herbicides has removed critical flowering plants that bumble bees use for foraging (Grixti et al. 2009). Lack of breaks in fields and less edge habitat also removes the undisturbed ground needed for nests. Pesticides directly kill or cause impairment in bees (Whitehorn et al. 2012, Hopwood et al. 2012, Thompson 2001). Another emerging threat is diseases carried by commercially produced bumble bees used in crop pollination, particularly the fungus Nosema bombi (Cameron et al. 2011, Colla et al. 2006). Cameron et al (2011) found that American bumble bees had a significantly higher presence of N. bombi than were found in stable species such as common eastern or two-spotted bumble bees. Fragmented populations can lead to loss of genetic diversity (Hatfield et al. 2012).

Distribution

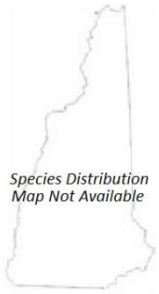
Bumble bees can be found statewide in a variety of habitats that support flower production. They are in agricultural settings, backyards, gardens, meadows and forested areas.

Habitat

Bumble bees frequent meadows, crop fields, orchards, gardens and other locations with flowering plants. They also require untilled soil nearby for their underground nests.

NH Wildlife Action Plan Habitats

- Grasslands
- Developed Habitats
- Shrublands



Distribution Map

Current Species and Habitat Condition in New Hampshire

Unknown. Data from museum collections suggest a major decline but New Hampshire specific data is lacking. The last recorded specimen is from 1997.

Population Management Status

Various NGOs promote pollinator conservation efforts including creating pollinator gardens, reducing pesticide use and promoting pollinator habitat near crops, including orchards (Hatfield 2012). NRCS will provide partial payment for actions on agricultural lands that promote pollinator habitat (USDA 2015). The University of New Hampshire Bee Lab promotes bee conservation and habitat enhancements, in particular nesting habitat.

Regulatory Protection (for explanations, see Appendix I)

- NHFG Permit for collection or possession
- NH NHB Database - current

Quality of Habitat

Bumble bee habitat is mostly privately owned. There is no quantitative measurement of bumble bee habitats. Some landowners are managing their properties to enhance bumble bee and other pollinator habitat.

Habitat Protection Status

Bumble bee habitat is generally not protected. Recent interest in and focus on agricultural land protection may lead to increased habitat protection.

Habitat Management Status

It is unknown how well the recent efforts to protect and enhance bumble bee and other pollinator habitat is working.

Threats to this Species or Habitat in NH

Threat rankings were calculated by groups of taxonomic or habitat experts using a multistep process (details in Chapter 4). Each threat was ranked for these factors: Spatial Extent, Severity, Immediacy, Certainty, and Reversibility (ability to address the threat). These combined scores produced one overall threat score. Only threats that received a "medium" or "high" score have accompanying text in this profile. Threats that have a low spatial extent, are unlikely to occur in the next ten years, or there is uncertainty in the data will be ranked lower due to these factors.

Mortality and species impacts from an offset of plant-pollinator phenology (Threat Rank: High)

Bumblebees depend on nectar-producing flowers for food. They collect both nectar and pollen from these flowers. Climate change has altered the timing of flowering dates (Hayhoe et al 2008) and this may also combine with summer drought (Northeast Climate Impacts Assessment 2007) to decrease the availability of forage in late summer.

Mortality and species impacts from neonicotinoids (Threat Rank: High)

Neonicotinoids are broad spectrum insecticides that are applied both to foliage and to seeds which absorb them into the growing plant. The insecticide accumulates in nectar and pollen, which bumble

bees consume. Bumble bees also may be exposed to direct spray or to residues on plant surfaces (Hopwood et al 2012). Use of neonicotinoids has expanded, with many crops and nursery plants receiving treatment. Nursery plants generally are not labelled as treated, and thus end up in gardens even when the gardener is trying to attract pollinators. Exposure to neonicotinoids causes increased queen mortality, reduced movements in workers and reduced storage of nectar (Scholer and Krischik 2014).

Mortality and species impacts from agricultural pesticide use (Threat Rank: High)

Insecticides are used regularly in agricultural production to control crop pests, but most insecticides are designed to kill all types of insects. During spraying of insecticides the chemical can drift outside of crop lands and affect habitat acres away. In addition, insecticides are often used in gardens. Spring applications of pesticides cause the largest declines in bumble bee populations as queens or just a few new workers are foraging at that time. The use of Integrated Pest Management (IPM), which targets treatment to actual pest outbreaks, has decreased in agricultural production, so more insecticides are being used prophylactically, meaning a greater amount of insecticides are being used.

Habitat conversion due to development (loss of nesting habitat, soils) (Threat Rank: Medium)

Development, especially when it occurs on agricultural land, removes essential nesting and foraging habitat.

Species impacts from range shifting of native species (Threat Rank: Medium)

As climate change shifts temperature ranges, precipitation patterns, and other factors, the geographic ranges of bumble bees will also shift (Kerr et al 2015). This will be compounded by the effects of disease, altered phenology and continued decline in wildflowers (Goulson et al 2015).

List of Lower Ranking Threats:

Disturbance from introduced or invasive animals (bee species)

Mortality and species impacts from pathogens (introduced and Apis spill-over)

Habitat degradation due to gardening practices that result in nest and forage loss

Habitat degradation from forestry practices

Habitat degradation due to agricultural practices causing loss of foraging and nesting components

Actions to benefit this Species or Habitat in NH

Conserve farmland.

Primary Threat Addressed: Habitat conversion due to development (loss of nesting habitat, soils)

Specific Threat (IUCN Threat Levels): Residential & commercial development

Objective:
Conserve farmland that is managed to protect pollinators through a variety of practices including

reduced chemical use and encouragement of foraging areas.

General Strategy:
Encourage land trusts and their funders to identify and put under permanent protection farm lands where the landowners agree to farm organically, or nearly so, and to provide untilled and unmown areas for nesting and foraging habitat.

Political Location:
Statewide

Watershed Location:
Statewide

Promote practices that enhance bumble bee and other pollinator habitat.

Primary Threat Addressed: Habitat degradation due to agricultural practices causing loss of foraging and nesting components

Specific Threat (IUCN Threat Levels): Agriculture & aquaculture

Objective:
Provide technical assistance to organizations that provide education, technical assistance and funding to farmers, landowners and landscapers on practices that enhance habitat for pollinators.

General Strategy:
Encourage NRCS to fund practices that enhance habitat for pollinators. Work with the NH Department of Agriculture and UNH Cooperative Extension to promote farming practices that enhance pollinator habitat. Work with the UNH Bee Lab to promote native pollinators including providing nesting habitat. Add information on the NHFG website or Taking Action for Wildlife website on pollinator friendly practices such as leaving grassy areas in orchards unmowed, providing unmowed areas at the edges of crop fields, putting in hedgerows and reducing chemical use. Include the creation and management of natural meadows. Encourage the UNH Cooperative Extension's Master Gardeners Program to promote gardening practices that enhance pollinator habitat. Work with others who provide education to landscapers on promoting pollinator habitat in gardens (in both private and commercial settings).

Political Location:
Statewide

Watershed Location:
Statewide

Promote organic practices and integrated pest management (IPM)

Primary Threat Addressed: Mortality and species impacts from agricultural pesticide use

Specific Threat (IUCN Threat Levels): Pollution / Agricultural & forestry effluents / Herbicides & pesticides

Objective:
Provide technical assistance to organizations that provide education, technical assistance and funding to farmers and homeowners on organic growing practices and IPM.

General Strategy:
Work with the Northeast Organic Farmers Association, UNH Cooperative Extension, NRCS, nursery

stock growers, garden centers, garden clubs, landscapers and others to educate farmers, homeowners and commercial landscapers on using IPM and organic practices.

Political Location:
Statewide

Watershed Location:
Statewide

Monitor Bumblebees

Objective:
Develop and implement a monitoring program for bumblebees.

General Strategy:
Develop a monitoring program for bumble bees in partnership with a university program such as the UNH Bee Lab. Work with other states to ensure the program is consistent with other monitoring programs. Consider developing this as a citizen science project. Begin to implement the program.

Political Location:
Statewide

Watershed Location:
Statewide

References, Data Sources and Authors

Data Sources
Data on bumble bee distribution comes for the published literature and a database of museum specimens provided by Dr. Leif Richardson. Data on habitat, nationwide population declines and threats come from the scientific literature.

Data Quality
There have been few surveys of bumble bees in NH, so the quality of information for NH must be extrapolated from regional or national studies.

2015 Authors:
Emily Preston, NHFG

2005 Authors:

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Scholer, J., & Krischik, V. 2014. Chronic exposure of imidacloprid and clothianidin reduce queen survival, foraging, and nectar storing in colonies of *Bombus impatiens*. PloS one, 9(3), e91573.

Thompson, H. M. 2001. Assessing the exposure and toxicity of pesticides to bumblebees (*Bombus sp*.). Apidologie, 32(4), 305-321.

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White Mountain Fritillary

Boloria titania montinus

Federal Listing	N/A
State Listing	E
Global Rank	
State Rank	S1
Regional Status	

Photo by © K.P. McFarland

Justification (Reason for Concern in NH)

White Mountain fritillary is limited to the 2,800 ac alpine zone of the White Mountain National Forest (WMNF). The natural communities used most frequently by White Mountain fritillary ranked S1 in New Hampshire. Climate change will likely alter alpine habitat structure, composition, phenology, and distribution, all of which directly impact White Mountain fritillary populations (Kimball and Weihrauch 2000, McFarland 2003, Lesica and McCune 2004). Habitat isolation further increases the species' vulnerability (Halloy and Mark 2003, McFarland 2003). Interdependent responses to climate change could disrupt ecological interactions throughout the alpine community, reducing the ability of sensitive species to endure other environmental stresses, such as acid deposition and increased UV-B radiation (McCarty 2001).

Distribution

White Mountain fritillary is a subspecies endemic to the 2,800 ac alpine zone of the Presidential Range of the WMNF (McFarland 2003). Habitat suitability depends on the abundance of host plants, particularly Alpine goldenrod, as well as ground temperature, moisture, and winter snow cover (Anthony 1970, McFarland 2003). White Mountain fritillary populations tend to be locally abundant, the northernmost occurrence is from Mt. Madison and the southernmost is Mt. Pierce at an elevation range of 1,220 to 1,860 m, with the highest densities at Cragway Spring and Wamsutta Trail (McFarland 2003). The only historical record occurring outside the Presidential Range alpine zone was a specimen collected by D. J. Lennox on 27 August 1966 in Jefferson Notch at 900 m elevation and deposited in the University of New Hampshire collections (McFarland 2003).

Habitat

The White Mountain fritillary, a subspecies of the Purple fritillary (*Boloria titania*), is endemic to the alpine zone of the Presidential Range of New Hampshire (McFarland 2003). White Mountain fritillary inhabits wet-mesic alpine communities above 1,220 to 1,860 m, specifically wet alpine meadows, alpine streamside communities, and snowbank communities (McFarland 2003). Wet-mesic alpine communities are typically sloped, have shallow organic soils, and are associated with late-melting snowbanks forming in lee positions of summits, ridges, outcrops, ravines, drainages, and at the alpine-treeline interface. Characteristic vegetation consists of *Geum peckii, Solidago cutleri, Spiraea septentrionalis, Scirpus cespitous, Salix* spp., and *Vaccinium* spp. (Sperduto and Nichols 2004). The preferred habitat of White Mountain fritillary includes a ground cover composed of herbs and forbs, host and nectar sources, and proximity to water. No obligate larval host plants are known, although possible species include *Salix* spp., *Viola palustris, Viola adunca,* and *Vaccinium* spp. (McFarland 2003). Adults prefer *Solidago cutleri* but will also nectar on Aster species (McFarland 2003).

NH Wildlife Action Plan Habitats

- Alpine

Distribution Map

Current Species and Habitat Condition in New Hampshire

The total abundance of White Mountain Fritillary in the alpine zone during the flight periods in 2012 and 2013 was estimated to be 1,764 (95% CI = 1,293 - 2,437) individuals (McFarland 2014). The White Mountain fritillary population is believed to be imperiled due to natural rarity (McFarland 2003) and susceptibility to climatic and atmospheric changes.

Population Management Status

Surveys have been conducted but long-term monitoring has not been implemented. Little or no targeted management has been implemented to date.

Regulatory Protection (for explanations, see Appendix I)

- Endangered Species Conservation Act (RSA 212-A)
- WMNF sensitive species

Quality of Habitat

High quality alpine communities used by White Mountain fritillary occur in the Alpine Garden, Tuckerman Ravine, Oakes gulf, Great Gulf (Sperduto and Nichols 2004). Records of adult White Mountain fritillary are most often reported from Cragway Spring and Wamsutta Trail, each with high densities of *Solidago cutleri* (McFarland 2003). During recent surveys, the highest density of White Mountain Fritillary was observed in herbaceous snowbank plant communities, but this habitat is available only in a limited amount (<1%) (McFarland 2003, McFarland 2014). The heath-shrub rush community covers most of the area in the alpine zone occupied by the species and contained 78% of the White Mountain Fritillary population at any given time (McFarland 2014).

Habitat Protection Status

Because White Mountain fritillary is protected under RSA 212, its habitat receives some special protection.

Habitat Management Status

Little or no targeted management has been implemented to date. See also Alpine Habitat Profile.

Threats to this Species or Habitat in NH

Threat rankings were calculated by groups of taxonomic or habitat experts using a multistep process (details in Chapter 4). Each threat was ranked for these factors: Spatial Extent, Severity, Immediacy, Certainty, and Reversibility (ability to address the threat). These combined scores produced one overall threat score. Only threats that received a "medium" or "high" score have accompanying text in this profile. Threats that have a low spatial extent, are unlikely to occur in the next ten years, or there is uncertainty in the data will be ranked lower due to these factors.

Mortality of host plants, eggs and larvae from trampling due to recreation. (Threat Rank: Medium)

List of Lower Ranking Threats:

Habitat degradation from acid deposition

Mortality from the collection of individuals from the wild

Habitat impacts from roads (limited dispersal)

Disturbance from phenology shifts of host plants and species

Habitat conversion from changes or shifts in available habitat

Habitat degradation from reduced habitat availability associated with climate change

Habitat conversion due to development

Habitat degradation from acid deposition

Mortality from the collection of individuals from the wild

Habitat impacts from roads (limited dispersal)

Disturbance from phenology shifts of host plants and species

Habitat conversion from changes or shifts in available habitat

Habitat degradation from reduced habitat availability associated with climate change

Habitat converison due to development

Actions to benefit this Species or Habitat in NH

Perform monitoring studies and captive rearing work to determine host plant(s) for the species.

Primary Threat Addressed: Disturbance from phenology shifts of host plants and species

Specific Threat (IUCN Threat Levels): Climate change & severe weather

Objective:

General Strategy:
Currently it is unknown what the primary host plant is for the species. More in depth work with the species to determine primary host plants that are supporting the populations in the White Mountains.

Political Location:
Coos County

Watershed Location:

Create signs informing the public of state law protecting the species.

Primary Threat Addressed: Mortality from the collection of individuals from the wild

Specific Threat (IUCN Threat Levels): Biological resource use

Objective:

General Strategy:

Political Location: **Watershed Location:**

Monitor the health of known populations; determine if captive propagation for augmentation or translocation is required.

Objective:

General Strategy:
Now that baseline population estimate has been determined for the species (McFarland 2014), a long- term monitoring strategy should be developed that can detect trend in species population over time. Determining population health and trend is especially important since the species appears to be dependent on snowbank communities and other wet areas, it is more likely to impacted by climate change.

Political Location: **Watershed Location:**

References, Data Sources and Authors

Data Sources
Published literature, NH Natural Heritage Database and consultation with experts.
Sources of information include databases, expert review and consultation.

Data Quality
The New Hampshire distribution of White Mountain fritillary is well documented.
Abundance data are inadequate to allow rigorous population estimates.

2015 Authors:
Heidi Holman, NHFG

2005 Authors:

Literature

Anthony, S. G. 1970. Field work on the population structure of *Oeneis melissa semidea* (Satyridae) from the Presidential Range, New Hampshire. Journal of Research on the Lepidoptera 7(3):133-148.

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Hessel's Hairstreak

Callophrys hesseli

Federal Listing	N/A
State Listing	
Global Rank	
State Rank	S1
Regional Status	

Photo by Pamela Hunt

Justification (Reason for Concern in NH)

Hessel's Hairstreak is a rare butterfly whose larval food plant is Atlantic White Cedar (*Chamaecyparis thyoides*). It is locally distributed along the Atlantic coastal plain from Maine to Florida. Many populations have gone extinct in recent decades (Natureserve). Formerly believed extirpated in NH, with historical records from Hampstead. Hessel's Hairstreak was rediscovered in Kingston in 2010 (Hunt, pers. obs.).

Distribution

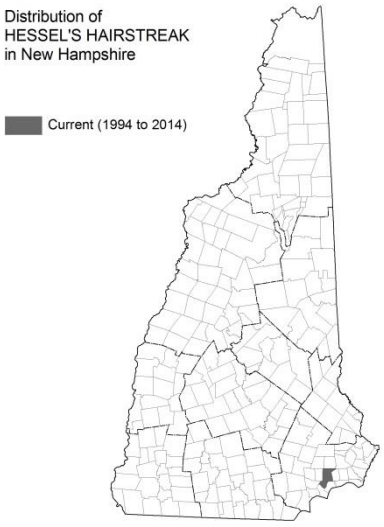
Found along coastal plain from Maine to Florida, although distribution is not continuous. Apparently most common in southern New Jersey (Natureserve). Historically known from Hampstead New Hampshire, but there were no additional records until the species was documented in Kingston in 2010-11.

Habitat

Larvae feed exclusively on Atlantic White Cedar (*Chamaecyparis thyoides*), and the species is thus limited to swamps containing this species. These swamps do not need to contain mature or virgin trees (Natureserve).

NH Wildlife Action Plan Habitats

- Temperate Swamps



Distribution Map

Current Species and Habitat Condition in New Hampshire

Unknown.

Population Management Status

Management is not currently in place for this species.

Regulatory Protection (for explanations, see Appendix I)

N/A

Quality of Habitat

Unknown.

Habitat Protection Status

Only known site is on conservation land.

Habitat Management Status

Habitat management has not been implemented for this species

Threats to this Species or Habitat in NH

Threat rankings were calculated by groups of taxonomic or habitat experts using a multistep process (details in Chapter 4). Each threat was ranked for these factors: Spatial Extent, Severity, Immediacy, Certainty, and Reversibility (ability to address the threat). These combined scores produced one overall threat score. Only threats that received a "medium" or "high" score have accompanying text in this profile. Threats that have a low spatial extent, are unlikely to occur in the next ten years, or there is uncertainty in the data will be ranked lower due to these factors.

Habitat conversion due to development (Threat Rank: Medium)

Although the known site for this species is protected, other potential sites in heavily developed southeastern NH could be at risk, See the Temperate Swamp habitat profile for more detail.

List of Lower Ranking Threats:

Species impacts from insecticide use (mosquito and gypsy moth treatment)

Habitat degradation from the loss of adult upland forest habitat

Actions to benefit this Species or Habitat in NH

Research and Monitoring

Primary Threat Addressed: Research

Specific Threat (IUCN Threat Levels):

Objective: Conduct targeted searches or historic and potential sites so as to determine the species' actual status in the state.

General Strategy: Experienced observers working in suitable habitat should be aware of this species' potential occurrence and report it if found and documented.

Political Location:
Rockingham, Hillsborough

Watershed Location:
Merrimack, Coastal

References, Data Sources and Authors

Data Sources

Data Quality
This species is sparsely distributed and occurs at low densities. Although at the northern edge of its range, it may occur elsewhere in NH but has not been documented.

2015 Authors:
Pamela Hunt, NHA

2005 Authors:
N/A

Literature

Natureserve. http://explorer.natureserve.org/.

Frosted Elfin

Callophrys iris

Federal Listing	N/A
State Listing	E
Global Rank	
State Rank	S1
Regional Status	

Photo by NHFG

Justification (Reason for Concern in NH)

The frosted elfin, along with the Karner blue butterfly, is an indicator of the health of the pine barrens habitat. As habitat goes unmanaged and reverts to a closed canopy system, the frosted elfin will die out. Frosted elfins are highly susceptible to population declines, which are a product of host plant specificity, environmental change, low dispersal rates, and small subpopulation size (Cushman and Murphy 1993), as well as cannibalism among larva. These factors are magnified by a severe loss of habitat. Nearly 90% of historic pine barrens communities along the Merrimack River have been lost, leaving a mere 560 fragmented acres, primarily in Concord (Helmbolt and Amaral 1994).

