Common Name: **Silver Redhorse**
Scientific Name: **Moxostoma anisurum**
Species Group: **Fish**

***Description of non-habitat threat(s):*** Water pollution may indirectly influence silver redhorse through negative impacts to its prey base. Depletion of food items will negatively affect species growth and survival.

## Research and Monitoring Needs

| Type | Need | Priority | Description |
|---|---|---|---|
| Research | Habitat Requirements | Low | |
| Research | Basic Life History | Low | |
| Research | Distribution and Abundance | High | Distribution, abundance and dynamics of Silver Redhorse populations in Vermont are poorly understood. |
| Research | Threats and Their Significance | Medium | |
| Research | Population Genetics | Low | |
| Research | Taxonomy | Low | |
| Research | Other Research | N/A | |
| Monitoring | Population Change | Medium | |
| Monitoring | Habitat Change | Medium | |
| Monitoring | Range Shifts | N/A | |
| Monitoring | Monitor Threats | Medium | Sediment and pollution |
| Monitoring | Other Monitoring Needs | N/A | |

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Common Name: **Silver Redhorse**
Scientific Name: **Moxostoma anisurum**
Species Group: **Fish**

## Species Strategies

| Strategy Type | Strategy Priority | Strategy Description | Performance Measure | Potential Partners | Potential Funding Sources |
|---|---|---|---|---|---|
| Awareness Raising and Communications | High | Enhance public awareness of SGCN and threats to Vermont's populations; a greater understanding of the effects of their own actions on SGCN and measures they can take to restore the population to the lake; develop public and professional partnerships to promote stewardship of aquatic habitat through outreach, education, and on-the-ground cooperative efforts. | Number of outreach efforts made to better inform the public . | VFWD, USFWS, VDEC, TNC, Echo Center, LCBP, LCI | VFWD, USFWS, VDEC, TNC, Echo Center, LCBP, LCI |
| Habitat Restoration | Medium | Monitor habitat conditions & effects of stressors on habitats; restore critical habitats or ameliorate threats when/where opportunities arise to secure/restore numbers of SGCN populations & targeted abundance levels. | Increase and/or maintain available habitat (river-miles or surface acres) in terms of quantity and quality required for all life stages of the SGCN. | VDEC, VFWD, USFWS, NRCS, LCBP, watershed associations , town & regional planning & Cons Comms | VDEC (ERG, VWG), VFWD (DJ, SWG) |
| Legislation | High | Support efforts, such as state, federal, regional and international Climate Change Action Plans to reduce greenhouse gas emissions in the Northeast and climate change risks to SGCN. | Adopt appropriate legislation & policies developed to reduce greenhouse emissions & reduce climate change risks to SGCN. | VDEC, VFWD, USFWS, NRCS, LCBP | |
| Research | Medium | Currently under VFWD fishing regulations Moxostoma species are "cull" fishes and as such their harvest and collection is essentially an unregulated activity. Whether or not Moxostoma are threatened by unrestricted harvest should be reviewed. | Review was conducted and recommendations were considered. | VFWD, USFWS, NYDEC, UVM | VFWD (SWG, DJ), USFWS, UVM |
| Natural Processes Restoration | Medium | Restore/maintain connectivity within aquatic systems supporting sustainable SGCN population(s); provide for safe & efficient up- and downstream SGCN passage at dams & other obstructions. | Based on historic distribution of the SGCN, number of miles of habitat to which access to critical habitat has been restored or maintained. | VDEC, VFWD, USFWS, dam owners | Dam owners |
| Natural Processes Restoration | Medium | Restore flow regimes and/or water levels that support sustainable SGCN population(s) & at targeted abundance levels. | Number of miles of SGCN habitat improved or restored. | VDEC, VFWD, USFWS, dam owners | Dam owners |

Common Name: **Silver Redhorse**
Scientific Name: **Moxostoma anisurum**
Species Group: **Fish**

| | | | | | |
|---|---|---|---|---|---|
| Habitat Restoration | High | Enforce and monitor compliance with applicable environmental protection laws & regulations. Monitor habitat conditions & effects of stressors on habitats; restore critical habitats or ameliorate threats when/where opportunities arise to secure/restore numbers of SGCN populations & targeted abundance levels. | Increase and/or maintain available habitat in terms of quantity and quality required for all life stages of the SGCN. | VDEC, VFWD, NHDES, NHFWD, NRCS, USFWS, CRWC, watershed associations, town & regional planning & Cons Comms | VDEC (ERG, VWG, WPAG, VBBRG, 604b), NRCS (EQIP) |

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Common Name: **Shorthead Redhorse**
Scientific Name: **Moxostoma macrolepidotum**
Species Group: **Fish**

## Conservation Assessment

**Final Assessment:** Medium Priority

**Global Rank:** G5 **Global Trend:** Unknown
**State Rank:** S2 **State Trend:** Unknown
**Extirpated in VT?** No **Regional SGCN?** No

**Assessment Narrative:**

Shorthead Redhorse in Vermont is confined to Lake Champlain and the lower accessible reaches of larger tributary rivers to the lake (Langdon et al. 2006). It appears to be a widespread species within its Vermont range but based on anecdotal observations appears to be fairly abundant where found (Ferguson 2014; Langdon 2014). Threats include poor water quality resulting from agricultural and urban pollution, artificial flow regimes, and habitat fragmentation (Cook et al. 2005). NatureServe (2014) identifies no known major threats to the species at the range-wide scale, but acknowledges that localized threats may exist. In Vermont, little is known of this population or threats to it. Because populations are not being monitored, trends influenced by threats may not be detected.

## Distribution

The Shorthead Redhorse is the most widely distributed of the redhorse species in North America. It occurs from the upper St. Lawrence River, south into the Lake Champlain drainage to the coast in New York, east of the Appalachian Mountains to South Carolina, west through Pennsylvania and Ohio, southwest into Indiana and Arkansas, the Tennessee River drainage in Alabama, west to Texas, northwest through eastern Colorado and Montana, north to central Alberta, east to southern Hudson Bay and the east shore of James Bay (Scott and Crossman 1973). In Vermont, the species is on the eastern edge of its North American range and is confined to Lake Champlain and several large tributaries up to the fall line.

### Distribution by Biophysical Region:

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

### Distribution by Watershed:

**Known Watersheds**
Winooski River
Missisquoi River

## Habitat Description

Habitat Information is based on the following:

Limited Local Knowledge ☑ Extensive Local Knowledge ☐ Regional Literature ☐ General Literature ☑

This species prefers the clear water of small to large rivers and sometimes lakes. Most individuals have been observed holding or feeding in deep pools. It is found over clean sand, gravel, and cobble substrate, and is tolerant of water temperatures up to 37°C. It requires a silt-free habitat and is thought to be susceptible to

Common Name: **Shorthead Redhorse**
Scientific Name: **Moxostoma macrolepidotum**
Species Group: **Fish**

many forms of water pollution (Langdon et al. 2006). It is common to find this species living in the same areas as other redhorse species. In Vermont, the Shorthead Redhorse is restricted to the larger tributaries of Lake Champlain (Langdon et al. 2006). The spawning period for Shorthead Redhorse occurs in spring from early April to early July, as influenced by local regional conditions (i.e. climate). Spawning water temperature is 11- 21°C. Spawning occurs in slow and moderate runs and pools over large gravel (Jenkins and Burkhead 1993). Shorthead Redhorse may perform spawning migrations to find optimal spawning habitat. Spawning groups of this species have been observed in streams where adults are normally not found except during breeding time (Jenkins and Burkhead 1993). Seasonal movement patterns may prove important for successful spawning.

Shorthead Redhorse is specialized to benthically feed on aquatic insects, small crustaceans, mollusks, algae, and detritus (Jenkins and Burkhead 1993). Highly silted or embedded substrate may preclude this species from consuming its preferred food items. Studies have shown that the principal, insect food items of redhorses are chironomids, ephemeropterans, and trichopterans (Meyer 1962)

### Habitat Types:

Aquatic: Fluvial

## *Current Threats*

### Habitat Threats:

Habitat Alteration

Sedimentation

Habitat Fragmentation

***Description of habitat threat(s):*** Flow alteration, temperature alteration, or decreased habitat diversity (i.e. loss of deep pool habitat) will most likely pose negative effects for different life stages of Shorthead Redhorse. For instance, shallow, channel margin habitats that are indicative of slower velocities are important for young redhorses. Anthropogenic flow alteration has been shown to alter and limit this habitat, affecting juvenile life stages (Scheidegger and Bain, 1995). Fragmentation of Shorthead Redhorse habitat may disrupt the seasonal movement patterns of this species. For example, these movement patterns may prove critical for successful reproduction, and therefore the completion of the species life cycle. Disruption to the spawning efforts of this species poses a problem to population viability (i.e. weak year classes over time compound negative influences and population declines). If the quantity or quality of Shorthead Redhorse habitat is limited in a system, then interconnected river reaches will prove necessary for this species to find and occupy optimal or suitable habitat. Loss of riparian vegetation, general construction activity, road maintenance activities (ditching, sanding), bridge and culvert construction, agriculture, timber harvest, dam failure, rapid drawdown of dam impoundments, streambank erosion, and shifts in channel form or location are sources of sediment for Shorthead Redhorse habitat. Controlling sediment input into streams may be crucial to prevent detrimental effects to Shorthead Redhorse, because sedimentation decreases the quality and quantity of optimal habitat (i.e. spawning, feeding) for this species. Sedimentation eliminates interstitial spaces which could be critical for egg deposition and development and for production of benthic organisms, such as aquatic insects, a source of food for shorthead redhorse. Sedimentation has been shown to cause loss or reduction in fish populations, and disrupt the feeding and reproductive activities of fishes (Berkman and Rabeni, 1987).