Distribution

The range of the frosted elfin extends from northern New England across to New York, Ohio, Indiana, Michigan, and Wisconsin, and along the eastern seaboard with pockets in southern New Jersey, eastern Maryland, West Virginia, South Carolina, and northern Florida (Swengel 1986, Schwitzer 1992, NatureServe 2005). The frosted elfin is believed to have been extirpated in Ontario, Maine, and Illinois (NatureServe 2015).

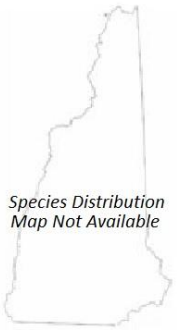
In New Hampshire, populations of the frosted elfin currently occur only in the Concord Pine Barrens, but there are records from the towns of Webster and Durham from the early 1900s, indicating that these areas once supported frosted elfin habitat (New Hampshire Natural Heritage Bureau 2015).

Habitat

The habitat of the frosted elfin in New Hampshire is identical to that of the federally endangered Karner blue butterfly *(Lycaeides melissa samuelis*): pine barrens with ample patches of blue lupine (*Lupinus perennis*), the only larval host plant (Schweitzer 1992, Swengel 1996). Whereas Karner blue butterfly larvae consume the leaves, frosted elfin larvae typically consume flowers and seedpods of the blue lupine (Swengel 1996). Flight period of the frosted elfin is from May to June, coinciding with the first flight of the Karner blue butterfly. Frosted elfin eggs are laid among the flower stalks and buds of the blue lupine (Swengel 1996). Larvae pupate underground and remain there until the following spring (Schwitzer 1992, Swengel 1996). For a detailed habitat description, see the Pine Barrens profile.

NH Wildlife Action Plan Habitats

- Pine Barrens



Distribution Map

Current Species and Habitat Condition in New Hampshire

The Concord pine barrens supports the largest and only known remaining population in the state. There is a possibility that the species still exists on the Manchester Airport where there is a small colony of lupine, but no surveys have been conducted. Monitoring of the species between 2005 and 2014 indicate that the population in Concord has remained stable with a estimated size of 1600 adults in 2008 (NHFG annual report). Habitat management in the pine barrens is designed to be rotational with intervals of recovery allowing recolonization of areas from nearby refugia. Frosted elfin pupate in the soil in New Hampshire (Schweitzer/Nature Serve 2015) providing them better protection and likelihood of survival during a fire. Frosted elfin larvae are frequently collected during the captive rearing of Karner blue butterfly during the collection of lupine leaves for larval feeding and flowers for oviposting females. Larvae are reared in the lab through to pupation on lupine leaves. There are currently no recovery goals outlined for the species in New Hampshire.

Population Management Status

Frosted elfins do not receive direct population management. Habitat management activities to maintain openings and restore lupine at the Concord Pine Barrens benefit the species.

Regulatory Protection (for explanations, see Appendix I)

- Endangered Species Conservation Act (RSA 212-A)
- Native Plant Protection Act RSA 217-A

Quality of Habitat

The minimum habitat requirements of frosted elfins have not been defined.

Habitat Protection Status

Approximately 227 ha of the remnant Concord pine barrens is protected through the Concord Municipal Airport Development and Conservation Management Agreement (2000). This area is managed to enhance and restore critical habitat for Karner blue butterflies as well as a suite of other rare species including the Frosted elfin. The land is owned by the City of Concord, with an 11 ha conservation easement granted to the United States Fish and Wildlife Service. The conservation easement is open to the public, but wheeled vehicles are forbidden. In addition to the conserved area

there is a 5 ha patch of habitat located along a powerline right-of-way. This parcel is privately owned and maintained by Eversource and NH Fish and Game in cooperation with the landowner.

Habitat Management Status

Current habitat management and restoration techniques include native plant propagation, vegetation management using specialized mowers and feller bunchers, and prescribed fire. These techniques create sandy and herbaceous openings within a matrix of heath, scrub-shrublands, and woodlands.

Threats to this Species or Habitat in NH

Threat rankings were calculated by groups of taxonomic or habitat experts using a multistep process (details in Chapter 4). Each threat was ranked for these factors: Spatial Extent, Severity, Immediacy, Certainty, and Reversibility (ability to address the threat). These combined scores produced one overall threat score. Only threats that received a "medium" or "high" score have accompanying text in this profile. Threats that have a low spatial extent, are unlikely to occur in the next ten years, or there is uncertainty in the data will be ranked lower due to these factors.

Habitat conversion and mortality due to development (conversion to pavement or infrastrucure) (Threat Rank: High)

The only known extant population of Frosted Elfin resides in the Concord pine barrens. Extensive commercial and residential development has severely reduced habitat for Frosted elfins; about 5-10% of the original Concord pine barrens remains today, and virtually all pine barrens south of Concord have been lost (Helmbolt and Amaral 1994). The remaining habitat is limited to the conservation area around the airport and one private parcel totalling ~230ha. Development projects within the airport boiundaries could result in a loss of lupine and primary habitat for the species.

Habitat degradation from lack of high intensity disturbance (Threat Rank: High)

Lack of fire in the pine barrens allows leaf litter to accumulate over time and canopy cover to increase reducing the amount of lupine available.

Seedling survival of lupine was four times greater in openings and partial shade than dense shade (Pavlovic and Grundel 2009). Seedling survival was also greatest when litter cover was low, but moderate amount of vegetation available to provide shade. Similar results were observed by Plenzler (2008), litter removal from prescribed burning was important to the establishment and recruitement of lupine, but the microhabitat influenced by soil moisture, ferns, moss cover etc. provided conditions for better seedling survival.

Mortality from litter and fuel accumulation that cause fires (Threat Rank: High)

The population of frosted elfin in Concord is limited to 227 hectares. A large-scale fire that burned a significant portion of this habitat could result in extirpation of the species.

Insects that are small in number and have a high degree of ecological specialization are extremely susceptible to extirpation from local fire (New 2014). Swengel and Swengel (2007) recommneded the establishment of permanent non-fire refugia that is maintained with low intesity mowing and brush control for the long-term benefit of species such as the frosted elfin and Karner blue butterfly.

A species response to fire is dependent on five characteristics 1) ecological specialization 2) vagility (movement ability) 3) above ground life stages 4) voltinism (number of broods) and 5) response to key plant food to fire (Swengel 1996).

Mortality caused by mowing activity (Threat Rank: Medium)

Maintenance of active runways and taxiways is required for safety compliance with FAA regulations. Mowing during the growing season may scatter eggs and developing larvae from lupine plants. Larvae dispersal is limited, and without access to a sufficient amount of lupine to complete development there could be a negative impact to the population.

Delayed annual mowing and partial mowing resulted in higher species richness and abundance of butterflies on road verges in Europe (Valtonen et al. 2006). Mowing no more than once a year after the adult flight resulted in the persistence of two endnagered butterfly species across multiple meadows, but only if mowing was done every second or third year did both species persist at the local level (Johst et al. 2006). Leaving an unmown grass refuge within hay meadows resulted in a higher abundance of buttreflies (Kuhne et al. 2015).

Habitat impacts from roads (limited dispersal) (Threat Rank: Medium)

Paved surfaces generate substantial heat during hot summer months; this heat combined with lack of herbaceous habitat limits the dispersal of butterflies across these surfaces between habitat patches.

Found no evidence of mortality associated with roads, but the distribution of the species was influenced by roads and other paved areas (Fuller 2008). Evidence from the work supported the barrier hypothesis that paved areas are barriers inhibiting flight, and adjacent areas become congested with individuals. Overtime selection for non-dispersive individuals may occur (Leimar and Norberg 1997).

Mortality of lupine, other plants, eggs and larvae from vehicles or equipment (Threat Rank: Medium)

Open space areas in the City of Concord are limited. Powerline ROW often serve as corridors for ATV use across the landscape.

OHRV traffic in lupine patches could result in direct loss of larvae or depletion of lupine available.

Species impacts from competition (aphids, blister beetles) (Threat Rank: Medium)

Large outbreaks of aphids in lupine patches of the conservation area result in early decline of the plants limiting the quallity and quantity of food available for developing larvae. Outbreaks of beetles on lupine habitat may alter adult butterfly behavior such as oviposition in Karner blue butterflies (Swanson and Neff 2007), there may be a similar behavior disruption in Frosted elfins.

List of Lower Ranking Threats:

Mortality from herbivory (deer and woodchuck feed on lupine and ingest larvae)

Habitat degradation due to invasive or introduced plants

Mortality from the collection of individuals from the wild

Actions to benefit this Species or Habitat in NH

Habitat management and restoration.

Primary Threat Addressed: Habitat degradation from lack of high intensity disturbance

Specific Threat (IUCN Threat Levels): Natural system modifications

Objective:

General Strategy:
Habitat management will increase the availability of suitable habitat for Frosted elfins by converting closed-canopy stands to an early-sucessional structure. Standard habitat management techniques including forestry, fire, and herbicide have well-documented efficacy in reducing the cover of canopy-forming, shade-tolerant, and fire-sensitive species. The technique, frequency, and intensity of management will be prescribed to increase light reaching the herbaceous strata, to create soil disturbances, and to connect existing blue lupine populations. Open-canopy corridors will offset failed dispersal and foraging in impermeable and/or unsuitable landscapes, such as the edges of runways and roads.

Political Location:
Merrimack County

Watershed Location:
Merrimack Watershed

Monitor OHRV activitiy in occupied areas.

Primary Threat Addressed: Mortality of lupine, other plants, eggs and larvae from vehicles or equipment

Specific Threat (IUCN Threat Levels): Human intrusions & disturbance

Objective:

General Strategy:
Maintain signs posting sensitive habitat for Frosted elfins. Monitor OHRV activity, especially in spring and summer where the most impact can occur. Provide information to law enforcement upon detection to facilitate issuance of a citation.

Political Location:
Merrimack County

Watershed Location:
Merrimack Watershed

Coordinate annual mowing with Concord Airport.

Primary Threat Addressed: Mortality caused by mowing activity

Specific Threat (IUCN Threat Levels): Transportation & service corridors

Objective:

General Strategy:
Coordinate maintenance in operational area to comply with safety requirements, while minimizing

negative impacts to Frosted Elfin.

Political Location:
Merrimack County

Watershed Location:
Merrimack Watershed

Conserve remaining pitch pine barrens in Concord to increase habitat available for the species.

Primary Threat Addressed: Habitat conversion and mortality due to development (conversion to pavement or infrastrucure)

Specific Threat (IUCN Threat Levels): Residential & commercial development

Objective:

General Strategy:
Maintain the current conservation agreement with the City of Concord and conservation partners to protect habitat for Frosted elfin and Karner blue butterfly. Look for additional opportunities to conserve the limited remaining patches of pine barrens nearby to increase habitat availability.

Political Location:
Merrimack County

Watershed Location:
Merrimack Watershed

Monitor population periodically for health and trend.

Objective:

General Strategy:
Perform population surveys every 2-4 years to monitor status of the species. Determine most resource efficient method for adequately detecting sugnificant changes in the population.

Political Location:

Watershed Location:
Merrimack Watershed

Research impacts of climate change and potential management actions.

Objective:

General Strategy:

Political Location:

Watershed Location:

References, Data Sources and Authors

Data Sources
Sources of information include field reports, agency data, scientific journal articles, and element

occurrence databases.
Information on habitat protection and management was obtained from Concord pine barrens recovery and management plans.

Data Quality

Lepidoptera surveys are conducted annually at the Concord Pine Barrens, and frosted elfin have been seen every year. Other areas where pine barrens habitat occurs have not been surveyed for frosted elfin or locations that support Baptisia tinctoria an alternative host plant for the species.
The frosted elfin has been monitored frequently during the past 10 years. Wild lupine has been mapped and/or monitored for almost 20 years.

2015 Authors:

Heidi Holman, NHFG

2005 Authors:

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Monarch

Danaus plexippus

Federal Listing	N/A
State Listing	petitioned
Global Rank	
State Rank	S5
Regional Status	

Photo by Robert Crow Dreamstime.com

Justification (Reason for Concern in NH)

Monarchs across their range have exhibited precipitous declines, from about a billion adults in 1996 to 56.5 million on their wintering grounds in 2015, a decline of about 94% (USFWS 2015a and Jepsen et al 2015). Habitat declines in both the US and Mexico have contributed to this. In Mexico, illegal logging has removed trees that the monarchs use for overwintering. In the US, increased herbicide use has reduced both foraging and milkweed habitat, and pesticide use causes direct mortality. In addition, drought and extreme weather has reduced foraging opportunities for both southbound and northbound butterflies. In August, 2014 the USFWS was petitioned to list the Monarch as threatened in the US. In December the USFWS found that there was enough evidence to warrant further review (Federal Register Dec 31, 2014 p79775). In February 2015 the USFWS partnered with other agencies and NGOs to form the Monarch Joint Venture (http://monarchjointventure.org/), collaborating on habitat enhancements and reduced use of chemicals as well as engaging citizens in habitat management and citizen science projects (USFWS http://www.fws.gov/news/ShowNews.cfm?ID=6F9989BD-0738-14CE-50EAC980BE1A75FC).

Distribution

Monarchs in NH represent just a small percentage of the population. Habitat for this species is found along the edges of agricultural fields; however farming has declined over the last 100 years. Backyard pollinator gardens have been encouraged recently, and citizens are involved in some of the national citizen science projects such as Monarch Watch

Habitat

Monarchs use a variety of habitats from meadows to edges of agricultural fields to gardens and anywhere else flowers are blooming that provide nectar sources for adults. Milkweeds are required for breeding, with eggs being laid on the underside of common milkweed and the caterpillars feeding exclusively on their leaves. Monarchs also pupate on milkweed plants. The third summer generation migrates southward, feeding on nectar throughout their journey to Mexico, where they overwinter on trees on one small section of mountainside forest. In 2015 all the monarchs from east of the Rockies ended up in a single, 3 acre patch of forest.

NH Wildlife Action Plan Habitats

- Grasslands
- Developed Habitats

Distribution Map

Current Species and Habitat Condition in New Hampshire

There is little data on monarch populations in NH.

Population Management Status

Monarch populations are not managed in NH.

Regulatory Protection (for explanations, see Appendix I)

- NHFG Permit for collection or possession
- Federal Endangered Species Act - under consideration
- NHFG Rule FIS 803.02. Importation.
- NHFG Rule FIS 804.02. Possession.

Quality of Habitat

Agriculture has declined in NH, but interest in pollinator gardens and monarch butterfly habitat has increased. There is no quantitative data on habitat quality in NH.

Habitat Protection Status

A few farms have conservation easements on them that allow normal farming practices. It is unknown if the owners are practicing pollinator or monarch friendly practices.

Habitat Management Status

Outreach efforts to encourage homeowners and farmers to create and maintain pollinator habitat are done by NRCS and UNH Cooperative extension as well as NGOs.

Threats to this Species or Habitat in NH

Threat rankings were calculated by groups of taxonomic or habitat experts using a multistep process (details in Chapter 4). Each threat was ranked for these factors: Spatial Extent, Severity, Immediacy, Certainty, and Reversibility (ability to address the threat). These combined scores produced one overall threat score. Only threats that received a "medium" or "high" score have accompanying text in this profile. Threats that have a low spatial extent, are unlikely to occur in the next ten years, or there is uncertainty in the data will be ranked lower due to these factors.

Mortality from the use of neonicotinoid and other pesticides (Threat Rank: High)

Neonicotinoids are broad spectrum insecticides that are applied both to foliage and to seeds which absorb them into the growing plant. The insecticide accumulates in nectar, which monarchs consume. Monarchs also may be exposed to direct spray or to residues on plant surfaces (CBC et al 2014). Use of neonicotinoids has expanded, with many crops and nursery plants receiving treatment. Nursery plants generally are not labelled as treated, and thus end up in gardens even when the gardener is trying to attract pollinators. Other pesticides also cause direct mortality or loss of fitness.

Habitat conversion from the loss of milkweed due to use of Roundup Ready corn and soy crops and subsequent herbiciding (Threat Rank: Medium)

Milkweeds and other wildflowers grow as weeds in crop fields. The use of roundup-ready crops allows farmers to spray herbicides to control weeds more effectively than other weed control methods resulting in a loss of milkweed (Jepsen et al 2015).

Habitat degradation from the loss of nectaring plants from herbicide drift (Threat Rank: Medium)

Herbicides that are sprayed can drift outside the treatment area, impacting milkweed and wildflowers at the edge of crop fields and beyond (CBC et al 2014)

Habitat conversion from development (Threat Rank: Medium)

Agricultural properties, including pastures and croplands, are easy to develop because they are level and lack trees. Removal of wildflowers that grow at the edge of or interspersed in agricultural lands removes critical habitat for monarchs. Monarchs are often killed as they cross roads.

Habitat degradation and mortality from invasive plants that act as dead-end host plants (Threat Rank: Medium)

Black swallow-wort (*Vincetoxicum nigrum*) and Pale swallow-wort (*V. rossicum*) are non-native milkweed-like plants which monarchs are attracted to for egg laying. The larvae die within a few days of hatching (Casagrande and Dacey 2007). In natural setting where the monarchs could choose between true milkweeds and these swallow-worts, 10-21% of eggs were laid on swallow-worts.

List of Lower Ranking Threats:

Habitat degradation and impacts from changes in precipitation and temperature that affect milkweed and nectar plant growth and larval growth

Mortality from predation and parasitism of eggs and larvae

Species impacts and morality from increased diseases that affect sex ratio

Species impacts from disease and genetic alteration due to commercial capture, rearing and release elsewhere of adult monarchs

Habitat degradation from the loss of milkweed and nectaring plants due to aggressive roadside vegetation management

Actions to benefit this Species or Habitat in NH

Promote organic practices and integrated pest management (IPM) and discourage use of neonicotinoids

Primary Threat Addressed: Mortality from the use of neonicotinoid and other pesticides

Specific Threat (IUCN Threat Levels): Pollution / Agricultural & forestry effluents / Herbicides & pesticides

Objective:
Provide technical assistance to organizations that provide education, technical assistance and funding to farmers and homeowners on organic growing practices and IPM.

General Strategy:
Work with the NH Department of Agriculture, Northeast Organic Farmers Association, UNH Cooperative Extension, NRCS, nursery stock growers, garden centers, garden clubs, landscapers and others to educate farmers, homeowners and commercial landscapers on using IPM and organic practices.

Political Location: **Watershed Location:**

Monitor monarchs

Objective:
Encourage participation in citizen science based national monarch monitoring programs

General Strategy:
Encourage UNHCE and nature center to promote Monarch Watch and other national monitoring programs.

Political Location: **Watershed Location:**

Promote practices that enhance monarch and other pollinator habitat.

Primary Threat Addressed: Habitat conversion from the loss of milkweed due to use of Roundup Ready corn and soy crops and subsequent herbiciding

Specific Threat (IUCN Threat Levels): Agriculture & aquaculture

Objective:
Provide technical assistance to organizations that provide education, technical assistance and funding to farmers on practices that enhance habitat for pollinators.

General Strategy:
Encourage NRCS to fund practices that enhance habitat for pollinators. Work with the NH Department of Agriculture and UNH Cooperative Extension to promote farming practices that enhance pollinator habitat.

Political Location: **Watershed Location:**

Regulate release of monarch butterflies.

Primary Threat Addressed: Species impacts from disease and genetic alteration due to commercial capture, rearing and release elsewhere of adult monarchs

Specific Threat (IUCN Threat Levels): Biological resource use

Objective:
Require permitting through NHFG rules for releases.

General Strategy:
Require only wild caught NH monarchs to be used for release. Require permits and facility inspections to insure compliance.

Political Location: **Watershed Location:**

Remove black and pale swallow-worts.

Primary Threat Addressed: Habitat degradation and mortality from invasive plants that act as dead-end host plants

Specific Threat (IUCN Threat Levels): Invasive & other problematic species, genes & diseases

Objective:
Identify locations where black and pale swallow-worts occur and remove them.

General Strategy:
Identify best methods for control of black and pale swallow-worts. Prioritize removal of these plants first at the leading edge of their spread, then elsewhere, targeting places where eradication is possible and then where control will remove plants particularly those large enough to attract monarchs.

Political Location: **Watershed Location:**

References, Data Sources and Authors

Data Sources
Information on this species has been collected predominantly from the USFWS including the petition to list and from the review of monarch issues compiled by NatureServe and the Xerces Society for Invertebrate Conservation.

Data Quality
The available data on monarchs nationally is fairly well documented, Data from NH is lacking.