### Non-Habitat Threats:

Pollution

Common Name: **Shorthead Redhorse**
Scientific Name: **Moxostoma macrolepidotum**
Species Group: **Fish**

***Description of non-habitat threat(s):*** Water pollution may indirectly influence Shorthead Redhorse through negative impacts to its prey base. Depletion of food items will negatively affect species growth and survival.

## Research and Monitoring Needs

| Type | Need | Priority | Description |
|---|---|---|---|
| Research | Habitat Requirements | Low | |
| Research | Basic Life History | Low | |
| Research | Distribution and Abundance | High | Distribution, abundance and dynamics of Shorthead Redhorse populations in Vermont are poorly understood. |
| Research | Threats and Their Significance | Medium | |
| Research | Population Genetics | Low | |
| Research | Taxonomy | Low | |
| Research | Other Research | N/A | |
| Monitoring | Population Change | Medium | |
| Monitoring | Habitat Change | Medium | |
| Monitoring | Range Shifts | N/A | |
| Monitoring | Monitor Threats | Medium | Sedimentation and pollution |
| Monitoring | Other Monitoring Needs | N/A | |

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Common Name: **Shorthead Redhorse**
Scientific Name: **Moxostoma macrolepidotum**
Species Group: **Fish**

## Species Strategies

| Strategy Type | Strategy Priority | Strategy Description | Performance Measure | Potential Partners | Potential Funding Sources |
|---|---|---|---|---|---|
| Awareness Raising and Communications | High | Enhance public awareness of SGCN and threats to Vermont's populations; a greater understanding of the effects of their own actions on SGCN and measures they can take to restore the population to the lake; develop public and professional partnerships to promote stewardship of aquatic habitat through outreach, education, and on-the-ground cooperative efforts. | Number of outreach efforts made to better inform the public . | VFWD, USFWS, VDEC, TNC, Echo Center, LCBP, LCI | VFWD, USFWS, VDEC, TNC, Echo Center, LCBP, LCI |
| Awareness Raising and Communications | High | Enhance public awareness of SGCN and threats to Vermont's populations; a greater understanding of the effects of their own actions on SGCN and measures they can take to restore the population to the lake; develop public and professional partnerships to promote stewardship of aquatic habitat through outreach, education, and on-the-ground cooperative efforts. | Number of outreach efforts made to better inform the public . | VFWD, USFWS, VDEC, TNC, Echo Center, LCBP, LCI | VFWD, USFWS, VDEC, TNC, Echo Center, LCBP, LCI |
| Natural Processes Restoration | Medium | Restore/maintain connectivity within aquatic systems supporting sustainable SGCN population(s); provide for safe & efficient up- and downstream SGCN passage at dams & other obstructions. | Based on historic distribution of the SGCN, number of miles of habitat to which access to critical habitat has been restored or maintained. | VDEC, VFWD, USFWS, dam owners | Dam owners |
| Legislation | High | Support efforts, such as state, federal, regional and international Climate Change Action Plans to reduce greenhouse gas emissions in the Northeast and climate change risks to SGCN. | Adopt appropriate legislation & policies developed to reduce greenhouse emissions & reduce climate change risks to SGCN. | VDEC, VFWD, USFWS, NRCS, LCBP | |
| Natural Processes Restoration | Medium | Restore flow regimes and/or water levels that support sustainable SGCN population(s) & at targeted abundance levels. | Number of miles of SGCN habitat improved or restored. | VDEC, VFWD, USFWS, dam owners | Dam owners |
| Habitat Restoration | Medium | Monitor habitat conditions & effects of stressors on habitats; restore critical habitats or ameliorate threats when/where opportunities arise to secure/restore numbers of SGCN populations & targeted abundance levels. | Increase and/or maintain available habitat (river-miles or surface acres) in terms of quantity and quality required for all life stages of the SGCN. | VDEC, VFWD, USFWS, NRCS, LCBP, watershed associations , town & regional planning & Cons Comms | VDEC (ERG, VWG), VFWD (DJ, SWG) |

Common Name: **Shorthead Redhorse**
Scientific Name: **Moxostoma macrolepidotum**
Species Group: **Fish**

| | | | | | |
|---|---|---|---|---|---|
| Policy & Regulations | Medium | Currently under VFWD fishing regulations Moxostoma species are "cull" fishes and as such their harvest and collection is essentially an unregulated activity. Whether or not Moxostoma are threatened by unrestricted harvest should be reviewed. | Review was conducted and recommendations were considered. | VFWD, USFWS, NYDEC, UVM | VFWD (SWG, DJ), USFWS, UVM |
| Habitat Restoration | High | Enforce and monitor compliance with applicable environmental protection laws & regulations. Monitor habitat conditions & effects of stressors on habitats; restore critical habitats or ameliorate threats when/where opportunities arise to secure/restore numbers of SGCN populations & targeted abundance levels. | Increase and/or maintain available habitat in terms of quantity and quality required for all life stages of the SGCN. | VDEC, VFWD, NHDES, NHFWD, NRCS, USFWS, CRWC, watershed associations, town & regional planning & Cons Comms | VDEC (ERG, VWG, WPAG, VBBRG, 604b), NRCS (EQIP) |
| Habitat Restoration | High | Enforce and monitor compliance with applicable environmental protection laws & regulations. Monitor habitat conditions & effects of stressors on habitats; restore critical habitats or ameliorate threats when/where opportunities arise to secure/restore numbers of SGCN populations & targeted abundance levels. | Increase and/or maintain available habitat in terms of quantity and quality required for all life stages of the SGCN. | VDEC, VFWD, NHDES, NHFWD, NRCS, USFWS, CRWC, watershed associations, town & regional planning & Cons Comms | VDEC (ERG, VWG, WPAG, VBBRG, 604b), NRCS (EQIP) |

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Common Name: **Greater Redhorse**
Scientific Name: **Moxostoma valenciennesi**
Species Group: **Fish**

## Conservation Assessment

**Final Assessment:** High Priority

**Global Rank:** G4 **Global Trend:** Unknown
**State Rank:** S1 **State Trend:** Unknown
**Extirpated in VT?** No **Regional SGCN?** No

**Assessment Narrative:**

Based on current survey information, which is scant, Greater Redhorse appears to have the most restricted distribution of the three Moxostoma species occurring in Vermont, i.e. limited to northern Lake Champlain and the lower accessible reach of the Missisquoi River (Langdon et al. 2006). In 2009, it was documented to occur in Lake Memphremagog (Kratzer 2015). Whether Greater Redhorse has long been resident of the lake but has evaded detection until recently is no known. It is reported to be not difficult to find in the Missisquoi River during the spring season (Ferguson 2014). Threats include poor water quality resulting from agricultural and urban pollution, artificial flow regimes, and habitat fragmentation (Cook et al. 2005). However, in Vermont, little is known of this population or threats to it. Because populations are not being monitored, trends influenced by threats may not be detected.

## Distribution

The Greater Redhorse is generally distributed in central and eastern North America primarily in the upper Mississippi and Great Lakes-St. Lawrence systems (Scott and Crossman 1979). This species has been recorded from northern Lake Champlain and the lower reach of the Missisquoi River (Langdon et al., 2006). In Vermont, the species is on the eastern edge of its North American range.

### Distribution by Biophysical Region:

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

### Distribution by Watershed:

**Known Watersheds**
Lake Champlain
Missisquoi River
St. Francois River

**Probable Watersheds**
Lamoille River
Otter Creek
Winooski River

## Habitat Description

Habitat Information is based on the following:

Limited Local Knowledge ☑ Extensive Local Knowledge ☐ Regional Literature ☐ General Literature ☑

The Greater Redhorse inhabits medium to large rivers, large lakes and impoundments. It prefers coarse substrate, such as gravel, cobble, and boulders in clean water. In rivers, this species is frequently found in moderate to swift current in run or riffle habitat and may also be found in large river pools. Generally, it is not found in silty areas and is believed to be intolerant of silt and turbidity (Jenkins and Burkhead 1993).