Appendix A: Insects

2015 Authors:
Emily Preston, NHFG

2005 Authors:

Literature

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Karner blue butterfly

Lycaeides melissa samuelis

Federal Listing	E
State Listing	E
Global Rank	
State Rank	S1
Regional Status	N/A

Photo by Janules 2014

Justification (Reason for Concern in NH)

Karner blue butterflies, as well as other members of the family Lycaenidae, are highly susceptible to environmental changes and population declines, which are a product of their host plant specificity, symbiotic relationship with attendant ants, low vagility, and small subpopulation size (Cushman and Murphy 1993, Grundel et al. 1999). Additionally, Karner blue butterflies have behavior-specific habitat requirements, where canopy heterogeneity is essential for successful mating, breeding, oviposition, and nectaring (Grundel et al. 1998b). Such specialization gives Karner blue butterflies the designation of an umbrella species. Not only do they serve as an indicator of habitat quality, but management for their stringent habitat requirements meets the needs of other state endangered and threatened wildlife species as well, thereby maximizing overall biodiversity throughout the community. Associated species include frosted elfins (*Callophrys irus*) and Persius duskywing skippers (*Erynnis persius persius*) whose larvae also feed solely on wild lupine, as various pine barrens moth specialists, eastern hognose snakes (*Heterodon platirhinos*), grasshopper sparrows (*Ammodramus savannarum*), and common nighthawks (*Chordeiles minor*). The limiting factors for Karner blue butterflies have been compounded by a severe loss of habitat. Nearly 90% of historic pine barren communities along the Merrimack River have been lost (Helmbolt and Amaral 1994). Without enough suitable habitats to support a viable population, Karner blue butterflies became extirpated in New Hampshire in 2000 (Amaral 2000), and were subsequently reintroduced.

Distribution

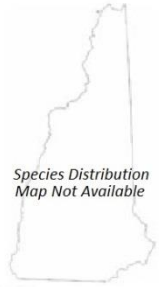
The distribution of Karner blue butterflies is largely dependent on the availability of blue lupine, the larval food source, and preferred native nectar sources (Schultz and Dlugosch 1999). In New Hampshire these plants are found in pine barrens which occur primarily on glacially deposited sand, shale, and serpentine soil types in parts of eastern North America (Sutton 1925). Pine barrens once spanned the Merrimack River valley from Canterbury to Nashua, occupying Windsor sandy loams and Hinckley cobbly sandy loams (VanLuven 1994). Today, only one site in New Hampshire, the Concord pine barrens, supports a population of Karner blue butterflies. A reintroduction program was initiated in 2001 to restore a viable metapopulations of Karner blue butterflies to the area.
This population represents the easternmost extent of this species' distribution and is separated from the nearest population in New York by over 225 km (140 mi) (Helmbolt and Amaral 1994). Regionally, Karner blue butterflies formerly occurred in a band extending across 12 states from Minnesota to Maine and in the province of Ontario, Canada, but now only occur in the 7 states of Minnesota, Wisconsin, Indiana, Michigan, New York, New Hampshire, and Ohio (USFWS 2003).

Habitat

Karner blue butterflies inhabit pine barrens, an early-successional community composed of four distinct vegetative strata: herbaceous, heath, scrub, and canopy. Within the scrub and canopy strata, shade- providing pitch pine (*Pinus rigida*) and scrub oak (*Quercus ilicifolia*) dominate. The lower strata include grasses, vascular plants, and heath. Throughout these layers little bluestem (*Schizachyrium scoparium*) and big bluestem (*Andropogon gerardii*) are the principle grass species, affording roost sites and predator protection by attendant ants. New Jersey tea (*Ceanothus americanus*), spreading dogbane (*Apocynum androsaemifolium*), lowbush blueberry (*Vaccinium angustifolium*), and huckleberry (*Gaylussacia bacata*), as well as state threatened wild lupine (*Lupinus perennis*), blunt-leaved milkweed (*Asclepias amplexicaulis*), and golden heather (*Hudsonia ericoides*) comprise the majority of the herbaceous and heath layer and provide a critical source of nectar (United States Fish and Wildlife Service 2003). Spatially, these strata form a heterogeneous matrix of open, sub-canopied, and canopied habitat patches across the landscape, which in turn create a gradient of light intensities and thermal conditions necessary for habitat-specific behaviors. Temporally, this structural diversity is in constant flux, a process maintained by periodic disturbance, namely fire. Currently, Karner blue butterflies are restricted to fragmented pine barren remnants, highway and powerline rights-of-way, airports, military camps, and gaps in forest stands that support their obligate host plant, blue lupine (USFWS 2003).

NH Wildlife Action Plan Habitats

- Pine Barrens



Distribution Map

Current Species and Habitat Condition in New Hampshire

Historically, Karner blue butterflies occurred in 5 sites in New Hampshire: Milford (1880), Merrimack (1880), Webster (1896), Manchester (no date), and Concord (New Hampshire Natural Heritage Bureau 2005). Of these sites, the Concord pine barrens supported the last remaining population in the state. In 1980, an estimated 3,700 butterflies occupied this area but the population was soon reduced to less than 50 by 1994 (Schweitzer 1983, Peteroy 1998). Extirpation followed in 2000, resulting in the initiation of a captive rearing and reintroduction program (USFWS 2003). Translocation success has been observed with a population existing in the Concord pine barrens consistently since reintroduction in 2001. Mark recapture surveys indicate that the wild population has reached the minimum 1,500 adults periodically over the past 10 years and may have reached over 2400. The New Hampshire population will be designated as fully recovered upon the establishment of one metapopulation of at least 3,000 first brood or second brood adults that is sustained for a minimum of 5 years (USFWS 2003).

Population Management Status

Release of translocated captive-reared butterflies has been underway at Concord Municipal Airport since 2001 (USFWS 2003). A reserve design has been developed in a metapopulation context, with intensive restoration sites connected by managed corridors (Fuller et al. 2003).

Regulatory Protection (for explanations, see Appendix I)

- Native Plant Protection Act RSA 217-A
- National Plant Protection Act

Quality of Habitat

The minimum habitat requirements of Karner blue butterflies include: 1) suitable habitat and occupied sites greater than 0.25 ha, 2) small areas (0.25-5 ha) having at least 500 blue lupine stems or 810 blue lupine stems per 0.4 ha, 3) larger habitat areas (>5 ha) having at least 0.1 blue lupine stem per m^2 or 405 blue lupine stems per 0.4 ha, 4) available nectar for each adult butterfly flight period, and 5) habitat heterogeneity for thermal regulation (USFWS 2003). Currently there is suitable habitat for the species in all the conservation zones. Quality of habitat varies over time based on management rotation. Some locations within the operational are of the airport are of lower quality. Annual mowing to maintain safety areas prevents the establishment of shrub and small trees for shade.

Habitat Protection Status

Approximately 227 ha of the remnant Concord pine barrens are protected through the Concord Municipal Airport Development and Conservation Management Agreement (2000). Conservation Zones have been established which are managed to enhance and restore critical habitat for Karner blue butterflies as well as a suite of other rare species. The land is owned by the city of Concord, with an 11 ha conservation easement granted to the USFWS. The conservation easement is open to the public but wheeled vehicles are forbidden. The historic main site, located along a powerline right-of-way, is privately owned. This site is generally maintained in coordination with Eversource during routine management cycles every 3 years. Since 2013 the private landowner has funded additional habitat management expanding the site from 1 ha to 5 ha. Staff have assisted NHFG with propagating and planting lupine and nectar in the area following a timber removal.

Habitat Management Status

Current habitat management and restoration techniques used in the Conservation Zones include native plant propagation, vegetation management using specialized mowers and feller bunchers, and prescribed fire. These techniques create sandy and herbaceous openings within a matrix of heath, scrub-shrublands, and woodlands. Habitat monitoring is completed before and after management implementation.

Threats to this Species or Habitat in NH

Threat rankings were calculated by groups of taxonomic or habitat experts using a multistep process (details in Chapter 4). Each threat was ranked for these factors: Spatial Extent, Severity, Immediacy, Certainty, and Reversibility (ability to address the threat). These combined scores produced one overall threat score. Only threats that received a "medium" or "high" score have accompanying text in this profile. Threats that have a low spatial extent, are unlikely to occur in the next ten years, or there is uncertainty in the data will be ranked lower due to these factors.

Habitat conversion and mortality due to development (conversion to pavement or infrastrucure) (Threat Rank: High)

The sandy soils associated with pine barrens communities make them optimal for development. Both commercial and residential developments contribute to habitat reduction and fragmentation. As habitat is lost and becomes more fragmented, colonization of the remaining habitat patches becomes increasingly difficult. Population reduction, extirpation or extinction is the ultimate result if habitat conditions are not improved. Karner blue butterfly populations fluctuate widely. As local populations become extinct, it is improbable that recolonization will occur.

Karner blue butterflies have a positive association with habitat areas that are large, have high light intensity, and are recently managed (Smallidge et al. 1996). Extensive commercial and residential development of the Concord pine barrens has severely reduced habitat for Karner blue butterflies. About 5-10% of the original Concord pine barrens remains today, and virtually all pine barrens south of Concord have been lost (Helmbolt and Amaral 1994).

Habitat degradation from lack of high intensity disturbance (Threat Rank: High)

Lack of fire in the pine barrens allows leaf litter to accumulate over time and canopy cover to increase.

Seedling survival of lupine was four times greater in openings and partial shade than dense shade (Pavlovic and Grundel 2009). Seedling survival was also greatest when litter cover was low, but moderate amount of vegetation available to provide shade. Similar results were observed by Plenzler (2008), litter removal from prescribed burning was important to the establishment and recruitment of lupine, but the microhabitat influenced by soil moisture, ferns, moss cover etc. provided conditions for better seedling survival.

Mortality from litter and fuel accumulation that cause fires (Threat Rank: High)

The population of Karner blue butterflies in Concord is limited to 227 ha. A large-scale fire that burned a significant portion of this habitat could result in extirpation of the species.

Insects that are small in number and have a high degree of ecological specialization are extremely susceptible to extirpation from local fire (New 2014).

Disturbance from severe weather that limits reproductive success (Threat Rank: Medium)

Preliminary research indicates that increasing temperatures are likely to result in production of third and possibly fourth broods of adults. Due to reduced quantity and quality of lupine resources for larval development, these third and fourth broods will likely be less fit, leading to reduced reproduction and overall population numbers (USFWS 2012).

Early spring emergence may result in variation of light exposure during grandparent or parent generations. This exposure may prevent eggs that normally overwinter from entering diapause producing additional broods later in the year when food sources are no longer available.

Habitat impacts from roads that limit dispersal and prevent colonization (Threat Rank: Medium)

Paved surfaces generate substantial heat during hot summer months; this heat combined with lack of herbaceous habitat limits the dispersal of butterflies across these surfaces between habitat patches.

Analysis of Karner blue butterfly population data in NY found no evidence of mortality associated with roads, but the distribution of the species was influenced by roads and other paved areas (Fuller

2008). Evidence from the work supported the barrier hypothesis that paved areas are barriers inhibiting flight, and adjacent areas become congested with individuals. Overtime selection for non-dispersive individuals may occur (Leimar and Norberg 1997).

Mortality caused by mowing activity (Threat Rank: Medium)

Maintenance of active runways and taxiways is required for safety compliance with FAA regulations. Mowing during the growing season may scatter eggs and developing larvae from lupine plants. Larvae dispersal is limited, and without access to a sufficient amount of lupine to complete development there could be a negative impact to the population.

Delayed annual mowing and partial mowing resulted in higher species richness and abundance of butterflies on road verges in Europe (Valtonen et al. 2006). Mowing no more than once a year after the adult flight resulted in the persistence of two endangered butterfly species across multiple meadows, but only if mowing was done every second or third year did both species persist at the local level (Johst et al. 2006). Leaving an unmown grass refuge within hay meadows resulted in a higher abundance of butterflies (Kuhne et al. 2015).

Habitat impacts from roads (limited dispersal) (Threat Rank: Medium)

Mortality of lupine, other plants, eggs and larvae from vehicles or equipment (Threat Rank: Medium)

Open space areas in the City of Concord are limited. Powerline ROW often serve as corridors for ATV use across the landscape.

OHRV traffic in lupine patches could result in direct loss of larvae or depletion of lupine available.

Species impacts from competition (aphids, beetles) (Threat Rank: Medium)

Large outbreaks of aphids in lupine patches of the conservation area result in early decline of the plants limiting the quality and quantity of food available for developing larvae. Outbreaks of beetles on lupine habitat may alter adult butterfly behavior such as oviposition in Karner blue butterflies (Swanson and Neff 2007), there may be a similar behavior disruption in Frosted elfins.

List of Lower Ranking Threats:

Mortality from pesticide use

Mortality from herbivory (deer and woodchuck feed on lupine and ingest larvae)

Habitat degradation due to invasive or introduced plants

Mortality from the collection of individuals from the wild

Actions to benefit this Species or Habitat in NH

Coordinate annual mowing activities with Concord Airport.

Primary Threat Addressed: Mortality caused by mowing activity

Specific Threat (IUCN Threat Levels): Transportation & service corridors

Objective:

General Strategy:
Coordinate maintenance in operational area to comply with safety requirements, while minimizing negative impacts to Karner blue butterfly.

Political Location:
Merrimack County

Watershed Location:
Merrimack Watershed

Monitor illegal OHRV use in the conservation area.

Primary Threat Addressed: Mortality of lupine, other plants, eggs and larvae from vehicles or equipment

Specific Threat (IUCN Threat Levels): Human intrusions & disturbance

Objective:

General Strategy:
Maintain signs posting sensitive habitat for Frosted elfins. Monitor OHRV activity, especially in spring and summer where the most impact can occur. Provide information to law enforcement upon detection to facilitate issuance of a citation.

Political Location:

Watershed Location:

Habitat Management and Restoration

Primary Threat Addressed: Habitat degradation from lack of high intensity disturbance

Specific Threat (IUCN Threat Levels): Natural system modifications

Objective:

General Strategy:
Habitat management will increase the availability of suitable habitat for Karner blue butterflies by converting closed-canopy stands to an early-successional structure. Standard habitat management techniques including forestry, fire, and herbicide have well-documented efficacy in reducing the cover of canopy-forming, shade-tolerant, and fire-sensitive species. The technique, frequency, and intensity of management will be prescribed to increase light reaching the herbaceous strata, to create soil disturbances, and to connect existing blue lupine populations. Open-canopy corridors will offset failed dispersal and foraging in impermeable and/or unsuitable landscapes, such as the edges of runways and roads.

Political Location:

Watershed Location:

Monitor population annually for health and trend.

Objective:

General Strategy:

Mark recapture surveys have been performed annually on first and/or second brood since the start of reintroduction. Continued monitoring of the population will inform decisions regarding augmentation and habitat management. As the population grows, the monitoring protocol may be switched to a less intensive method that provides sufficient sensitivity for detecting change in the population.

Political Location:
Merrimack County

Watershed Location:
Merrimack Watershed

Captive Rearing and Augmentation

Primary Threat Addressed: Habitat conversion and mortality due to development (conversion to pavement or infrastructure)

Specific Threat (IUCN Threat Levels): Residential & commercial development

Objective:

General Strategy:

A captive rearing program provided the opportunity for re-establishing a population of Karner blue butterflies at the Concord Pine Barrens following the species extirpation from the state. The program has also contributed to the recovery effort in Albany, NY providing butterflies for accelerated colonization in recently managed habitat. NHFG should continue to coordinate and run the captive rearing program until it has been sufficiently demonstrated that there is no longer a need to augment the population in NH.

Political Location:

Watershed Location:

Conserve remaining parcels of pine barrens in the Concord area.

Primary Threat Addressed: Habitat conversion and mortality due to development (conversion to pavement or infrastructure)

Specific Threat (IUCN Threat Levels): Residential & commercial development

Objective:

General Strategy:

Maintain the current conservation agreement with the City of Concord and conservation partners to protect habitat for Frosted elfin and Karner blue butterfly. Look for additional opportunities to conserve the limited remaining patches of pine barrens nearby to increase habitat availability.

Political Location:
Merrimack County

Watershed Location:
Merrimack Watershed

References, Data Sources and Authors

Data Sources

Information on Karner blue butterfly habitat, population distribution, and status was collected from habitat and recovery conservation plans, technical field reports, agency data, and scientific journals. Information on habitat protection and management was obtained from Concord pine barrens recovery and management plans.

Data Quality

The Karner blue butterfly is one of the most intensely managed and monitored species in New Hampshire. The Concord pine barrens have been monitored for Karner blue butterflies for at least the past 20 years and results are well documented.
The Karner blue butterfly is one of the most intensely monitored and studied species in New Hampshire. The Concord pine barrens have been monitored for Karner blue butterflies for at least the past 20 years.

2015 Authors:

Heidi Holman, NHFG

2005 Authors:

Literature

Fuller, S.G. 2008. Population dynamics of the endangered Karner blue butterfly (*Lycaeides melissa samuelis* Nabokov). Dissertation, State University of New York Syracuse, New York. 173 pp.

Helmbolt, K and Amaral, M. 1994. Status of the Karner blue butterfly in New Hampshire. Pages 123-128 in D.A. Andow, R.J. Baker, and C.P. Lane, eds. Karner blue butterfly: a

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White Mountain Arctic

Oeneis melissa semidea

Federal Listing	N/A
State Listing	T
Global Rank	
State Rank	S2
Regional Status	

Photo by © K.P. McFarland

Justification (Reason for Concern in NH)

White Mountain arctic is limited to a 2,800 ac alpine zone of the White Mountain National Forest (WMNF). The species is highly susceptible to climate changes and population declines because of its fragile habitat, isolation, and host plant specificity (Halloy and Mark 2003, McFarland 2003). The structure, composition, phenology, and distribution of alpine habitat communities are extremely susceptible to climate change (Kimball and Weihrauch 2000, McFarland 2003, Lesica and McCune 2004). Alpine plant and animal species respond interdependently to environmental changes, expanding or contracting their ranges in relation to polarity and elevation (McFarland 2003, Lesica and McCune 2004). Asynchronous range fluctuations could disrupt plant-animal interactions such as pollination, seed dispersal, and food availability. This could lead to biotic feedbacks that are detrimental to overall ecosystem function (Bowman 2000, Walther et al. 2002). The obligate host plant of White Mountain arctic is Bigelow's sedge, a rare high-elevation plant that characterizes Bigelow's sedge meadows (S1) (McFarland 2003, Lesica and McCune 2004). Additional threats may emerge as climate continues to change, especially as climate interacts with other stressors such as habitat fragmentation, acid deposition, and increased solar ultraviolet radiation (McCarty 2001).

Distribution

Disjunct populations of *O. m. semidea* are restricted to the 2800 ac alpine zone of the Presidential Range of the WMNF (USFS 2001, McFarland 2003). Its presence or absence in a given area of its range is dependent on the abundance of host plants as well as ground temperature, moisture, and winter snow cover depth (Anthony 1970, McFarland 2003). *O. m. semidea* populations tend to be locally abundant around sedge meadows, a community covering approximately 198 ac (7%) of the alpine zone within the Presidential Range, with few individuals found between them (McFarland 2003). The most northern record was from Mt. Jefferson and the most southern from Mt. Monroe, with the greatest number of observations occurring at Monticello Lawn on Mt. Jefferson, Gulf Tanks along the Mt. Washington Cog Railway, the Cow Pasture, and the Bigelow Lawn on Mt. Washington (McFarland 2003).

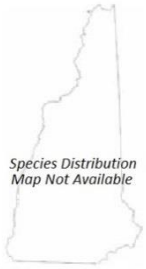
Habitat

The White Mountain arctic is a subspecies of the Melissa arctic (*Oeneis melissa*) and is endemic to the alpine zone of the Presidential Range of New Hampshire (McFarland 2003). It inhabits alpine and subalpine communities above 4,900 ft, specifically the dwarf shrub/sedge-rush meadow community (McFarland 2003). Dwarf shrub/sedge-rush meadows are composed of 4 communities: alpine heath snowbank, Bigelow's sedge meadow, sedge-rush-heath meadow, and dwarf shrub-bilberry-rush barren. These communities occur at elevations ranging from 1,340 to 1,890 m on moderate slopes oriented to the northwest and are characterized by Bigelow sedge (*Carex bigelowii*), Highland rush

(*Juncus trifidus*), and dwarf heath (*Vaccinium spp*.) (McFarland 2003, Sperduto and Nichols 2004). The ground cover is comprised of herbs, forbs, moss, lichen, and sparse, rocky openings interspersed with Bigelow sedge, the host plant for White Mountain arctic. Adults primarily feed on Moss campion (*Silene acaulis*), Mountain sandwort (*Arenaria groenlandica*), and *Vaccinium* species (McFarland 2003).

NH Wildlife Action Plan Habitats

- Alpine



Distribution Map

Current Species and Habitat Condition in New Hampshire

Relative abundance within the Presidential Unit is unknown, however, the White Mountain arctic population is considered imperiled due to natural rarity (McFarland 2003) and susceptibility to climatic and atmospheric changes. Recent genetic work indicated that the population appears to have a more continuous distribution than previously thought and can be managed as a single population (Gradish 2015). There is evidence of genetic differentiation between cohorts of even and odd years; additional work needs to be conducted for confirmation.

Population Management Status

Surveys have been conducted but long-term monitoring has not been implemented. Little or no targeted management has been implemented to date.