Common Name: **Greater Redhorse**
Scientific Name: **Moxostoma valenciennesi**
Species Group: **Fish**

Spawning occurs in spring or summer in high velocity riffle habitat over gravel or cobble substrate that is silt free. Spawning has been found to occur in moderate stream velocities (3.8-116.9 cm/s) and at shallow depths (10-100 cm) (Healy 2002). Greater redhorse may perform annual migrations upstream to spawn and downstream after spawning. In an Ontario river, this species was observed dispersing up to 15 km downstream from its spawning habitat (Healy 2002). This species demonstrates important seasonal movement patterns. Different life stages have specific habitat preferences. Age-0 fish were found in shallow (20 cm), slow velocity pools (21 cm/s). Juvenile fish (greater than age-0 but not sexually mature) were found in slightly deeper pools (60-149 cm) and higher velocities (37 cm/s) (Healy 2002). The Greater Redhorse is a specialized benthic feeder such that highly silted or embedded substrate may preclude this species from consuming its preferred food items.

### Habitat Types:

Aquatic: Fluvial

Aquatic: Lacustrine

Aquatic: Lake Champlain

## *Current Threats*

### Habitat Threats:

Habitat Alteration

Sedimentation

Habitat Fragmentation

Unknown Habitat Threats

***Description of habitat threat(s):*** Flow alteration, temperature alteration, or low habitat diversity (i.e., loss of deep pool habitat, shallow riffles, or large woody debris due to human-induced change) will most likely pose negative effects for different life stages of greater redhorse. For instance, shallow channel margin habitats that are indicative of slower velocities are important for young redhorses. Flow alteration has been shown to alter and limit this habitat for juvenile life stages (Scheidegger and Bain 1995). Fragmentation of greater redhorse habitat may disrupt the seasonal movement patterns of this species. For example, these movement patterns may prove critical for successful reproduction, and therefore the completion of the species life cycle. Viability of Greater Redhorse populations most likely depends on optimal habitat availability (i.e., optimal or suitable depths, velocities, substrate, temperature, and flow regimes). Some evidence suggests that Greater Redhorse presence and abundance are correlated with longer contiguous river reaches (Healy 2002). If the quantity and quality of Greater Redhorse habitat is limited in a system, then interconnected river reaches will prove necessary for this species to find and occupy optimal or suitable habitat. Loss of riparian vegetation, general construction activities, road maintenance activities (ditching, sanding), bridge and culvert construction, agriculture, timber harvest, dam failure, rapid drawdown of dam impoundments, streambank erosion, and shifts in channel form or location are sources of sediment into Greater Redhorse habitat. Controlling sediment input into streams may be crucial to prevent detrimental effects to Greater Redhorse, because sedimentation decreases the quality and quantity of optimal habitat (i.e., spawning , feeding) for this species. Sedimentation eliminates interstitial spaces which could be critical for egg deposition and development and for production of benthic organisms, a primary food source for Greater Redhorse. Specialized benthic feeders, such as greater redhorse, represent a very ecologically vulnerable group to increased sedimentation, because they are unable to modify their feeding habits. Sedimentation has been shown to cause loss or reduction in fish populations, and disrupt the feeding and reproductive activities of fish (Berkman and Rabeni 1987). The Greater

Common Name: **Greater Redhorse**
Scientific Name: **Moxostoma valenciennesi**
Species Group: **Fish**

Redhorse seems to be rare over the majority of its range (Healy 2002). Determining the primary mechanism behind this trend is a challenge. Unknown habitat problems may exist.

### Non-Habitat Threats:

Pollution

***Description of non-habitat threat(s):*** The reproductive strategy of the Greater Redhorse is a crucial aspect to its conservation. It becomes sexually mature at a late age, is highly fecund, and spawns seasonally. Disruption to the spawning efforts of this species poses a problem to population viability (i.e., week year classes over time compound negative influences and population declines). Water pollution may indirectly influence Greater Redhorse through negative impacts on its prey base. Depletion of food items will negatively affect species growth and survival.

## *Research and Monitoring Needs*

| *Type* | *Need* | *Priority* | *Description* |
|---|---|---|---|
| Research | Habitat Requirements | Low | |
| Research | Basic Life History | Low | |
| Research | Distribution and Abundance | High | Distribution, abundance and dynamics of Greater Redhorse populations in Vermont are poorly understood. |
| Research | Threats and Their Significance | High | |
| Research | Population Genetics | Low | |
| Research | Taxonomy | Low | |
| Research | Other Research | N/A | |
| Monitoring | Population Change | High | |
| Monitoring | Habitat Change | Medium | |
| Monitoring | Range Shifts | N/A | |
| Monitoring | Monitor Threats | Medium | Sediment and pollution |
| Monitoring | Other Monitoring Needs | N/A | |

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Common Name: **Greater Redhorse**
Scientific Name: **Moxostoma valenciennesi**
Species Group: **Fish**

## Species Strategies

| Strategy Type | Strategy Priority | Strategy Description | Performance Measure | Potential Partners | Potential Funding Sources |
|---|---|---|---|---|---|
| Habitat Restoration | Medium | Monitor habitat conditions & effects of stressors on habitats; restore critical habitats or ameliorate threats when/where opportunities arise to secure/restore numbers of SGCN populations & targeted abundance levels. | Increase and/or maintain available habitat (river-miles or surface acres) in terms of quantity and quality required for all life stages of the SGCN. | VDEC, VFWD, USFWS, NRCS, LCBP, watershed associations, town & regional planning & Cons Comms | VDEC (ERG, VWG), VFWD (DJ, SWG) |
| Natural Processes Restoration | Medium | Restore/maintain connectivity within aquatic systems supporting sustainable SGCN population(s); provide for safe & efficient up- and downstream SGCN passage at dams & other obstructions. | Based on historic distribution of the SGCN, number of miles of habitat to which access to critical habitat has been restored or maintained. | VDEC, VFWD, USFWS, dam owners | Dam owners |
| Natural Processes Restoration | Medium | Restore flow regimes and/or water levels that support sustainable SGCN population(s) & at targeted abundance levels. | Number of miles of SGCN habitat improved or restored. | VDEC, VFWD, USFWS, dam owners | Dam owners |
| Policy & Regulations | Medium | Currently under VFWD fishing regulations Moxostoma species are "cull" fishes and as such their harvest and collection is essentially an unregulated activity. Whether or not Moxostoma are threatened by unrestricted harvest should be reviewed. | Review was conducted and recommendations were considered. | VFWD, USFWS, NYDEC, UVM | VFWD (SWG, DJ), USFWS, UVM |
| Legislation | High | Support efforts, such as state, federal, regional and international Climate Change Action Plans to reduce greenhouse gas emissions in the Northeast and climate change risks to SGCN. | Adopt appropriate legislation & policies developed to reduce greenhouse emissions & reduce climate change risks to SGCN. | VDEC, VFWD, USFWS, NRCS, LCBP | |

Common Name: **Greater Redhorse**
Scientific Name: **Moxostoma valenciennesi**
Species Group: **Fish**

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Common Name: **Stonecat**
Scientific Name: **Noturus flavus**
Species Group: **Fish**

## Conservation Assessment

**Final Assessment:** High Priority

**Global Rank:** G5 **Global Trend:** Unknown
**State Rank:** S1 **State Trend:** Unknown
**Extirpated in VT?** No **Regional SGCN?** Yes

**Assessment Narrative:**

Two populations are known to occur in Vermont: one in the Missisquoi River and the other in the LaPlatte River. In the Missisquoi River sub-populations occur immediately below Swanton Dam and the other from that dam upriver to the Highgate Falls Dam. In the LaPlatte River sub-populations occur down- and upstream of Shelburne Falls. The Vermont Cooperative Fish and Wildlife Research Unit at the University of Vermont is currently conducting research of populations in both rivers including estimating abundance, age structure, distribution and habitat use. The project is partially funded by a Vermont Fish and Wildlife Department State Wildlife Grant. On a wide-range scale no major threats are known; however, localized threats to populations may exist such as siltation, pollution and impoundment of habitat (NatureServe 2013). Low winter flows effects on overwinter survival are believed to be the most likely factor influencing stonecat abundance in the Milk River in Alberta (ASRD 2004). During the summer of 2012, stonecat stranding and mortality was observed immediately below Swanton Dam (Pientka 2014; Puchala 2014). The lack of adequate spillage over the dam to keep stonecat habitat under water as a consequence of unusually low base river flows and dam leakage are believed to have been the cause. Chemical control of parasitic Sea Lamprey also has the potential to cause non-target mortality. Large numbers of Stonecats are typically killed when the Great Chazy River in New York is treated with lampricides. Incidental mortality has also occurred in the lower Missisquoi River when lampricide has been applied to habitat holding stonecats. Recently, the U.S. Fish & Wildlife Service announced an interest in treating the LaPlatte River with lampricide to control Sea Lamprey ammocoetes numbers there (Langdon 2014).