Regulatory Protection (for explanations, see Appendix I)

- Endangered Species Conservation Act (RSA 212-A)
- WMNF sensitive species

Quality of Habitat

High quality occurrences of alpine communities used by White Mountain arctic occur in Alpine Garden, Tuckerman Ravine, Oakes Gulf, Great Gulf, Mt. Eisenhower, Mt. Franklin, Monroe Flats, Bigelow Lawn, the upper slopes of Mt. Adams, Monticello Lawn, and on the north and west sides of the cone of Mt. Washington (Sperduto and Nichols 2004). No data has been collected on condition of habitat in these areas relative to the White Mountain Arctic.

Habitat Protection Status

Because White Mountain arctic is protected under RSA 212, its habitat receives some protection.

Habitat Management Status

Little or no targeted management has been implemented to date. See also Alpine Habitat Profile.

Threats to this Species or Habitat in NH

Threat rankings were calculated by groups of taxonomic or habitat experts using a multistep process (details in Chapter 4). Each threat was ranked for these factors: Spatial Extent, Severity, Immediacy, Certainty, and Reversibility (ability to address the threat). These combined scores produced one overall threat score. Only threats that received a "medium" or "high" score have accompanying text in this profile. Threats that have a low spatial extent, are unlikely to occur in the next ten years, or there is uncertainty in the data will be ranked lower due to these factors.

Mortality of host plant, eggs and larvae from trampling due to recreation. (Threat Rank: Medium)

The first winter is passed in second or third instar and the second winter as mature larvae (fifth instar) (Scott 1986) making the species vulnerable for a long time to trampling before reaching mature adult stage for breeding and reproduction.

McFarland (2003) estimated the direct impact of existing hiking trails in relevant alpine communities totaling only 3.2 ha of the estimated 80 ha potentially available. People may wander off trails in alpine meadows impacting additional habitat (Sperduto and Cogbill 1999)

NR (Threat Rank: Medium)

NR (Threat Rank: Medium)

Mortality of lupine, other plants, eggs and larvae from trampling (Threat Rank: Medium)

List of Lower Ranking Threats:

Mortality from the collection of individuals from the wild

Habitat conversion due to development

Habitat degradation from reduced habitat availability associated with climate change

Habitat conversion from changes or shifts in available habitat

Habitat impacts from roads (limited dispersal)

Disturbance from phenology shifts of host plants and species

Habitat degradation from acid deposition

Actions to benefit this Species or Habitat in NH

Monitor the health of known populations, determine if captive propagation for augmentation or translocation is required.

Objective:

General Strategy:

Develop a long-term monitoring strategy that can detect trend in species population over time.

Transect surveys can be challenging to complete, further exploration of genetic monitoring should be considered. Preliminary work resulted in a recommendation for some management action to increase population size (Gradish 2014).

Political Location: **Watershed Location:**

Create signs informing the public of state law protecting the species.

Primary Threat Addressed: Mortality from the collection of individuals from the wild

Specific Threat (IUCN Threat Levels): Biological resource use

Objective:

General Strategy:
Post signs informing the public and potential collectors of the implications for being caught collecting *Oeneis melissa semidea*. Coordinate with law enforcement to patrol the area once or twice during flight period.

Political Location: **Watershed Location:**

Work with trail managers to better mark and patrol off trail traffic to prevent impacts to the species and it's host plant.

Primary Threat Addressed: Mortality of host plant, eggs and larvae from trampling due to recreation.

Specific Threat (IUCN Threat Levels): Human intrusions & disturbance

Objective:

General Strategy:
Create and educational campaign regarding the species to better inform the public about impacts to alpine species when going off trail. Make sure existing education materials regarding alpine vegetation include Lepidoptera species also.

Political Location: **Watershed Location:**
Coos County

References, Data Sources and Authors

Data Sources
Information on *O. m. semidea* was collected from technical field reports, agency data, scientific journals and consultation with experts.
Sources of information include databases, expert review and consultation.

Data Quality
Limited to the alpine zone of the White Mountains, the abundance and distributional data of *O. m. semidea* has remained stable to known occupied sedge meadows on Mt. Jeffereson and Mt. Washington (McFarland 2003. Gradish 2014).

Abundance data are inadequate to allow rigorous population estimates.

2015 Authors:

Heidi Holman, NHFG

2005 Authors:

Literature

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Walther, G. R., Post, E., Convey, P., Menzel, A., Parmesan, C., Beebee, T. J., Fromentin, J. M., Hoegh-Guldberg, O., and F. Bairlein. 2002. Ecological responses to recent climate change. Nature 416:389-395.

Pine Barrens Lepidoptera

Pine Barrens Lepidoptera

Federal Listing	N/A
State Listing	
Global Rank	
State Rank	
Regional Status	N/A

This Profile Includes:

Barrens Itame	(*Speranza exonerate*)
Barrens xylotype	(*Xylotype capax*)
Broad-lined Catopyrrha	(*Erastria coloraria*)
Cora moth	(*Cerma cora*)
Edward's Hairstreak	(*Satyrium edwardsii*)
Graceful Clearwing	(*Hemaris gracilis*)
New Jersey tea Spanworm	(*Apodrepanulatrix liberaria*)
Noctuid Moth	(*Chaetaglaea cerata*)
Persius Duskywing Skipper	(*Erynnis persius*)
Pine pinion moth	(*Lithophane lepida lepida*)
Pinion Moth	(*Xylena thoracica*)
Phyllira tiger moth	(*Grammia phyllira*)
Sleepy duskywing	(*Erynnis brizo brizo*)
Twilight Moth	(*Lycia rachelae*)
Zale sp. 1 nr. Lunifera	

Justification (Reason for Concern in NH)

These pitch pine-scrub oak woodland specialists serve as indicators of the ecological condition of the community. As the habitat goes unmanaged and reverts to a closed canopy system, populations decline and become increasingly vulnerable to extirpation, a reflection of the loss of vital compositional and structural elements within the community.

Distribution

This group of Lepidoptera occupies pine barrens. This will include both scrub oak woodlands and mature oak-pine woodlands composed of a dense scrub oak understory and greater canopy closure. Larval host plants include tyical pine barrens plant species such as scrub oak (*Quercus ilicifolia*), various heath species (*Ericaceae sp*.), and less common plants such as *Ceanothus americanus*.

Habitat

This group of Lepidoptera occupies pine barrens, woodlands dominated by pitch pine (*Pinus rigida*) and scrub oak (*Quercus ilicifolia*) (Sperduto and Nichols 2004). Some species also occur in oak-pine woodlands composed of a dense scrub oak understory and greater canopy closure. For a detailed habitat description refer to the pine barrens habitat profile. Larval host plants include typical pine barrens plant species such as scrub oak, various heath species (*Ericaceae sp*.), and less common plants such as *Ceanothus americanus*.

NH Wildlife Action Plan Habitats

- Pine Barrens

Distribution Map

Current Species and Habitat Condition in New Hampshire

The relative health of populations for each species is not known at this time.

Population Management Status

Need to monitor population level for some species to determine if there is a need for population management such as captive rearing and augmentation.

Regulatory Protection (for explanations, see Appendix I)

#Type!

Quality of Habitat

Habitat quality is relatively stable or improving in the two key units in New Hampshire – Concord and Ossipee. Evaluate the need to introduce uncommon elements such as New Jersey tea to Ossipee pine barrens.

Habitat Protection Status

Habitat Management Status

Current habitat management and restoration techniques in Concord and Ossipee pine barrens include native plant propagation, vegetation management using specialized mowers and feller bunchers, and prescribed fire. Habitat monitoring is often completed before and after management implementation.

Threats to this Species or Habitat in NH

Threat rankings were calculated by groups of taxonomic or habitat experts using a multistep process (details in Chapter 4). Each threat was ranked for these factors: Spatial Extent, Severity, Immediacy, Certainty, and Reversibility (ability to address the threat). These combined scores produced one overall threat score. Only threats that received a "medium" or "high" score have accompanying text in this profile. Threats that have a low spatial extent, are unlikely to occur in the next ten years, or there is uncertainty in the data will be ranked lower due to these factors.

Mortality and habitat impacts from catastrophic fire (Threat Rank: Medium)

The amount of habitat available for rare pine barrens lepidoptera is limited within NH. A catastrophic fire of large extent and high intensity could result in significant losses to already small populations preventing the ability for recovery.

Appendix A: Insects

A species response to fire is dependent on five characteristics 1) ecological specialization 2) vagility (movement ability) 3) above ground life stages 4) voltinism (number of broods) and 5) response to key plant food to fire (Swengel 1996). Insects that are small in number and have a high degree of ecological specialization are extremely susceptible to extirpation from local fire (New 2014). Recent surveys for pine barrens lepidoptera in the Ossipee Pine Barrens revealed that some species showed significant differences in abundance following limited controlled burning over a short period of time (Brown 2013).

Habitat degradation and impacts from landscaping with non-pine barrens species or allowing the forest to get overgrown in adjacent developed landscapes (Threat Rank: Medium)

Private landowners within the pine barrens community may selectively manage their property removing or degrading the habitat quality, and fragmenting the landscape.

Habitat and species impacts from inappropriate management and over-use of fire (Threat Rank: Medium)

Mechanical treatments and prescribed burning conducted in high frequency during the same time period each year may result in a negative effect on pine barrens lepidopteran species.

Swengel et al. 2010 determined there were declines in tallgrass prairie specialist butterflies that were not co-evolved with implemented fire regimes in the midwest.

List of Lower Ranking Threats:

Habitat degradation and impacts from powerline maintenance with herbicide

Mortality from insecticide use (mosquito and gypsy moth treatment)

Mortality and species impacts from change in behavior due to pollution

Species impacts from competition (gypsy moth eruptions)

Habitat and species impacts from cessation of timber management where management has enhanced habitat previously

Habitat degradation and species impacts from change of structure

Species and habitat impacts from shifts and changes in species composition

Habitat and species impacts from prolonged drought or windstorm damage that results in catastrophic fire

Habitat impacts from changes in precipitation that impacts use of fire

Species impacts from changes in precipitation that impact reproduction

Species impacts from phenology shifts (pollination and food sources)

Actions to benefit this Species or Habitat in NH

Manage pitch-pine scrub oak habitat in a rotational matrix.

Primary Threat Addressed: Habitat degradation and species impacts from change of structure

Specific Threat (IUCN Threat Levels): Natural system modifications

Objective:

General Strategy:
Management creates areas of open or semi-open habitat that provide a range of light intensity and diverse vegetation native to the pines barrens that support a diversity of pine barrens lepidoptera. Habitat heterogeneity satisfies microhabitat needs and moderates the impact of large-scale environmental events. Habitat management also provides connectivity among resource-rich habitat patches, increasing dispersal rates, colonization, and overall suitable habitat area.

Political Location: **Watershed Location:**

Coordinate citizen science program for data collection.

Objective:

General Strategy:
Develop a group of trained volunteers to assist with more frequent surveys at identified locations.

Political Location: **Watershed Location:**

Continue intensive monitoring every ten years at managed sites.

Objective:

General Strategy:
Sites that are managed for pine barrens should be monitoring on a consistent interval to evaluate long term trends in species and identify any significant changes in the species composition.

Political Location: **Watershed Location:**

Review current list of SGCN species to determine other species that may need additional conservation actions.

Objective:

General Strategy:
Compile a list of all tracked species from Natural Heritage Bureau and new publications for review. Work with taxa experts at the national level to determine priority species for conservation actions in the future.

Political Location: **Watershed Location:**

Monitor the health of known populations, determine if captive propagation would be useful for some species.

Objective:

General Strategy:
Coordinate targeted surveys for specific species over numerous consecutive years to determine health of the populations. Instead of lethal black light trapping, non-lethal sheet surveys could be used to minimize the adverse effect of the study.

Political Location: **Watershed Location:**

References, Data Sources and Authors

Data Sources
Technical field reports, agency data, scientific journal articles, and element occurrence databases were used to determine habitat and distribution of pine barrens lepidoptera.
Technical field reports, agency data, scientific journal articles and element occurrence database.

Data Quality
The quality and extent of data on pine barrens Lepidoptera in New Hampshire is limited to targeted surveys conducted by a few conservation groups. Since 2005 follow up surveys have been conducted in sites that are managed to evaluate impacts. In addition, a survey was conducted in 2007 to begin looking at potential pine barrens identified in the WAP mapping for the presence of rare species. This was only conducted for one year not providing information on trend to date.

2015 Authors:
Heidi Holman, NHFG

2005 Authors:

Literature

Brown, C. 2013. An assessment of the impact of fire on rare lepidoptera in the Ossipee Pine Barrens Preserve. A report to The Nature Conservancy, 54 pp.

Helmbolt, K and Amaral, M. 1994. Status of the Karner blue butterfly in New Hampshire. Pages 123-128 in D.A. Andow, R.J. Baker, and C.P. Lane, eds. Karner blue butterfly: a

New Hampshire Fish and Game. 2011. Final Report: Habitat Management and Monitoring for Mitigation of the NH Army National Guard Army Aviation Facility on the Concord Municipal Airport. 55pp.

New, T.R. 2014. Insects, Fire and Conservation. Springer International Publishing. 208 pp.

Swengel, S.R. , D. Schlicht, F. Olsen, and A.B. Swengel. 2011. Declines of prairie butterflies in the Midwestern USA. Journal of Insect Conservation 15:327-339.

Wagner, D.L., Nelson, M.W. and Schweitzer, D.F. 2003. Shrubland Lepidoptera of southern New England and southeastern New York: ecology, conservation, and management. Forest Ecology and Management 185: 95-112.

Sedge Darner

Aeshna juncea

Federal Listing	N/A
State Listing	
Global Rank	G5
State Rank	S1
Regional Status	High

+

Photo by Pamela Hunt

Justification (Reason for Concern in NH)

Several species of Odonata are specialized on peatlands of various types, and while many are widespread in appropriate habitat in New Hampshire, a handful appear to be sufficiently rare to warrant additional considerations. In the Northeast Odonata Conservation Assessment (White et al. 2014), Sedge Darner was considered "high vulnerability" due to habitat specificity and a restricted range in the Northeast.

Distribution

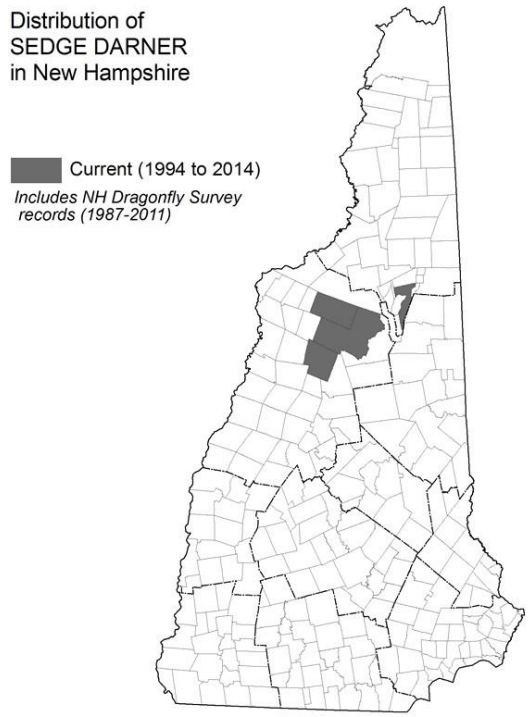
The Sedge Darner occurs across boreal regions of the northern Hemisphere, south in North America to Oregon, Colorado, Michigan, and New Hampshire. In NH it is currently known from five sites in the White Mountains: Profile Lake (Franconia), Beaver Pond (Woodstock), Lonesome Lake (Lincoln), Nancy Pond (Livermore, historical record), and Hermit Lake (Sargent's Purchase).

Habitat

Small ponds at relatively high elevation, bordered by fringing peatlands and/or graminoid fens.

NH Wildlife Action Plan Habitats

- Peatlands
- Lakes and Ponds with Coldwater Habitat
- High Elevation Spruce-Fir Forest
- Northern Hardwood-Conifer Forest



Distribution Map

Current Species and Habitat Condition in New Hampshire

Unknown

Population Management Status

Not managed

Regulatory Protection (for explanations, see Appendix I)

- Fill and Dredge in Wetlands - NHDES
- Comprehensive Shoreland Protection Act - NHDES

Quality of Habitat

Unknown

Habitat Protection Status

All known sites are on the White Mountain National Forest

Habitat Management Status

Not managed

Threats to this Species or Habitat in NH

Threat rankings were calculated by groups of taxonomic or habitat experts using a multistep process (details in Chapter 4). Each threat was ranked for these factors: Spatial Extent, Severity, Immediacy, Certainty, and Reversibility (ability to address the threat). These combined scores produced one overall threat score. Only threats that received a "medium" or "high" score have accompanying text in this profile. Threats that have a low spatial extent, are unlikely to occur in the next ten years, or there is uncertainty in the data will be ranked lower due to these factors.

There were no threats ranked high or medium for this species.

List of Lower Ranking Threats:

Habitat degradation and disturbance from acid deposition

Habitat impacts from stocking fish in formerly "fishless" ponds

Habitat conversion due to development

Actions to benefit this Species or Habitat in NH

Sedge Darner surveys

Objective:
Determine status of this species in the state

General Strategy:
Experienced observers working in suitable habitat should be aware of this species' potential occurrence and report it if found and documented.

Political Location:
Carroll County, Coos County, Grafton County

Watershed Location:

References, Data Sources and Authors

Data Sources
NH Dragonfly Survey (Hunt 2012). Hunt, unpub. Data

Data Quality

2015 Authors:
Pamela Hunt, NHA

2005 Authors:

Literature

Amico, F.D., S. Darblade, S. Avignon, S. Blanc-Manel, and S.J. Ormerod. 2004. Odonates as indicators of shallow lake restoration by liming: Comparing adult and larval responses. Restoration Ecology 12: 439-446.

Hudson, J., and M. Berrill. 1986. Tolerance of low pH exposure by the eggs of Odonata (dragonflies and damselflies). Hydrobiologia 140: 21-25.

Hunt, P.D. 2012. The New Hampshire Dragonfly Survey: A final report. Report to NH Fish and Game Department, Nongame and Endangered Species Program. New Hampshire Audubon, Concord, NH.

White, E.L., P.D. Hunt, M.D. Schessinger, J.D. Corser, and P.G. deMaynadier. 2014. A conservation status assessment of Odonata for the northeastern United States. Report to Northeastern Association of Fish and Wildlife Agencies. New York Natural Heritage Program, Albany, NY.

Pine Barrens Bluet

Enallagma recurvatum

Federal Listing	N/A
State Listing	SC
Global Rank	G3
State Rank	S1
Regional Status	High

Photo by Blair Nikula

Justification (Reason for Concern in NH)

Several species of Odonata are specialized on peatlands of various types, and while many are widespread in appropriate habitat in New Hampshire, a handful appear to be sufficiently rare to warrant additional considerations. In the Northeast Odonata Conservation Assessment (White et al. 2014), Pine Barrens Bluet was considered "high vulnerability" due to habitat specificity and a restricted range in the Northeast.

Distribution

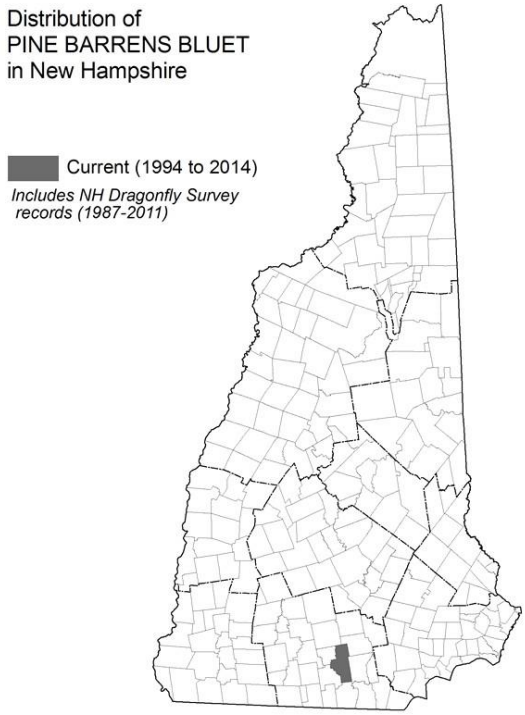
Endemic to the northeastern United States, where it is found along the coastal plain from extreme southern NH to southern New Jersey. In NH known only from a single site in Amherst.

Habitat

Generally considered a coastal plain pond species over most of its range. Such sites are characterized by sandy bottoms, low pH, and emergent shoreline vegetation, and some also have peatland elements (White et al. 2010). In NH, the species is only known from a single site, where records have all come from the herbaceous fringe of the open water pool in the center of a peatland.

NH Wildlife Action Plan Habitats

- Peatlands



Distribution Map

Current Species and Habitat Condition in New Hampshire

Unknown

Population Management Status

Not managed

Regulatory Protection (for explanations, see Appendix I)

- Fill and Dredge in Wetlands - NHDES
- Comprehensive Shoreland Protection Act - NHDES

Quality of Habitat

Unknown

Habitat Protection Status

Single known site is protected by NH Audubon

Habitat Management Status

Not managed

Threats to this Species or Habitat in NH

Threat rankings were calculated by groups of taxonomic or habitat experts using a multistep process (details in Chapter 4). Each threat was ranked for these factors: Spatial Extent, Severity, Immediacy, Certainty, and Reversibility (ability to address the threat). These combined scores produced one overall threat score. Only threats that received a "medium" or "high" score have accompanying text in this profile. Threats that have a low spatial extent, are unlikely to occur in the next ten years, or there is uncertainty in the data will be ranked lower due to these factors.

Habitat conversion due to development (Threat Rank: Medium)

Although the known site for this species is protected, other potential sites in heavily developed southeastern NH could be at risk, See the peatland profile for more detail on this threat.

List of Lower Ranking Threats:

Habitat degradation from impervious surface run-off

Habitat degradation from agricultural run-off (nutrients and sediment)

Habitat degradation from roads that alter hydrology (culverts)

Actions to benefit this Species or Habitat in NH

Pine Barrens Bluet Surveys

Objective:
Status assessment

General Strategy:
Conduct periodic surveys at known site to determine if population persists

Political Location:
Hillsborough County

Watershed Location:
Merrimack Watershed

Pine Barrens Bluet Surveys

Objective:
Determine if other sites exist for this species in the state

General Strategy:
Experienced observers working in suitable habitat should be aware of this species' potential occurrence and report it if found and documented.

Political Location:
Hillsborough County, Rockingham County

Watershed Location:
Merrimack Watershed, Coastal Watershed

References, Data Sources and Authors

Data Sources
NH Dragonfly Survey (Hunt 2012)

Data Quality
This species is sparsely distributed and occurs at low densities. Although at the northern edge of its range, it likely occurs elsewhere in NH but has not been documented. Identification is complicated by its extreme similarity to several more common species in the genus *Enallagma*.

2015 Authors:
Pamela Hunt, NHA

2005 Authors:

Literature

Hunt, P.D. 2012. The New Hampshire Dragonfly Survey: A final report. Report to NH Fish and Game Department, Nongame and Endangered Species Program. New Hampshire Audubon, Concord, NH.

White, E., J.D. Corser, and M.D. Schessinger. 2010. The New York dragonfly and damselfly survey: Distribution and status of the odonates of New York. New York Natural Heritage Program, Albany.

White, E.L., P.D. Hunt, M.D. Schessinger, J.D. Corser, and P.G. deMaynadier. 2014. A conservation status assessment of Odonata for the northeastern United States. Report to Northeastern Association of Fish and Wildlife Agencies. New York Natural Heritage Program, Albany, NY.

Rapids Clubtail

Gomphus quadricolor

Federal Listing	N/A
State Listing	SC
Global Rank	G3
State Rank	S1
Regional Status	

Photo by Pamela Hunt

Justification (Reason for Concern in NH)

This is among the rarest of the river clubtails in NH, and as such was considered Special Concern in 2008. Recent surveys suggest that it may be more widespread than previously believed. Because of a small population size and apparent extirpation from two historic sites, the species was listed as Endangered in Canada in 2008 (COSEWIC 2008).

Distribution

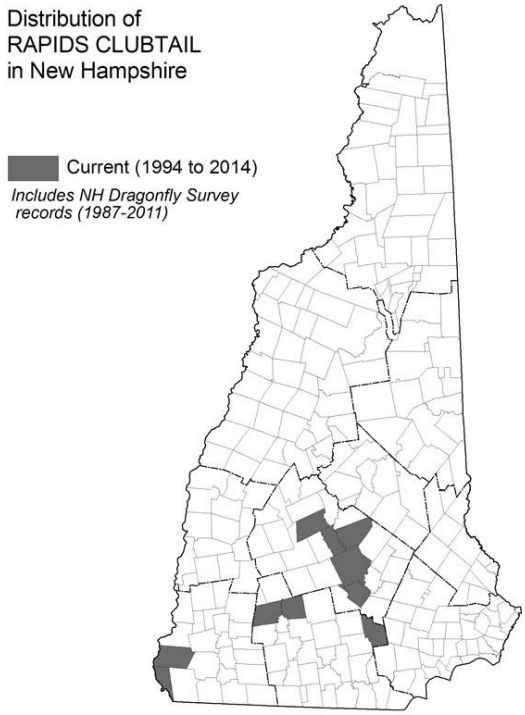
The Rapids Clubtail occurs throughout the eastern part of the U.S. In New Hampshire it occurs in low numbers in the Merrimack River and at least three of its tributaries (Souhegan, Contoocook, and Blackwater) and the southernmost portion of the Connecticut (Hinsdale and Chesterfield).

Habitat

Moderate to large rivers with muddy to silty bottoms, sometimes but not always with interspersed riffles. Adults rest and forage in adjacent forested habitats.

NH Wildlife Action Plan Habitats

- Large Warmwater Rivers
- Warmwater Rivers and Streams
- Appalachian Oak Pine Forest
- Floodplain Habitats
- Hemlock Hardwood Pine Forest
- Northern Hardwood-Conifer Forest



Distribution Map

Current Species and Habitat Condition in New Hampshire

Unknown, but appears more common than previously believed in New Hampshire.

Population Management Status

Not managed

Regulatory Protection (for explanations, see Appendix I)

- Fill and Dredge in Wetlands - NHDES
- Comprehensive Shoreland Protection Act - NHDES

Quality of Habitat

Unknown

Habitat Protection Status

Unknown

Habitat Management Status

Habitat management has not been implemented for this species

Threats to this Species or Habitat in NH

Threat rankings were calculated by groups of taxonomic or habitat experts using a multistep process (details in Chapter 4). Each threat was ranked for these factors: Spatial Extent, Severity, Immediacy, Certainty, and Reversibility (ability to address the threat). These combined scores produced one overall threat score. Only threats that received a "medium" or "high" score have accompanying text in this profile. Threats that have a low spatial extent, are unlikely to occur in the next ten years, or there is uncertainty in the data will be ranked lower due to these factors.

Habitat degradation due to bank stabilization that limits emergence habitat (Threat Rank: Medium)

When emerging, gomphid larvae climb onto exposed banks, where they travel a variable distance prior to eclosure (McLain et al. 2006). Distance traveled may vary by species and substrates, with some evidence that larvae travel shorter distances on artificial (e.g., stabilized) banks. Eclosing adults closer to the water are more susceptible to mortality from upstream water releases and wash-over from watercraft wakes (Wagner and Thomas 1996).

Habitat degradation and mortality from water releases (Threat Rank: Medium)

When emerging, gomphid larvae climb onto exposed banks, where they travel a variable distance prior to eclosure (McLain et al. 2006). Distance traveled may vary by species and substrates, with some evidence that larvae travel shorter distances on artificial (e.g., stabilized) banks. Eclosing adults closer to the water are more susceptible to mortality from upstream water releases. Extreme discharge events also have the potential to move river sediments around and disturb larval habitat.

List of Lower Ranking Threats:

Habitat degradation and species impacts from sedimentation (various sources including roads and agriculture)

Mortality of emerging adults from watercraft causing wakes

Habitat degradation from the loss of adjacent forested habitat

Actions to benefit this Species or Habitat in NH

Rapids Clubtail surveys

Objective:
Maintain current information on the distribution and abundance of this species in NH

General Strategy:
Experienced observers working in suitable habitat should be aware of this species' potential occurrence and report it if found and documented.

Political Location:
Cheshire County, Hillsborough County, Merrimack County

Watershed Location:

References, Data Sources and Authors

Data Sources
NH Dragonfly Survey (Hunt 2012)

Data Quality
River-dwelling clubtails can be difficult to detect as adults, and most information on distribution has come from exuviae (shed skins left behind when adults emerge). NH data on distribution is likely fairly accurate as a result, but there are still areas where exuviae searches were not untaken - and where this species may occur.

2015 Authors:
Pamela Hunt, NHA

2005 Authors:

Literature

COSEWIC. 2008. COSEWIC assessment and status report on the Rapids Clubtail *Gomphus quadricolor* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. (www.sararegistry.gc.ca/status/status_e.cfm).

Hunt, P.D. 2012. The New Hampshire Dragonfly Survey: A final report. Report to NH Fish and Game Department, Nongame and Endangered Species Program. New Hampshire Audubon, Concord, NH.

McLain, D., F. Morrison, and L. Sanders. 2006. Bank stabilization and dragonfly emergence, population dynamics, and larval ecology in the Turners Falls pool of the Connecticut River: 2005 field season. Report to Northeast Generation Services, Massachusetts Environmental Trust Fund, and Franklin Land Trust. A Natural Focus, Westhampton, MA.

Wagner, D., and M. Thomas. 1996. Big days on the big river. Ode News 3: 6-8.

White, E.L., P.D. Hunt, M.D. Schessinger, J.D. Corser, and P.G. deMaynadier. 2014. A conservation status assessment of Odonata for the northeastern United States. Report to Northeastern Association of Fish and Wildlife Agencies. New York Natural Heritage Program, Albany, NY.

Skillet Clubtail

Gomphus ventricosus

Federal Listing	N/A
State Listing	SC
Global Rank	G3
State Rank	S1
Regional Status	
Moderate	

Photo by Scott Young

Justification (Reason for Concern in NH)

Several species of Odonata are specialized on large or medium sized rivers, and while many are widespread in appropriate habitat in New Hampshire, a handful appear to be sufficiently rare to warrant additional considerations. In the Northeast Odonata Conservation Assessment (White et al. 2014), Skillet Clubtail was considered "moderate vulnerability" due to habitat specificity, but it is retained as a New Hampshire SGCN due to restricted range and low population density.

Distribution

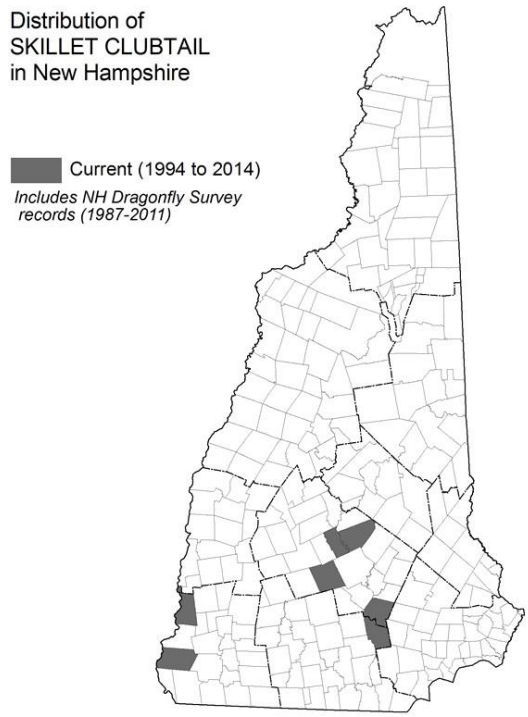
The Skillet Clubtail occurs from Minnesota and Missouri east to Nova Scotia and North Carolina. It is sparsely distributed across this range, with concentrations in the Midwest and along the lower Connecticut River. In New Hampshire most records come from the Merrimack River between Canterbury and Manchester, with an additional record from the Contoocook River in Hopkinton (Hunt 2012). On the Connecticut, there is a single historical record (1939) from Hinsdale, and unverified records from Chesterfield and Walpole. It was not detected in any of these locations despite extensive surveys in 2006 (Hunt 2006) and in 2007-2011 (Hunt 2012), although it remains more common farther south in Massachusetts and Connecticut (Hunt et al. 2010).

Habitat

Large, slow-moving rivers with mud or silt bottoms. Forested shoreline habitat is probably important for emerging adults.

NH Wildlife Action Plan Habitats

- Large Warmwater Rivers
- Warmwater Rivers and Streams
- Appalachian Oak Pine Forest
- Floodplain Habitats
- Hemlock Hardwood Pine Forest



Distribution Map

Current Species and Habitat Condition in New Hampshire

Unknown

Population Management Status

Not managed

Regulatory Protection (for explanations, see Appendix I)

- Fill and Dredge in Wetlands - NHDES
- Comprehensive Shoreland Protection Act - NHDES

Quality of Habitat

Unknown

Habitat Protection Status

Unknown

Habitat Management Status

Habitat management has not been implemented for this species

Threats to this Species or Habitat in NH

Threat rankings were calculated by groups of taxonomic or habitat experts using a multistep process (details in Chapter 4). Each threat was ranked for these factors: Spatial Extent, Severity, Immediacy, Certainty, and Reversibility (ability to address the threat). These combined scores produced one overall threat score. Only threats that received a "medium" or "high" score have accompanying text in this profile. Threats that have a low spatial extent, are unlikely to occur in the next ten years, or there is uncertainty in the data will be ranked lower due to these factors.

Habitat degradation due to bank stabilization that limits emergence habitat (Threat Rank: Medium)

When emerging, gomphid larvae climb onto exposed banks, where they travel a variable distance prior to eclosure (McLain et al. 2006). Distance traveled may vary by species and substrates, with some evidence that larvae travel shorter distances on artificial (e.g., stabilized) banks. Eclosing adults closer to the water are more susceptible to mortality from upstream water releases and wash-over from watercraft wakes (Wagner and Thomas 1996).

Habitat degradation and mortality from water releases (Threat Rank: Medium)

When emerging, gomphid larvae climb onto exposed banks, where they travel a variable distance prior to eclosure (McLain et al. 2006). Distance traveled may vary by species and substrates, with some evidence that larvae travel shorter distances on artificial (e.g., stabilized) banks. Eclosing adults closer to the water are more susceptible to mortality from upstream water releases. Extreme discharge events also have the potential to move river sediments around and disturb larval habitat.

List of Lower Ranking Threats:

Habitat degradation and species impacts from sedimentation (various sources including roads and agriculture)

Mortality of emerging adults from watercraft causing wakes

Habitat degradation from the loss of adjacent forested habitat

Actions to benefit this Species or Habitat in NH

Skillet Clubtail surveys

Objective: Maintain current information on the distribution and abundance of this species in NH

General Strategy:

Experienced observers working in suitable habitat should be aware of this species' potential occurrence and report it if found and documented.

Political Location:
Cheshire County, Hillsborough County, Merrimack County

Watershed Location:

References, Data Sources and Authors

Data Sources
NH Dragonfly Survey (Hunt 2012); Hunt unpublished data
Hunt et al. 2010; Hunt 2012; Hunt, unpublished data

Data Quality
This species is sparsely distributed and occurs at low densities. Adults fly far over large rivers or roost in tree canopies and are thus rarely detected. Most New Hampshire records are of exuviae (the shed larval skins left behind after emergence), which can be hard to distinguish from those of similar and more common species. As a result, the species is likely underreported, although it is still considerably less common than most other clubtails in its habitat.

2015 Authors:
Pamela Hunt, NHA

2005 Authors:

Literature

Hunt, P.D. 2006. Odonata of the Connecticut River mainstem. Report to Connecticut River Joint Commissions. New England Institute for Landscape Ecology, Canaan, NH.

Hunt, P.D. 2012. The New Hampshire Dragonfly Survey: A final report. Report to NH Fish and Game Department, Nongame and Endangered Species Program. New Hampshire Audubon, Concord, NH.

Hunt, P.D., M. Blust, and F. Morrison. 2010. Lotic Odonata of the Connecticut River in New Hampshire and Vermont. Northeastern Naturalist 17: 175-188.

McLain, D., F. Morrison, and L. Sanders. 2006. Bank stabilization and dragonfly emergence, population dynamics, and larval ecology in the Turners Falls pool of the Connecticut River: 2005 field season. Report to Northeast Generation Services, Massachusetts Environmental Trust Fund, and Franklin Land Trust. A Natural Focus, Westhampton, MA.

Wagner, D., and M. Thomas. 1996. Big days on the big river. Ode News 3: 6-8.

White, E.L., P.D. Hunt, M.D. Schessinger, J.D. Corser, and P.G. deMaynadier. 2014. A conservation status assessment of Odonata for the northeastern United States. Report to Northeastern Association of Fish and Wildlife Agencies. New York Natural Heritage Program, Albany, NY.

Lyre-tipped Spreadwing

Lestes unguiculatus

Federal Listing	N/A
State Listing	
Global Rank	G5
State Rank	S1
Regional Status	Moderate

Photo by Cliff Bernstein

Justification (Reason for Concern in NH)

The Northeastern Odonata Conservation Assessment (White et al 2014), considered Lyre-tipped Spreadwing a species of "moderate" vulnerability. An important factor in this ranking was a region-wide decrease in range occupancy, in which metric the species fell in the bottom 10% of 228 species. It was also relatively low with respect to habitat diversity and habitat vulnerability. Recent data from the Northeast suggest widespread absence from formerly-occupied areas (White et al. 2010, Hunt 2012) or overall rarity (Brunelle and DeMaynadier 2005).

Distribution

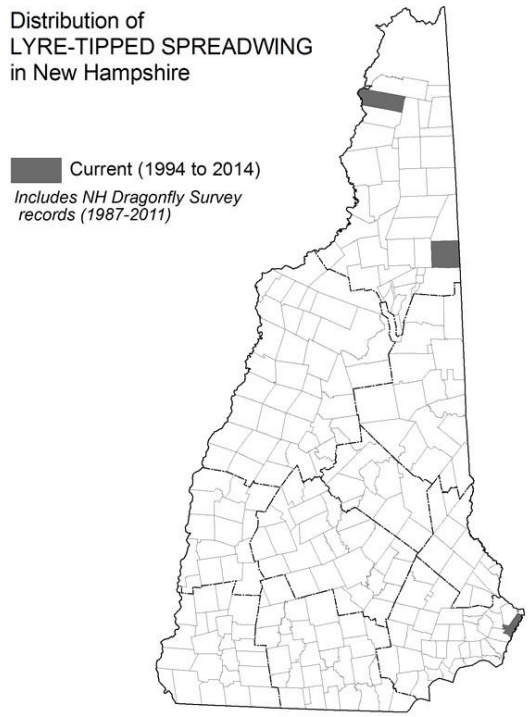
Widespread across the northern and central United State and southern Canada. In general it is a northern and western species, with the northeast at the periphery of a much larger continental range. Suitable habitat is presumably widespread in New Hampshire, but the species has been recorded in only ten towns through 2014. These are clustered in two areas: northern NH and near the seacoast, perhaps reflecting an observer bias. Despite extensive field work, it was only documented from two sites during the NH Dragonfly Survey in 2007-2011: Stewartstown and Rye.

Habitat

Appears to use a variety of small and/or temporary wetlands, with recent New Hampshire sites including a gravel pit pond, shrubby roadside pond, and wetlands within a northern white cedar swamp.

NH Wildlife Action Plan Habitats

- Marsh and Shrub Wetlands
- Vernal Pools
- Northern Swamps



Distribution Map

Current Species and Habitat Condition in New Hampshire

Unknown, but may be less common in NH than historically

Population Management Status

Not managed

Regulatory Protection (for explanations, see Appendix I)

- Fill and Dredge in Wetlands - NHDES
- Comprehensive Shoreland Protection Act - NHDES

Quality of Habitat

No information

Habitat Protection Status

Limited information, although two of the recent sites are in protected areas.

Habitat Management Status

Habitat is not currently managed for this species.

Threats to this Species or Habitat in NH

Threat rankings were calculated by groups of taxonomic or habitat experts using a multistep process (details in Chapter 4). Each threat was ranked for these factors: Spatial Extent, Severity, Immediacy, Certainty, and Reversibility (ability to address the threat). These combined scores produced one overall threat score. Only threats that received a "medium" or "high" score have accompanying text in this profile. Threats that have a low spatial extent, are unlikely to occur in the next ten years, or there is uncertainty in the data will be ranked lower due to these factors.

Habitat conversion from the direct filling of wetlands for development (Threat Rank: Medium)

Although most habitat for this species is not at high risk for development, the potential exists in parts of its NH range. See the vernal pool and marsh/shrub wetlands habitat profiles for more detail.

List of Lower Ranking Threats:

Mortality and species impacts from insecticide use (mosquito treatment)

Habitat degradation from fertilizer use

Mortality and disturbance from extreme drought and pond drying that impacts reproduction

Habitat conversion and impacts from the development of uplands surrounding breeding sites

Actions to benefit this Species or Habitat in NH

Lyre-tipped Spreadwing Surveys

Objective:
Determine species status in the state

General Strategy:
Experienced observers working in suitable habitat should be aware of this species' potential occurrence and report it if found and documented.

Political Location:
Statewide

Watershed Location:

References, Data Sources and Authors

Data Sources
NH Dragonfly Survey (Hunt 2012); Hunt unpublished data

Data Quality
This species is sparsely distributed and occurs at low densities. This, in combination with its similar to more common species in the genus *Lestes*, makes it likely that the Lyre-tipped Spreadwing is more common than generally believed. Even so, it is clearly rare given the lack of records during extensive survey effort in 2007-2011.