## Distribution

This is a North American species with a distribution described by Scott and Crossman (1973) as the St. Lawrence River and tributaries in Quebec, south in the Hudson, Allegheny and Mohawk systems in New York, west to the Appalachian Mountains, to western North Carolina and northern Alabama (Tennessee River), north through central Tennessee, west through northern Missouri, Kansas and northeastern Colorado, Wyoming to Alberta, east through North Dakota into Manitoba, southeast through the tip of Lake Superior to central Michigan, and into southern Ontario and Quebec (Scott and Crossman 1973). Only two populations of Stonecat are known to occur in Vermont. One population is located within a relatively short reach of the LaPlatte River immediately above and below the fall line; and the second is in Hungerford Brook, a tributary of the Missisquoi River. In Vermont, the species is on the eastern edge of its North American range.

### Distribution by Biophysical Region:

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

### Distribution by Watershed:

***Vermont Department of Fish and Wildlife***
***Wildlife Action Plan - Revision 2015***
***Species Conservation Report***

Common Name: **Stonecat**
Scientific Name: **Noturus flavus**
Species Group: **Fish**

**Known Watersheds**
Lake Champlain
Missisquoi River

## *Habitat Description*

Habitat Information is based on the following:

Limited Local Knowledge ☑ Extensive Local Knowledge ☑ Regional Literature ☐ General Literature ☑

The Stonecat prefers moderate currents of medium to large rocky-bottomed streams. It is absent, however, from high gradient streams with fast currents. It is also found in lakes near gravel shoals where the current is produced by wave action. The Stonecat appears to require a current to prosper, since it has been eliminated from streams where flows have been slowed by the construction of dams. It appears to be intolerant to siltation and general habitat degradation. The Stonecat is a state listed endangered species in Vermont with one known population in the state. This population is in a very short section of the river encompassing habitat immediately below and above the fall line. Population monitoring suggests the population has been declining due to unidentified causes. It appears from the literature and Vermont data from the LaPlatte River that this species requires moderate current and a low silt, coarse substrate. Stonecat prefer to use large cobble and boulders for hiding. The combination of habitat requirements of low silt, moderate current, and large substrate represent a somewhat restrictive combination within the Champlain Valley biophysical region.

### Habitat Types:

Aquatic: Fluvial

Aquatic: Large Lake Champlain Tribs Below Falls

## *Current Threats*

### Habitat Threats:

Habitat Alteration

Sedimentation

***Description of habitat threat(s):*** It has been reported that this species is sensitive to siltation but the exact mechanism of impact is not known. It may be that siltation covers the developing eggs; however, this may not be a problem, since parents are cavity nesters, preparing the nest and providing care for the young. Or, siltation may embed coarse substrate materials eliminating cover habitat and nesting sites. Since in Vermont the stonecat is only found in the LaPlatte River and Hungerford Brook, a primary conservation consideration is the limiting of upstream land use activities that increase siltation in moderate gradient habitats.

### Non-Habitat Threats:

Genetics

Loss of Prey Base

***Description of non-habitat threat(s):*** Stonecat is a benthic insectivore, specializing in aquatic insects. Excess sedimentation can impact aquatic insects populations and reduce this species' food base. This species would have difficulty shifting to non-benthic foods. Because stonecat has one of the most restricted distributions of any other fish species in Vermont, reductions in population size causing a bottleneck which could possibly result in a loss of genetic variation forfeiting the evolutionary potential of the species. Natural selection can only act in the presence of genetic variation, and therefore, the higher the genetic

Common Name: **Stonecat**
Scientific Name: **Noturus flavus**
Species Group: **Fish**

diversity in a population, the higher the likelihood for population persistence. If gene flow is limited to within one population of stonecat (estimated number probably much less than 100 individuals), the species is not prepared to adapt to environmental changes of time.

## Research and Monitoring Needs

| Type | Need | Priority | Description |
|---|---|---|---|
| Research | Habitat Requirements | High | Comparative studies of habitat occupied by the more abundant New York populations to LaPlatte River habitat. |
| Research | Basic Life History | High | |
| Research | Distribution and Abundance | High | |
| Research | Threats and Their Significance | High | |
| Research | Population Genetics | Medium | Investigate genetic characteristics of the LaPlatte River Stonecat population and genetic similarity to populations in New York. |
| Research | Taxonomy | Low | |
| Research | Other Research | N/A | |
| Monitoring | Population Change | High | |
| Monitoring | Habitat Change | Medium | |
| Monitoring | Range Shifts | N/A | |
| Monitoring | Monitor Threats | High | |
| Monitoring | Other Monitoring Needs | N/A | |

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*Wildlife Action Plan - Revision 2015*
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Common Name: **Stonecat**
Scientific Name: **Noturus flavus**
Species Group: **Fish**