Appendix A: Insects

2015 Authors:
Pamela Hunt, NHA

2005 Authors:

Literature

Brunelle, P.-M., and P.G. deMaynadier. 2010. The Maine damselfly and dragonfly survey: A final report. Report to Maine Department of Inland Fisheries and Wildlife, Bangor, ME. New York Natural Heritage Program, Albany.

Hunt, P.D. 2012. The New Hampshire Dragonfly Survey: A final report. Report to NH Fish and Game Department, Nongame and Endangered Species Program. New Hampshire Audubon, Concord, NH.

White, E., J. D. Corser, and M. D. Schlesinger. 2010. The New York dragonfly and damselfly survey: Distribution and status of the odonates of New York. New York Natural Heritage Program, Albany, NY.

White, E.L., P.D. Hunt, M.D. Schessinger, J.D. Corser, and P.G. deMaynadier. 2014. A conservation status assessment of Odonata for the northeastern United States. Report to Northeastern Association of Fish and Wildlife Agencies. New York Natural Heritage Program, Albany, NY.

Ringed Emerald

Somatochlora albicincta

Federal Listing	N/A
State Listing	
Global Rank	G5
State Rank	S2
Regional Status	
Moderate	

Photo by Pamela Hunt

Justification (Reason for Concern in NH)

In New Hampshire, the Ringed Emerald occurs only at small coldwater ponds above 1500'. Although this distribution remains stable, it is at the extreme southern of the species range in the Northeast, and may be vulnerable to both climate change and non-native species. Considered "moderate" vulnerability in White et al. 2013.

Distribution

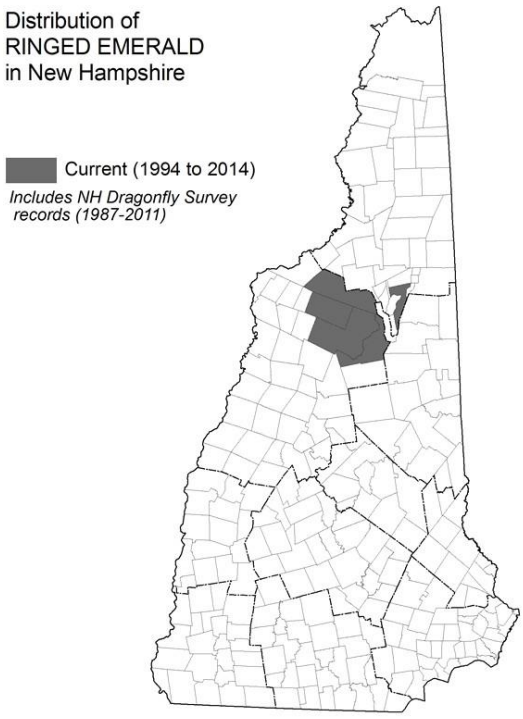
Found across the boreal regions of North America from Alaska to Newfoundland, and south in western mountains to northern California and western Montana. In the northeastern U.S. known from a single (historical) site in NY, a handful of sites in northern Vermont and northwest Maine, and 10-12 sites in the White Mountains of NH.

Habitat

All NH sites are small high-elevation ponds ranging from 1750' to 5000', with an average of 3000'. All ponds are located in rock basins and are surrounded by high elevation coniferous forest or alpine tundra, depending on elevation. Ponds may have a limited peat margin, but this is not usually a significant component of this species' habitat.

NH Wildlife Action Plan Habitats

- Lakes and Ponds with Coldwater Habitat
- High Elevation Spruce-Fir Forest
- Alpine
- Northern Hardwood-Conifer Forest



Distribution Map

Current Species and Habitat Condition in New Hampshire

Population sizes for Ringed Emerald among known sites are highly variable, although the species can be abundant at higher elevations (e.g., Presidential Range). There is limited information on changes in abundance and/or distribution in NH or for most of its larger range. As in NH, it appears relatively widespread and secure in the highlands of northern and western Maine (Brunelle and DeMaynadier 2005). Surveys in NY failed to locate the species 2005-2009 (White et al. 2010), although coverage was limited at the known historic site in the Adirondacks.

Population Management Status

Not managed

Regulatory Protection (for explanations, see Appendix I)

- Fill and Dredge in Wetlands - NHDES
- Comprehensive Shoreland Protection Act - NHDES

Quality of Habitat

Unknown

Habitat Protection Status

Most of the NH sites where the species occurs are within the White Mountain National Forest.

Habitat Management Status

Habitat management has not been implemented for this species.

Threats to this Species or Habitat in NH

Threat rankings were calculated by groups of taxonomic or habitat experts using a multistep process (details in Chapter 4). Each threat was ranked for these factors: Spatial Extent, Severity, Immediacy, Certainty, and Reversibility (ability to address the threat). These combined scores produced one overall threat score. Only threats that received a "medium" or "high" score have accompanying text in this profile. Threats that have a low spatial extent, are unlikely to occur in the next ten years, or there is uncertainty in the data will be ranked lower due to these factors.

There were no threats ranked high or medium for this species.

List of Lower Ranking Threats:

Habitat degradation and disturbance from acid deposition

Habitat impacts from stocking fish in formerly "fishless" ponds

Habitat impacts from invasive or introduced species

Species disturbance from thermal stress

Actions to benefit this Species or Habitat in NH

Ringed Emerald Surveys

Objective:
Maintain up-to-date information on the distribution and abundance of this species in NH

General Strategy:
Experienced observers should be aware of the possibility of this species when in appropriate habitat, and report it if detected.

Political Location:
Carroll County, Coos County, Grafton County

Watershed Location:

Ringed Emerald threat research

Objective:
Research on specific habitat needs and response to introduced predators or competitors would provide better information with which to assess those threats. Sensitivity to climate change (primarily warming temperatures) may also be of value.

General Strategy:

Political Location:

Watershed Location:

References, Data Sources and Authors

Data Sources

NH Dragonfly Survey (Hunt 2012); Hunt unpublished data

Data Quality

Because the habitats preferred by this species are often difficult to access, it is not frequently reported except by people actually looking for it. And even at such sites, its behavior makes it difficult to capture. The more common and very similar *S. cingulata* occurs in the same habitat, and may be mistaken for this species at a distance. As a result, the Ringed Emerald is probably more widely distributed than current data indicate.

2015 Authors:

Pamela Hunt, NHA

2005 Authors:

Literature

Amico, F.D., S. Darblade, S. Avignon, S. Blanc-Manel, and S.J. Ormerod. 2004. Odonates as indicators of shallow lake restoration by liming: Comparing adult and larval responses. Restoration Ecology 12: 439-446.

Brunelle, P.-M., and P.G. deMaynadier. 2005. The Maine damselfly and dragonfly survey: A final report. Report to Maine Department of Inland Fisheries and Wildlife, Bangor, ME.

Flenner, I., and G. Sahlén. 2008. Dragonfly community reorganization in boreal forest lakes: rapid species turnover driven by climate change? Insect Conservation and Diversity 1: 169–179.

Hassall, C. and D.J. Thompson. 2008. The effects of environmental warming on Odonata: a review. International Journal of Odonatology 11: 131-153.

Hudson, J., and M. Berrill. 1986. Tolerance of low pH exposure by the eggs of Odonata (dragonflies and damselflies). Hydrobiologia 140: 21-25.

Hunt, P.D. 2012. The New Hampshire Dragonfly Survey: A final report. Report to NH Fish and Game Department, Nongame and Endangered Species Program. New Hampshire Audubon, Concord, NH.

Oertli, B., N. Indermuehle, S. Angélibert, H. Hinden, and A. Stoll. 2008. Macroinvertebrate assemblages in 25 high alpine ponds of the Swiss National Park (Cirque of Macun) and relation to environmental variables. Hydrobiologia 597:29–41.

White, E., J. D. Corser, and M. D. Schlesinger. 2010. The New York dragonfly and damselfly survey: Distribution and status of the odonates of New York. New York Natural Heritage Program, Albany, NY.

White, E.L., P.D. Hunt, M.D. Schessinger, J.D. Corser, and P.G. deMaynadier. 2014. A conservation status assessment of Odonata for the northeastern United States. Report to Northeastern Association of Fish and Wildlife Agencies. New York Natural Heritage Program, Albany, NY.

Coppery Emerald

Somatochlora georgiana

Federal Listing	N/A
State Listing	SC
Global Rank	G3G4
State Rank	S1
Regional Status	High

Photo by Pamela Hunt

Justification (Reason for Concern in NH)

Several species of Odonata are specialized on peatlands of various types, and while many are widespread in appropriate habitat in New Hampshire, a handful appear to be sufficiently rare to warrant additional considerations. The Coppery Emerald was identified as "high vulnerability" in the Northeast Odonata Conservation Assessment (White et al. 2014) due to a combination on restricted/dispersed range and high habitat specificity.

Distribution

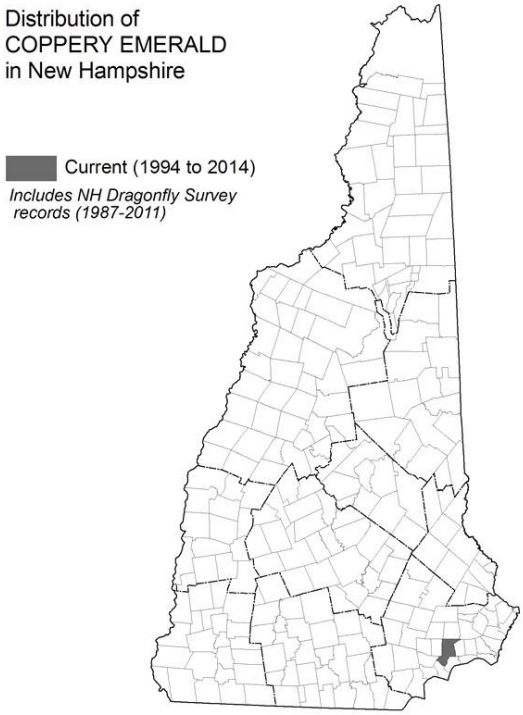
Found along coastal plain from LA to NH, although populations in RI, MA, and NH are disjunct from the next most northerly sites in NJ. In NH this species is known only from a single site in Kingston.

Habitat

Generally occurs in forested peatlands or forest streams. In NH, known only from adults captured over fields near an Atlantic White Cedar swamp, which is the presumed breeding site.

NH Wildlife Action Plan Habitats

- Temperate Swamps
- Appalachian Oak Pine Forest



Distribution Map

Current Species and Habitat Condition in New Hampshire

Unknown

Population Management Status

Not managed

Regulatory Protection (for explanations, see Appendix I)

- Fill and Dredge in Wetlands - NHDES
- Comprehensive Shoreland Protection Act - NHDES

Quality of Habitat

Unknown

Habitat Protection Status

Known site is currently protected

Habitat Management Status

Habitat management has not been implemented for this species

Threats to this Species or Habitat in NH

Threat rankings were calculated by groups of taxonomic or habitat experts using a multistep process (details in Chapter 4). Each threat was ranked for these factors: Spatial Extent, Severity, Immediacy, Certainty, and Reversibility (ability to address the threat). These combined scores produced one overall threat score. Only threats that received a "medium" or "high" score have accompanying text in this profile. Threats that have a low spatial extent, are unlikely to occur in the next ten years, or there is uncertainty in the data will be ranked lower due to these factors.

Habitat conversion due to development (Threat Rank: Medium)

Development may involve filling of wetlands to a variable degree, which reduces or degrades habitat for this species.

Although the known site for this species is protected, other potential sites in heavily developed southeastern NH could be at risk, See the Temperate Swamp profile for more detail.

List of Lower Ranking Threats:

Habitat degradation from impervious surface run-off

Habitat degradation from agricultural run-off (nutrients and sediment)

Habitat degradation from the loss of adult upland forest habitat

Habitat degradation from roads that alter hydrology (culverts)

Mortality from extreme drought and reduced productivity; increased decomposition of peat

Actions to benefit this Species or Habitat in NH

Determine breeding site for NH population

Specific Threat (IUCN Threat Levels): None

Specific Action: Research, survey or monitoring - fish and wildlife populations

Objective:
Confirm breeding site for this species in NH

General Strategy:
Search suitable microhabitats in the vicinity of all adult records for signs of mating, oviposition, larvae, or exuviae.

Political Location:
Hillsborough County

Watershed Location:
Merrimack Watershed

Coppery Emerald surveys

Specific Threat (IUCN Threat Levels): None

Objective:
Maintain an up-to-date database on this species' distribution in NH

General Strategy:
Experienced observers working in suitable habitat should be aware of this species' potential occurrence and report it if found and documented.

Political Location: **Watershed Location:**

References, Data Sources and Authors

Data Sources
NH Dragonfly Survey (Hunt 2012). No information on condition

Data Quality
Data on actual breeding site is still not available. This species, like many in its genus, generally occurs at low densities and can be hard to capture. As a result, there is a good possibility that it occurs elsewhere in southeast NH but has not been detected.
no data

2015 Authors:
Pamela Hunt, NHA

2005 Authors:

Literature

Hunt, P.D. 2012. The New Hampshire Dragonfly Survey: A final report. Report to NH Fish and Game Department, Nongame and Endangered Species Program. New Hampshire Audubon, Concord, NH.

White, E.L., P.D. Hunt, M.D. Schessinger, J.D. Corser, and P.G. deMaynadier. 2014. A conservation status assessment of Odonata for the northeastern United States. Report to Northeastern Association of Fish and Wildlife Agencies. New York Natural Heritage Program, Albany, NY.

Kennedy's Emerald

Somatochlora kennedyi

Federal Listing	N/A
State Listing	
Global Rank	G5
State Rank	S2
Regional Status	Moderate

Photo by Kete Redmond

Justification (Reason for Concern in NH)

Several species of Odonata are specialized on peatlands of various types, and while many are widespread in appropriate habitat in New Hampshire, a handful appear to be sufficiently rare to warrant additional considerations. In the Northeast Odonata Conservation Assessment (White et al. 2014), Kennedy's Emerald was considered "moderate vulnerability," which would not justify its inclusion as a NH SGCN. However, extensive surveying of potential habitat during the NH Dragonfly Survey (Hunt 2012) failed to detect this species, and the most recent record is from 2006. It also went undetected during the NY Dragonfly and Damselfly Survey (White et al. 2010). This lack of recent records on statewide survey projects suggests the possibility of a population decline or range retraction.

Distribution

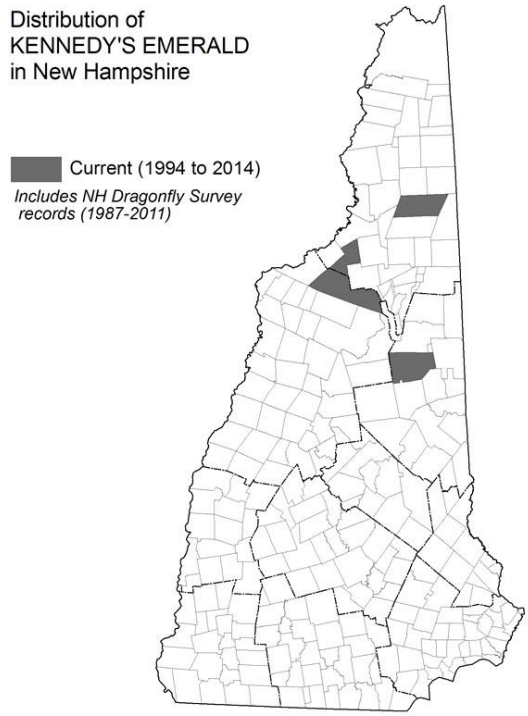
Bulk of distribution from southern Manitoba and Minnesota east to Massachusetts and Nova Scotia. Disjunct records from western Canada suggest that it may occur throughout the boreal region of North America. Records from NH are scattered across the state, although there are no records from the southwest.

Habitat

Generally occurs in a variety of bogs, fens and swamps, often with flowing water, and adults forage over adjacent uplands.

NH Wildlife Action Plan Habitats

- Peatlands
- Marsh and Shrub Wetlands
- Northern Swamps
- Temperate Swamps



Distribution Map

Current Species and Habitat Condition in New Hampshire

Unknown, but lack of recent records suggests that the population in NH may be in decline.

Population Management Status

Not managed

Regulatory Protection (for explanations, see Appendix I)

- Fill and Dredge in Wetlands - NHDES
- Comprehensive Shoreland Protection Act - NHDES

Quality of Habitat

Unknown, and much of the older data lacks detail on specific locations that would allow for habitat assessment

Habitat Protection Status

Some recent sites are in protected areas (WMNF, Pondicherry), but generally protection status is variable. Lack of data on most historic sites precludes determination of protection status.

Habitat Management Status

Habitat management has not been implemented for this species

Threats to this Species or Habitat in NH

Threat rankings were calculated by groups of taxonomic or habitat experts using a multistep process (details in Chapter 4). Each threat was ranked for these factors: Spatial Extent, Severity, Immediacy, Certainty, and Reversibility (ability to address the threat). These combined scores produced one overall threat score. Only threats that received a "medium" or "high" score have accompanying text in this profile. Threats that have a low spatial extent, are unlikely to occur in the next ten years, or there is uncertainty in the data will be ranked lower due to these factors.

Habitat conversion due to development (Threat Rank: Medium)

Development may involve filling of wetlands to a variable degree, which reduces or degrades habitat for this species.

Although most habitat for this species is not at high risk for development, the potential exists in parts of its NH range. See the corresponding habitat profiles for more detail.

List of Lower Ranking Threats:

Habitat degradation from impervious surface run-off

Habitat degradation from agricultural run-off (nutrients and sediment)

Habitat degradation from the loss of adult upland forest habitat

Habitat degradation from roads that alter hydrology (culverts)

Mortality from extreme drought and reduced productivity; increased decomposition of peat

Actions to benefit this Species or Habitat in NH

Kennedy's Emerald surveys

Objective:
Maintain up-to-date information on the distribution and abundance of this species in the state

General Strategy:
Experienced observers working in suitable habitat should be aware of this species' potential occurrence and report it if found and documented.

Political Location: **Watershed Location:**

References, Data Sources and Authors

Data Sources
NH Dragonfly Survey (Hunt 2012). Limited to no data on condition other than distributional trend (Hunt 2012).

Data Quality
Species in this genus often occur in low densities and can be hard to find, capture, and even identify. As a result, their distributions are generally considered larger than the number of known sites would indicate. However, given the level of survey effort that went into the NH Dragonfly Survey, and the number of detections for other secretive/cryptic species, it is reasonable to conclude that Kennedy's Emerald is indeed quite rare and local in NH.

Appendix A: Insects

2015 Authors:
Pamela Hunt, NHA

2005 Authors:

Literature

Hunt, P.D. 2012. The New Hampshire Dragonfly Survey: A final report. Report to NH Fish and Game Department, Nongame and Endangered Species Program. New Hampshire Audubon, Concord, NH.

White, E., J.D. Corser, and M.D. Schessinger. 2010. The New York dragonfly and damselfly survey: Distribution and status of the odonates of New York. New York Natural Heritage Program, Albany.

White, E.L., P.D. Hunt, M.D. Schessinger, J.D. Corser, and P.G. deMaynadier. 2014. A conservation status assessment of Odonata for the northeastern United States. Report to Northeastern Association of Fish and Wildlife Agencies. New York Natural Heritage Program, Albany, NY.

Ocellated Emerald

Somatochlora minor

Federal Listing	N/A
State Listing	
Global Rank	G5
State Rank	S1
Regional Status	High

Photo by Pamela Hunt

Justification (Reason for Concern in NH)

Several species of Odonata are specialized on peatlands of various types, and while many are widespread in appropriate habitat in New Hampshire, a handful appear to be sufficiently rare to warrant additional considerations. In the Northeast Odonata Conservation Assessment (White et al. 2014), Ocellated Emerald was considered "high vulnerability" due to habitat specificity and a restricted range in the Northeast.

Distribution

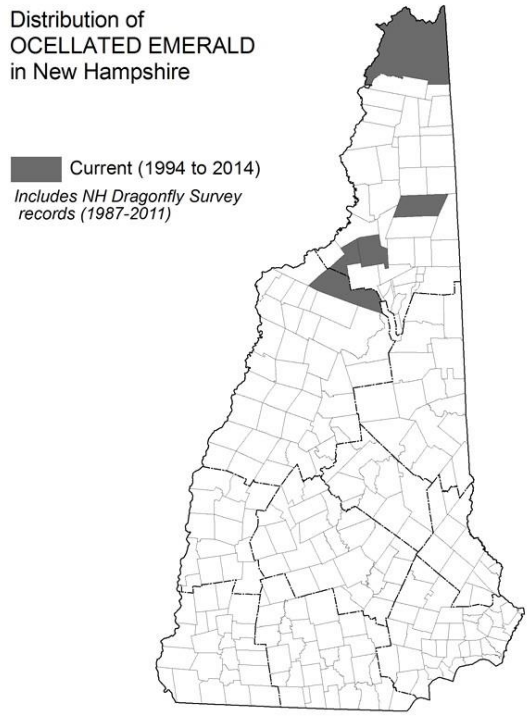
Occurs across Canada from southern Yukon to Newfoundland, and south to the northern U.S. from Oregon to Massachusetts (where rare). In NH it is known from the White Mountains and Coos County.

Habitat

Generally occurs in forested peatlands or forest streams, and adults forage over adjacent uplands.

NH Wildlife Action Plan Habitats

- Peatlands
- Northern Swamps
- Lowland Spruce-Fir Forest



Distribution Map

Current Species and Habitat Condition in New Hampshire

Unknown

Population Management Status

Not managed

Regulatory Protection (for explanations, see Appendix I)

- Fill and Dredge in Wetlands - NHDES
- Comprehensive Shoreland Protection Act - NHDES

Quality of Habitat

Unknown

Habitat Protection Status

Highly variable, although much suitable habitat is protected in the White Mountain National Forest or by other conservation entities in Coos County (e.g., Pondicherry, Connecticut Headwaters).

Habitat Management Status

Habitat management has not been implemented for this species

Threats to this Species or Habitat in NH

Threat rankings were calculated by groups of taxonomic or habitat experts using a multistep process (details in Chapter 4). Each threat was ranked for these factors: Spatial Extent, Severity, Immediacy, Certainty, and Reversibility (ability to address the threat). These combined scores produced one overall threat score. Only threats that received a "medium" or "high" score have accompanying text in this profile. Threats that have a low spatial extent, are unlikely to occur in the next ten years, or there is uncertainty in the data will be ranked lower due to these factors.

Habitat conversion due to development (Threat Rank: Medium)

Development may involve filling of wetlands to a variable degree, which reduces or degrades habitat for this species.

Although most habitat for this species is not at high risk for development, the potential exists in parts of its NH range. See the corresponding habitat profiles for more detail.

List of Lower Ranking Threats:

Habitat degradation from the loss of adult upland forest habitat

Habitat degradation from roads that alter hydrology (culverts)

Mortality from extreme drought and reduced productivity; increased decomposition of peat

Actions to benefit this Species or Habitat in NH

Ocellated Emerald Surveys

Objective:
Maintain up-to-date information on this species' distribution and abundance in NH

General Strategy:
Experienced observers working in suitable habitat should be aware of this species' potential occurrence and report it if found and documented.

Political Location:

Watershed Location:

References, Data Sources and Authors

Data Sources
NH Dragonfly Survey (Hunt 2012).

Data Quality
Like most members of its genus, the Ocellated Emerald occurs at low densities and can be difficult to detect. It was only found at three sites during the NH Dragonfly Survey (Hunt 2012), but has a relatively wide historic range within which current records are evenly dispersed. This suggests there has been no significant change in distribution and that the species is simply overlooked regularly.

Appendix A: Insects

2015 Authors:
Pamela Hunt, NHA

2005 Authors:

Literature

Hunt, P.D. 2012. The New Hampshire Dragonfly Survey: A final report. Report to NH Fish and Game Department, Nongame and Endangered Species Program. New Hampshire Audubon, Concord, NH.

White, E.L., P.D. Hunt, M.D. Schessinger, J.D. Corser, and P.G. deMaynadier. 2014. A conservation status assessment of Odonata for the northeastern United States. Report to Northeastern Association of Fish and Wildlife Agencies. New York Natural Heritage Program, Albany, NY.

Ringed Boghaunter

Williamsonia lintneri

Federal Listing	N/A
State Listing	E
Global Rank	G3
State Rank	S2
Regional Status	High

Photo by Pamela Hunt

Justification (Reason for Concern in NH)

Considered "highly vulnerable" by the Northeastern Odonata Conservation Assessment (White et al 2014), because of its restricted range, specialized habitat, and historic loss of peripheral populations in NY and NJ. Most of the population occurs in the heavily developed coastal plain from Maine to Connecticut, and the species is listed as threatened or endangered in all states where it occurs.

Distribution

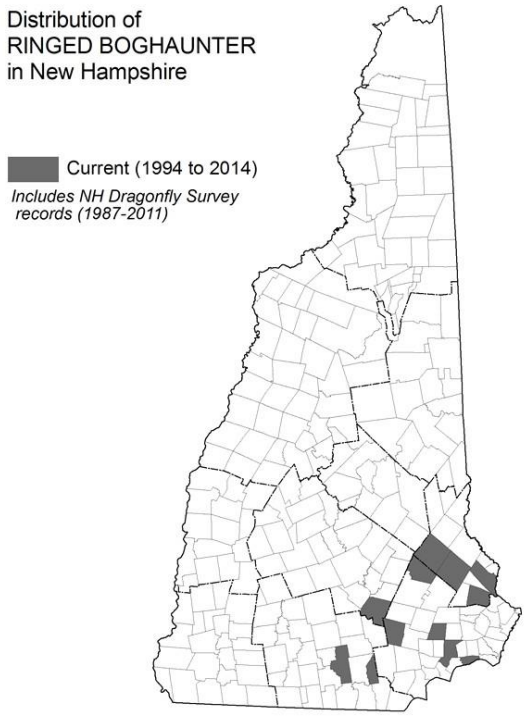
Most of the global population occurs from southwestern Maine to eastern Connecticut, with disjunct populations in Wisconsin and Michigan. There are also historic records from northern New Jersey and Albany, NY. Ringed Boghaunters have been documented at roughly 15 sites in New Hampshire, all in the southeast portion of the state in a band from Strafford and Durham to Amherst and South Hampton. Extensive field work in 2007-2011 doubled the number of locations with this species, although it has not been detected at some sites for several years. Breeding has not been conclusively shown at all sites, but is suspected at most through a combination of repeated detection or relatively high abundance.

Habitat

Ringed Boghaunters are restricted to wetland habitats containing extensive floating or suspended Sphagnum. These are generally acidic fens (deMaynadier and Carlson 1998, Lundgren 1999), which are weakly minerotrophic peatlands that receive some nutrients from groundwater springs, seeps, and streams. Vegetation can be highly variable, including shrubby basins, dwarf shrub fens, graminoid-dominated fens (usually sedges), and Sphagnum-filled pools or basins (Lundgren 1999). At least one New Hampshire site appears to be within an Atlantic white cedar swamp. Shrubs, robust sedges and rushes with persistent stems provide places for larvae to emerge in the spring. An analysis of water chemistry in Rhode Island found no differences between occupied and unoccupied sites in terms of pH, dissolved nitrogen or oxygen, conductivity, and other factors (Biber 2002). This same study also found that occupied sites tended to have deeper water, suggesting that hydroperiod may be important to this species in some situations. An informal survey of eight NH sites found pH values ranging from 3.8 to 5.2, with five sites in the 4.0-4.5 range (A. Dillon, unpubl. data). Like most Odonata, adults may require relatively intact upland forests to rest, develop, and feed immediately after emergence and between mating bouts.

NH Wildlife Action Plan Habitats

- Peatlands
- Temperate Swamps
- Appalachian Oak Pine Forest
- Hemlock Hardwood Pine Forest
- Marsh and Shrub Wetlands



Distribution Map

Current Species and Habitat Condition in New Hampshire

Most sites have not been consistently monitored to determine local population size or trend. Increasingly older data from sites that pre-date the NH Dragonfly Survey (2007-2011) suggest relatively stable populations, albeit over a short time period. Recently-discovered sites in Strafford, Fremont, South Hampton, and Barrington appear to support relatively high populations, although detailed inventories or monitoring have yet to be carried out.

Population Management Status

Not managed

Regulatory Protection (for explanations, see Appendix I)

- Endangered Species Conservation Act (RSA 212-A)
- Fill and Dredge in Wetlands - NHDES
- Comprehensive Shoreland Protection Act - NHDES

Quality of Habitat

Generally poorly known, although the proximity of several sites to roads or development may pose the risk of contaminated runoff entering the wetlands , particularly those of relatively small size. Larger sphagnum peatlands surrounded by intact wetland or upland forests appear to have the most potential for the long-term persistence of ringed boghaunters. The long-term biological cost of adult road mortality and increased predation by domestic animals and subsidized predators is not known.

Habitat Protection Status

Ownership and protection status vary widely among sites, although roughly half are under some sort of conservation.

Habitat Management Status

Habitat management for the ringed boghaunter is limited to a site in Durham, and consists of cattail removal to maintain some open water in this small peatland. It is unknown whether this activity has benefited the species.

Threats to this Species or Habitat in NH

Threat rankings were calculated by groups of taxonomic or habitat experts using a multistep process (details in Chapter 4). Each threat was ranked for these factors: Spatial Extent, Severity, Immediacy, Certainty, and Reversibility (ability to address the threat). These combined scores produced one overall threat score. Only threats that received a "medium" or "high" score have accompanying text in this profile. Threats that have a low spatial extent, are unlikely to occur in the next ten years, or there is uncertainty in the data will be ranked lower due to these factors.

Habitat conversion to development (Threat Rank: Medium)

In the context of the Ringed Boghaunter, this threat pertains to forested habitat surrounding breeding sites. Such habitat is important to recently-emerged adults, as well as to females between oviposition events. Loss of such habitats may increase predation risk or other sources of mortality. In Rhode Island, occupied sites were in significantly less developed landscapes (area within 460 meters of the wetland) than unoccupied sites (Biber 2002).

See also peatlands profile

Habitat conversion from the direct filling of wetlands for development (Threat Rank: Medium)

Because most known and potential sites for this species are in the more heavily developed southeastern portion of New Hampshire, they should be considered at relatively high risk from development. Smaller wetlands may be particularly vulnerable, since they are more likely to be embedded in heavily developed landscapes and suffer incremental degradation even without direct filling.

See peatlands profile

List of Lower Ranking Threats:

Habitat degradation from impervious surface run-off

Mortality and species impacts from pesticide use

Habitat degradation from introduced or invasive plants

Mortality from subsidized or introduced predators

Habitat degradation from an increase in cattails and other successional processes

Habitat impacts (drying or flooding) due to culvert-constrained water flows

Mortality of individuals from vehicles on roadways

Actions to benefit this Species or Habitat in NH

Ringed Boghaunter monitoring

Specific Action: Data Collection and Analysis

Objective:
Confirm breeding at boghaunter sites where it has not been documented

General Strategy:
Visit sites where there are only records of adults and undertake comprehensive searches of suitable habitat for exuviae. Such documentation is important in order to effectively conserve the wetlands where Ringed Boghaunters are actually breeding.

Political Location:
Hillsborough County, Merrimack County, Rockingham County, Strafford County

Watershed Location:

Ringed Boghaunter population monitoring

Objective:
Access status of NH Ringed Boghaunter populations

General Strategy:
Periodically search known sites for adults and exuviae to determine if the species persists at the locations. Surveys could occur every two years and involve trained volunteers.

Political Location:
Hillsborough County, Merrimack County, Rockingham County, Strafford County

Watershed Location:

References, Data Sources and Authors

Data Sources
NH Dragonfly Survey (Hunt 2012); UNH entomology collection (historic records), P. Hunt and NHFG, unpubl. Data. Ringed Boghaunter inventory and monitoring reports of New Hampshire sites contain survey data and conservation concerns. Pam Hunt of ASNH and Sara Cairns of NHNHB provided information regarding the protection status of known breeding sites, as well as habitat quality indicators.

Data Quality
Adult Ringed Boghaunters are distinctive, and most recent records have been substantiated with photographs, so the quality of data is good. The mapped extent of the species' current distribution is likely an underestimate, given its dispersed population, specialized habitat, and early flight season. The fact that the number of known sites was roughly doubled during the NH Dragonfly Survey supports this point, and suggests Ringed Boghanter may be more widespread than previously

believed. For these same reasons, the absence of individuals during a single survey does not prove a site is no longer unoccupied. Data on population size and persistence are of lower quality, since there is no systematic monitoring program in place, and all recent records are essentially incidental.

The condition of Ringed Boghaunter populations in New Hampshire is not well understood. Inconsistency in surveying efforts between years and sites make it difficult to compare between and within populations. Site conditions, especially water levels, greatly influence monitoring results. The flight period for this species is short and early, and exuviae are delicate and easily dislodged from the stems of emergent vegetation by wind or high water. Therefore, the absence of individuals during a single survey does not prove the habitat is unoccupied.

2015 Authors:
Pamela Hunt, NHA

2005 Authors:
Kim Tuttle, NHFG

Literature

Biber, E. 2002. Habitat analysis of a rare dragonfly (*Williamsonia linteri*) in Rhode Island. Northeastern Naturalist 9: 341-352.

deMaynadier, P., and B. Carlson. 1998. A survey and evaluation of habitat potential for *Willilamsonia lintneri* in southern Maine, 1998. A report to the Maine Department of Inland fisheries and Wildlife.

Lundgren, J.A. 1999. Characterization and classification of plant communities inhabited by the ringed boghaunter dragonfly (*Williamsonia lintneri*). Report to The Nature Conservancy, Rhode Island Field Office. The Nature Conservancy, Eastern Conservation Science, Boston, MA.

Rao, R.S.PO., and M.K.S. Girish. 2007. Road kills: Assessing insect casualties using flagship taxon. Current Science 92: 830-837.

White, E.L., P.D. Hunt, M.D. Schessinger, J.D. Corser, and P.G. deMaynadier. 2014. A conservation status assessment of Odonata for the northeastern United States. Report to Northeastern Association of Fish and Wildlife Agencies. New York Natural Heritage Program, Albany, NY.

Appalachian Tiger Beetle

Cicindela ancocisconensis

Federal Listing	N/A
State Listing	
Global Rank	G3
State Rank	S1
Regional Status	high

Photo by Pamela Hunt

Justification (Reason for Concern in NH)

Considered declining but not imperiled by NatureServe. Mawdsley (2007) found this species widespread and often common along the Saco and Ammonoosuc Rivers in 2004 and 2006, and suggests that it may be less rare than generally perceived. However, Schlesinger and Novak (2011) failed to find it in over two thirds of historic sites in New York, and in only 10% of other suitable sites within the potential range in that state. It appears extirpated or nearly so from the Ohio River valley (Pearson et al. 2006, Mawdsley 2007). Apparently declining/not relocated in VT (VT WAP).

Distribution

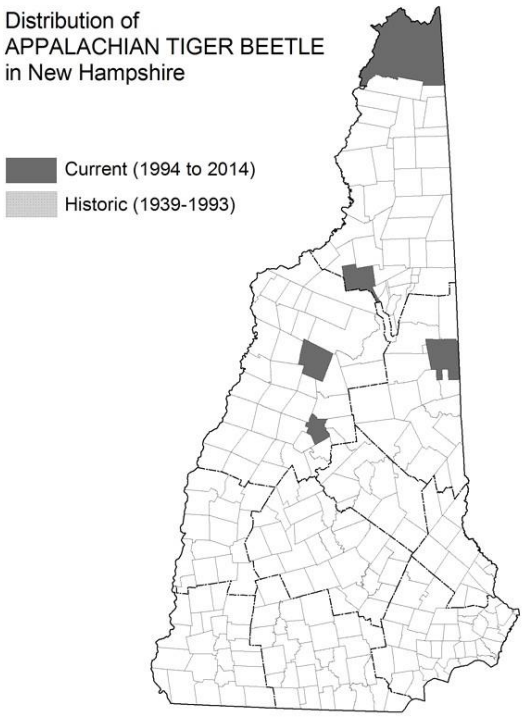
The Appalachian Tiger Beetle occurs from Quebec to Georgia, with historic records west along the Ohio River to Indiana (Leonard and Bell 1999, Pearson et al. 2006). It appears most abundant in the northernmost portion of this range in northern New England (White Mountains) and adjacent areas. In NH it is known from several localities in Coos, Grafton, and Carroll counties, and at least historically from near Mount Sunapee (Dunn 1981).

Habitat

The Appalachian Tiger Beetle occurs along cool rocky rivers and streams. Occupied sites tend to have some combination of sand interspersed with rocks, often with more vegetation than sites used by other beach-using tiger beetles (Leonard and Bell 1999, Pearson et al. 2006, Mawdsley 2007). Larvae burrow into sand among rocks above the normal high-water line, and adults forage throughout exposed habitat.

NH Wildlife Action Plan Habitats

- Warmwater Rivers and Streams
- Coldwater Rivers and Streams



Distribution Map

Current Species and Habitat Condition in New Hampshire

Unknown, but Mawdsley (2007) found this species widespread and often common along the Saco and Ammonoosuc Rivers in 2004 and 2006, and suggests that it may be less rare than generally perceived. However, Schlesinger and Novak (2011) failed to find it in over two thirds of historic sites in New York, and in only 10% of other suitable sites within the potential range in that state. It appears extirpated or nearly so from the Ohio River valley (Pearson et al. 2006, Mawdsley 2007). Apparently declining/not relocated in VT (VT WAP).

Population Management Status

Not managed

Regulatory Protection (for explanations, see Appendix I)

- Rivers Mngmt and Protection Program - NHDES

Quality of Habitat

Unknown

Habitat Protection Status

Likely highly variable, and dependent upon ownership of abutting uplands

Habitat Management Status

Variable depending on ownership

Threats to this Species or Habitat in NH

Threat rankings were calculated by groups of taxonomic or habitat experts using a multistep process (details in Chapter 4). Each threat was ranked for these factors: Spatial Extent, Severity, Immediacy, Certainty, and Reversibility (ability to address the threat). These combined scores produced one overall threat score. Only threats that received a "medium" or "high" score have accompanying text in this profile. Threats that have a low spatial extent, are unlikely to occur in the next ten years, or there is uncertainty in the data will be ranked lower due to these factors.

There were no threats ranked high or medium for this species.

List of Lower Ranking Threats:

Habitat degradation from proactive and reactive flood control or erosion control

Mortality from recreational use that tramples larval burrows

Habitat degradation and mortality from increased flooding

Actions to benefit this Species or Habitat in NH

Appalachian Tiger Beetle surveys

Specific Threat (IUCN Threat Levels): None

Specific Action: Research, survey or monitoring - fish and wildlife populations

Objective:
Determine the current distribution and abundance of this species in NH

General Strategy:
Survey areas of suitable habitat statewide so as to determine current distribution

Political Location:
Statewide

Watershed Location:

Location Description:
Primarily from White Mountains north

References, Data Sources and Authors

Data Sources

Leonard and Bell 1999; Pearson et al. 2006; Mawdsley 2007; Dunn 1981; P. Hunt, unpublished data; UNH insect collection. Most recent NH surveys by Mawdsley (2007), but limited to gross distribution vs. condition.

Data Quality
Given limited survey effort and sometimes difficult access to this species' habitat, it is likely underreported. It is superficially similar to the more widespread *C. repanda*, which may also complicate accurate reporting. No data on condition

2015 Authors:
Pamela Hunt, NHA

2005 Authors:

Literature

Dunn, G.A. 1981. Tiger beetles of New Hampshire. Cicindela 13: 1-28.

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, Boca Raton, FL.

Mawdsley, J.R. 2007. Comments on the conservation status of the tiger *beetle Cicindela ancocisconensis* T.W. Harris (Coleoptera: Carabidae: Cincindelinae). Proceedings of the Entomological Society of Washington 109: 721-724.

Pearson, D.L., C.B. Knisley, and C.J. Kazilek. 2006. A field guide to the tiger beetles of the United States and Canada. Oxford University Press, New York.

Schlesinger, M.D., and P.G. Novak. 2011. Status and conservation of an imperiled tiger beetle fauna in New York State, USA. Journal of Insect Conservation DOI: 10.1007/s10841-011-9382-y

Margined Tiger Beetle

Cicindela marginata

Federal Listing	N/A
State Listing	
Global Rank	G5
State Rank	S1
Regional Status	

Photo by Pamela Hunt

Justification (Reason for Concern in NH)

The Margined Tiger Beetle formerly occurred at several sites in NH, but as of 1977 was believed extirpated from the last known site in Rye (Leonard and Bell 1999). However, a specimen (UNH) from Seabrook in 1989 indicates that the species still occurred in the state after 1977. The Seabrook population was confirmed as extant in 2014 (Hunt and Lambert, pers. obs.). The potential for extirpation and vulnerability of this species' habitats justifies its inclusion as a NH SGCN.

Distribution

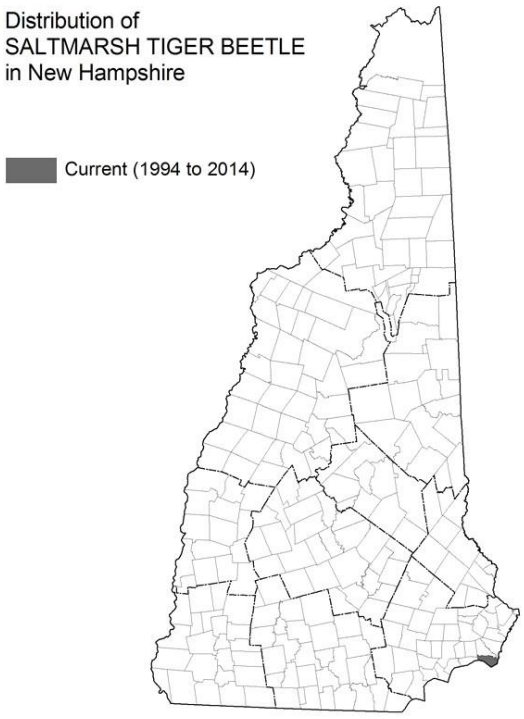
Occurs along the Atlantic coast from Florida to Maine. Perceptions of a regional decline (Pearson et al. 2006) may be based on limited surveys, and the species appears stable over most of its distribution in the Northeast (Ward and Mays 2015). Apparently formerly more widespread in NH (Leonard and Bell 1999) but now may be restricted to a single site in Seabrook.

Habitat

The Margined Tiger Beetle is distributed along the entire Atlantic coast of the United States, where it inhabits salt pannes, mud flats, and adjacent upland areas of dunes (Leonard and Bell 1999, Pearson et al. 2006). Larvae live in sandy areas within a few meters of the water line (Pearson et al. 2006).

NH Wildlife Action Plan Habitats

- Dunes
- Salt Marshes



Distribution Map

Current Species and Habitat Condition in New Hampshire

Unknown. Believed extirpated as of 1999 (Dunn 1981, Leonard and Bell 1999), but now known to persist in at least one site.

Population Management Status

Not managed

Regulatory Protection (for explanations, see Appendix I)

- Rivers Mngmt and Protection Program - NHDES

Quality of Habitat

Existing site may be the only remaining example in the state of an intact back-dune saltmarsh system. Most - if not all - other such sites in NH have likely been developed or permanently altered as a result of development.

Habitat Protection Status

The known site is protected by the Town of Seabrook.

Habitat Management Status

No management

Threats to this Species or Habitat in NH

Threat rankings were calculated by groups of taxonomic or habitat experts using a multistep process (details in Chapter 4). Each threat was ranked for these factors: Spatial Extent, Severity, Immediacy, Certainty, and Reversibility (ability to address the threat). These combined scores produced one overall threat score. Only threats that received a "medium" or "high" score have accompanying text in this profile. Threats that have a low spatial extent, are unlikely to occur in the next ten years, or there is uncertainty in the data will be ranked lower due to these factors.

Habitat conversion and degradation due to sea level rise (Threat Rank: High)

Rising sea levels will flood salt marsh pannes that this species uses for foraging. In extreme cases, lower reaches of dunes could also become inundated, or be more subject to erosion from storms.

Mortality from pesticide application (species is not the intended target) (Threat Rank: High)

The presumed extirpation of this species was believed the result of insecticide spraying, and while current insecticides may be of lower toxicity to non-target insects, the rarity of this species in the state warrants additional caution.

Pesticide application for mosquito control is believed to have caused the extirpation of a population in Rye in 1977 (Dunn 1981, Leonard and Bell 1999).

Habitat conversion due to development (Threat Rank: Medium)

Although the known site is protected, adjacent areas of similar habitat are not, nor is much other potential habitat in the state.

List of Lower Ranking Threats:

None

Actions to benefit this Species or Habitat in NH

Margined Tiger Beetle surveys

Specific Threat (IUCN Threat Levels): None

Specific Action: Research, survey or monitoring - fish and wildlife populations

Objective:
Targeted surveys at the known and potential sites along the NH coast are needed to get an accurate picture of this species' distribution and abundance in the state.

General Strategy:
Survey areas of suitable habitat statewide so as to determine current distribution

Political Location:
Rockingham County

Watershed Location:
Coastal Watershed

Location Description:
Dunes and adjacent salt marsh along the immediate NH coast

References, Data Sources and Authors

Data Sources

Tiger beetle field guides, UNH insect collection, personal observation
Dunn (1981) and Leonard and Bell (1999) both reference population declines and presumed extirpation in NH. However, Perceptions of a regional decline (Pearson et al. 2006) may be based on limited surveys, and the species appears stable over most of its distribution in the Northeast (Ward and Mays 2015).

Data Quality

It is likely that there has been little to no survey effort directed toward this species, with recent records being derived from broad insect surveys (UNH specimen) or specific visits to the site of the UNH specimen. The species could thus occur elsewhere along the NH coast where suitable habitat conditions are present (likely a limited number of sites). Limited to sporadic surveys, no directed data-collection efforts at present.

2015 Authors:

Pamela Hunt, NHA

2005 Authors:

Literature

Dunn, G.A. 1981. Tiger beetles of New Hampshire. Cicindela 13: 1-28.

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, Boca Raton, FL.

Pearson, D.L., C.B. Knisley, and C.J. Kazilek. 2006. A field guide to the tiger beetles of the United States and Canada. Oxford University Press, New York.

Schlesinger, M.D., and P.G. Novak. 2011. Status and conservation of an imperiled tiger beetle fauna in New York State, USA. Journal of Insect Conservation DOI: 10.1007/s10841-011-9382-y

Ward, M.A., and J.D. Mays. 2015. *Cicindela marginata* (Carabidae: Cicindelinae) in the northeastern United States: A tiger beetle in decline? Northeastern Naturalist 22: 192-199.

Cobblestone Tiger Beetle

Cicindela marginipennis

Federal Listing	N/A
State Listing	E
Global Rank	G2
State Rank	S1
Regional Status	high

Photo by Pamela Hunt

Justification (Reason for Concern in NH)

The Cobblestone Tiger Beetle occurs in small and often isolated populations on medium-to-large rivers in the eastern United States, where it is restricted to the upstream ends of cobble bars. These habitats are subject to numerous stressors relating to altered hydrology (inundation by dams, flooding, etc.) and possible human disturbance. The species was considered both high responsibility and high concern in USFWS Region 5, and thus listed as a Regional SGCN.

Distribution

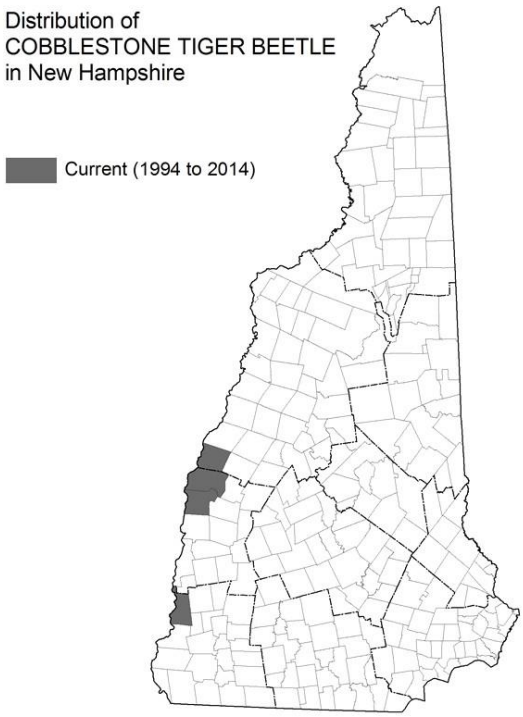
The Cobblestone Tiger Beetle has a disjunct distribution along rivers in the eastern United States. An isolated population is found in Alabama and Mississippi, but the bulk of the range is in the Northeast. Populations occur in a narrow band from Indiana to Ohio. Two additional small populations occur in western New York and southwestern New Brunswick (Pearson et al. 2006). In New England it is known only from Vermont and New Hampshire, with the latter supporting five known populations along the Connecticut River from Walpole to Lebanon. These are located at Walpole Island (Walpole), Chase Island (Cornish), Hart Island (Plainfield), Burnaps Island (Plainfield), and Johnson Island (Lebanon).

Habitat

Cobblestone tiger beetles inhabit sandy cobble beaches on the upstream ends of islands and along the banks of free-flowing rivers (Leonard and Bell 1999, Hudgins et al. 2011). The upstream ends of islands are typically covered with pebbles and cobble-sized stones, while downstream ends are sandy (Leonard and Bell 1999). Vegetation is sparse at the upstream end with a moderate diversity of grasses, herbs, and forbs, and few shrubs and trees (Leonard and Bell 1999, Hudgins et al. 2011). Data from the Genesee River in NY suggest that beetles prefer larger islands and those with a larger area-to-perimeter ratio (Hudgins et al. 2011). Riverine islands are subject to annual disturbance from frequent flooding and ice scouring in the spring, which maintains suitable habitat by eliminating encroaching vegetation from the cobbled shore (TNC 1995).

NH Wildlife Action Plan Habitats

- Large Warmwater Rivers



Distribution Map

Current Species and Habitat Condition in New Hampshire

Surveys in 1983 and 1993 indicated small but stable populations of Cobblestone Tiger Beetles (Nothnagle 1993). Johnston and Burnaps Islands had the fewest cobblestone tiger beetles (10 and 7, respectively - perhaps higher on Johnston [Hunt, pers. obs. 2006]), whereas Walpole and Chase Island had the most (58 and 26, respectively) (Nothnagle 1993). Surveys in 2014 documented the species on all five sites, but relative abundance was not available as this profile was being written.

Population Management Status

Not currently in place for this species.

Regulatory Protection (for explanations, see Appendix I)

- Endangered Species Conservation Act (RSA 212-A)
- Rivers Mngmt and Protection Program - NHDES

Quality of Habitat

Cobblestone tiger beetles are restricted to the open, cobbled, and sparsely vegetated areas of river islands. The upstream sections of Burnaps, Chase, Hart, Johnston, and Walpole Islands all provide suitable habitat for cobblestone tiger beetles. The lower sections of these islands support well-established floodplain forests, which do not provide adequate habitat due to heavy sedimentation and dense vegetation cover (TNC 1995). Appropriate habitats for cobblestone tiger beetles south of Walpole Island in the Connecticut River in Massachusetts and Connecticut, as well as in feeder

streams, have not been surveyed (Nothnagle 1993).

Habitat Protection Status

All islands that support cobblestone tiger beetles are protected under the state Endangered Species Act. The Connecticut River was designated as an American Heritage River in 1999. The Silvio O. Conte National Wildlife Refuge Act (1991) and the Rivers Management and Protection Act (RSA 483) protect the Connecticut River. Burnaps Island is owned by the town of Plainfield. Chase Island is a wildlife management area owned by NHFG where hunting and trapping of small game is permitted. Hart Island is owned and managed by The Nature Conservancy. Johnston and Walpole Islands are owned by an unknown agency of the State of New Hampshire (TNC 1995).

Habitat Management Status

None of the islands that support cobblestone tiger beetles are actively managed because of the uncertain distribution of cobblestone tiger beetles in New Hampshire and because of insufficient and dated information.

Threats to this Species or Habitat in NH

Threat rankings were calculated by groups of taxonomic or habitat experts using a multistep process (details in Chapter 4). Each threat was ranked for these factors: Spatial Extent, Severity, Immediacy, Certainty, and Reversibility (ability to address the threat). These combined scores produced one overall threat score. Only threats that received a "medium" or "high" score have accompanying text in this profile. Threats that have a low spatial extent, are unlikely to occur in the next ten years, or there is uncertainty in the data will be ranked lower due to these factors.

Mortality from boaters that land on islands (Threat Rank: Medium)

People landing boats on islands where this species breeds have the potential to trample larvae in their burrows if there is considerable human activity (walking, picnicking, etc.) in larval habitat. Overall extent of this threat, however, is poorly known.

List of Lower Ranking Threats:

Habitat degradation from extended periods of high water that covers substrate

Habitat degradation from introduced or invasive plants that colonize due to a lack of disturbance

Habitat degradation and conversion from water releases that erode breeding substrate

Habitat degradation from a lack of scour that allows succession

Mortality from water releases and associated flooding

Mortality and habitat degradation from ATVs on cobble bars

Mortality from the collection of individuals from the wild

Habitat degradation and mortality from increased flooding

Habitat conversion due to development

Actions to benefit this Species or Habitat in NH

Implement periodic monitoring to assess this species' status in the state over time

Specific Threat (IUCN Threat Levels): None

Specific Action: Research, survey or monitoring - fish and wildlife populations

Objective:
Because surveys for this species have been to date sporadic, there is value in implementing regular monitoring so as to determine if subpopulations change significantly in size or if currently unoccupied areas of suitable habitat are colonized.

General Strategy:
Search known and potential sites for this species during its primary flight period in July and August. Record actual or estimated numbers of individuals detected on each visit.

Political Location:
Cheshire County, Grafton County, Sullivan County

Watershed Location:

Location Description:
Sites along mainstem of the Connecticut River generally between Lebanon and Walpole

Cobblestone Tiger Beetle condition research

Objective:
Assess habitat condition at known and potential Cobblestone Tiger Beetle sites in NH

General Strategy:
Conduct habitat assessments at known sites and use these to model potential additional sites within the species' range. Important variables to consider include flooding regime (frequency, duration, effects on substrate), substrate characterization, and vegetation extent and composition.

Political Location:
Cheshire County, Grafton County, Sullivan County

Watershed Location:

References, Data Sources and Authors

Data Sources
Sources of information include tiger beetle field guides, peer-reviewed journal articles, reports, and the NatureServe database. Sources of information include the NHNHB Element Occurrence Database, conservation plans, and field surveys and reports.

Data Quality

Locations of cobblestone tiger beetles in New Hampshire have been well documented since their discovery in the 1960s (Dunn 1978, Nothnagle 1989, NHNHB 2005, Normandeau Associates unpubl. data). Current population estimates of cobblestone tiger beetles do not exist. The most recent survey was conducted in 2014 (Normandeau Associates, unpubl. data). Habitat quality has not been assessed since 1995 (TNC 1995).

2015 Authors:

Pamela Hunt, NHA

2005 Authors:

Alina Pyzikiewicz, NHFG

Literature

Hudgins, R., C. Norment, M.D. Schlessinger, and P.G. Novak. 2011. Habitat selection and dispersal of the Cobblestone Tiger Beetle (*Cicindela merginipennis* Dejean) along the Genesee River, New York. American Midland Naturalist 165: 304-318.

Knisley, C.B., and J.M. Hill. 1992. Effects of habitat change from ecological succession and human impacts on tiger beetles. Virginia Journal of Science 43: 133-142.

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, Boca Raton, FL.

Nothnagle, P. 1989. Population estimates of Vermont populations of the Cobblestone Tiger Beetle, *Cicindela marginipennis*. Technical Report 15. Nongame and Natural Heritage Program, Vermont Fish and Wildlife Department, Waterbury, VT.

Pearson, D.L., C.B. Knisley, and C.J. Kazilek. 2006. A field guide to the tiger beetles of the United States and Canada. Oxford University Press, New York.

The Nature Conservancy. 1995. Conservation plan for Burnaps, Chase, Hart, Johnson, and Walpole Islands, New Hampshire. The Nature Conservancy, Concord, NH.

Puritan Tiger Beetle

Cicindela puritana

Federal Listing	T
State Listing	E
Global Rank	G1G2
State Rank	SH
Regional Status	Very High

Justification (Reason for Concern in NH)

The Puritan Tiger Beetle is a federally-threatened species that now occurs in only two areas: Chesapeake Bay and the lower Connecticut River. It has declined considerably and now occupies a fraction of its former range, where it is threatened by habitat loss and degradation, flooding, and human disturbance.

Distribution

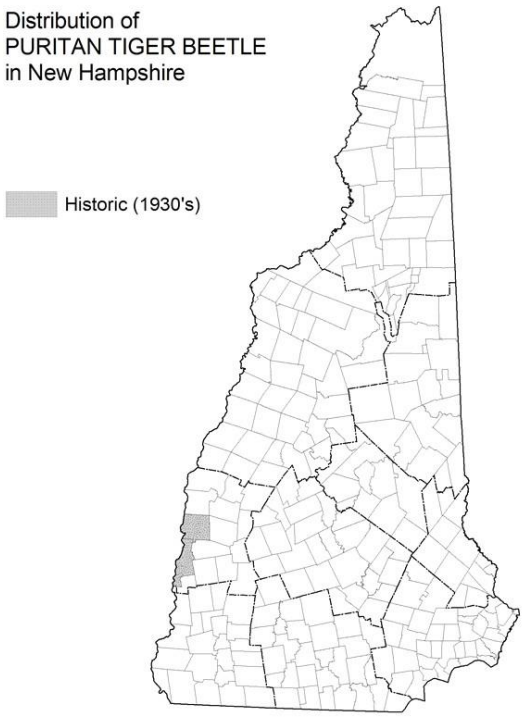
There are two distinct populations of Puritan Tiger Beetles, one along the Connecticut River in Massachusetts and Connecticut and the other along Chesapeake Bay in Maryland (USFWS 1993, Omland 2002, Pearson et al. 2007). Along the Connecticut, the species was historically known from 11 sites between Cromwell, CT and Claremont, NH (Dunn 1981, USFWS 1993). The upper Connecticut River populations became extirpated in the early 1900s due to dam construction and riverbank stabilization (USFWS 1993). Only two Connecticut River populations remain, one near Hadley, Massachusetts and one in Cromwell, Connecticut (USFWS 1993, Omland 2002), with the former population only maintained through translocations from the latter (S. von Oettingen, USFWS, pers. comm.). In New Hampshire, Puritan Tiger Beetles were historically known from the Connecticut River in Claremont and Charlestown, but have not been observed in the state since 1939 (Dunn 1981).

Habitat

Puritan tiger beetles use different habitats in the two parts of its range. Along the Connecticut River occurs on sandy riverine beaches (including islands), where larvae burrow between sparse herbaceous vegetation (20-30% cover) in fine to medium sand particles (0.125-0.5 mm) at the upper margins of sandy beaches (Omland 2002). Along Chesapeake Bay in Maryland, larvae burrow in long, high, sandy, and non- vegetated bluff faces (Omland 2002, Pearson et al. 2007).

NH Wildlife Action Plan Habitats

- Large Warmwater Rivers



Distribution Map

Current Species and Habitat Condition in New Hampshire

The Connecticut River population is smaller than that along Chesapeake Bay, and most of the former is at a single site in Connecticut. Numbers at the smaller site in Massachusetts are in decline, and the species persists there only through translocations from Connecticut. The species no longer occurs at nine other sites from CT to NH.

Population Management Status

No management in NH. The Massachusetts' population is subject to high human disturbance, and active areas are indicated by signage. There have also been recent attempts to supplement this population with beetles translocated from Connecticut.

Regulatory Protection (for explanations, see Appendix I)

- Federal Endangered Species Act
- Endangered Species Conservation Act (RSA 212-A)
- Rivers Mngmt and Protection Program - NHDES

Quality of Habitat

Species is absent from the two known historic sites in NH.

Habitat Protection Status

Barring specific details on the historic NH sites, it is not possible to determine what level of protection, if any, they are subject to.

Habitat Management Status

Unknown, pending identification of historic sites.

Threats to this Species or Habitat in NH

Threat rankings were calculated by groups of taxonomic or habitat experts using a multistep process (details in Chapter 4). Each threat was ranked for these factors: Spatial Extent, Severity, Immediacy, Certainty, and Reversibility (ability to address the threat). These combined scores produced one overall threat score. Only threats that received a "medium" or "high" score have accompanying text in this profile. Threats that have a low spatial extent, are unlikely to occur in the next ten years, or there is uncertainty in the data will be ranked lower due to these factors.

Habitat degradation from bank stabilization and associated loss of beach habitat (Threat Rank: Medium)

Bank stabilization and armoring can increase erosion in non-stabilized river sections (through changes in flow patterns) and reduce sediment inputs into rivers that are the source of deposition at downstream locations.

List of Lower Ranking Threats:

Habitat conversion and degradation from water management that causes erosion and excessive flooding

Mortality from recreational activity that tramples larval burrows

Actions to benefit this Species or Habitat in NH

Reintroduction Feasibility Research

Objective:
Determine the suitability of areas along the Connecticut River in NH and VT for establishment of a new population of Puritan Tiger Beetles

General Strategy:
Collect data on habitat conditions, including flood regime, erosional patterns, and substrate composition that could inform selection of sites suitable for future attempts at transloction of individuals from Connecticut.

Political Location: **Watershed Location:**

References, Data Sources and Authors

Data Sources

Sources of information include the species recovery plan, tiger beetle identification guides, peer-reviewed literature, field surveys, and technical reports. Tiger beetle field guides, fact sheets from USFWS and Connecticut DEEP.

Data Quality

The life history and habitat requirements of puritan tiger beetles are well documented, although most sources are over 10 years old. Current locations of puritan tiger beetles are well known, but historic New England locations are poorly documented. Dispersal patterns are not well known and need further research. None for NH.

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2005 Authors:

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Literature

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