## Species Strategies

| Strategy Type | Strategy Priority | Strategy Description | Performance Measure | Potential Partners | Potential Funding Sources |
|---|---|---|---|---|---|
| Awareness Raising and Communications | High | Enhance public awareness of SGCN and threats to Vermont's populations; a greater understanding of the effects of their own actions on SGCN and measures they can take to restore the population to the lake; develop public and professional partnerships to promote stewardship of aquatic habitat through outreach, education, and on-the-ground cooperative efforts. | Number of outreach efforts made to better inform the public . | VFWD, USFWS, VDEC, TNC, Echo Center, LCBP, LCI | VFWD, USFWS, VDEC, TNC, Echo Center, LCBP, LCI |
| Habitat Restoration | High | Monitor habitat conditions & effects of stressors on habitats; restore critical habitats or ameliorate threats when/where opportunities arise to secure/restore numbers of SGCN populations & targeted abundance levels. | Increase and/or maintain available habitat (river-miles or surface acres) in terms of quantity and quality required for all life stages of the SGCN. | VFWD, VDEC, USFWS, NRCS, LCBP, watershed associations , town & regional planning & Cons Comms | VDEC (ERG, VWG), VFWD (DJ, SWG) |
| Invasive Species Control & Prevention | High | Manage potential non-target impacts of the Lake Champlain Sea Lamprey control program on Stonecat populations. | Number of existing populations of Stonecat protected and sustained. | VFWD, USFWS | USFWS, VFWD |
| Natural Processes Restoration | High | Restore flow regimes and/or water levels that support sustainable SGCN population(s) & at targeted abundance levels. | Number of miles of SGCN habitat improved or restored. | VDEC, VFWD, USFWS, TU, dam owners, watershed associations , town & regional planning & Cons Comms | Dam owners |
| Natural Processes Restoration | High | Restore/maintain connectivity within aquatic systems supporting sustainable SGCN population(s); provide for safe & efficient up- and downstream SGCN passage at dams & other obstructions. | Based on historic distribution of the SGCN, number of miles of habitat to which access to critical habitat has been restored or maintained. | VDEC, VFWD, USFWS, VTrans, TU, dam owners, watershed associations , town & regional planning & Cons Comms | Dam owners, VFWD (SWG), USFWS, VDEC, VTrans |

Common Name: **Stonecat**
Scientific Name: **Noturus flavus**
Species Group: **Fish**

| | | | | | |
|---|---|---|---|---|---|
| Habitat Restoration | High | Enforce and monitor compliance with applicable environmental protection laws & regulations. Monitor habitat conditions & effects of stressors on habitats; restore critical habitats or ameliorate threats when/where opportunities arise to secure/restore numbers of SGCN populations & targeted abundance levels. | Increase and/or maintain available habitat in terms of quantity and quality required for all life stages of the SGCN. | VDEC, VFWD, NHDES, NHFWD, NRCS, USFWS, CRWC, watershed associations, town & regional planning & Cons Comms | VDEC (ERG, VWG, WPAG, VBBRG, 604b), NRCS (EQIP) |

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Common Name: **Redbreast Sunfish**
Scientific Name: **Lepomis auritus**
Species Group: **Fish**

## Conservation Assessment

**Final Assessment:** Medium Priority

**Global Rank:** G5
**State Rank:** S4
**Extirpated in VT?** No

**Global Trend:** Unknown
**State Trend:** Unknown
**Regional SGCN?** Yes

**Assessment Narrative:**

Scarola (1973) reported Redbreast Sunfish to be in the New Hampshire portion of the Connecticut River watershed. More recently (2008), Yoder et al. (2010) during a fish assemblage assessment of the Connecticut River extending from Lake Francis in NH downriver to Turners Falls Dam in MA collected two Redbreast Sunfish from separate locations in the river situated between Bellows Falls and Wilder dams. NAI (2004) fish community monitoring conducted in the vicinity of Vermont Yankee Nuclear Power Station (Vernon, VT and Hinsdale, NH) captured a total of 14 Redbreast Sunfish from the Connecticut River during the years 1991-1999. Reports of the species occurring in Vermont "inland" waters, as far as known, appear to be limited to Lake Morey and Lake Fairlee. Extensive sampling in both waters over the past 25 years has not resulted in a confirmed observation of this species. This strongly suggests the species is uncommon in both the Connecticut River and likely extirpated from the two "inland" lakes where it was previously reported in Vermont.

NatureServe (2014) states there are no known threats to the species; however, dams and pollution have caused local declines. COSEWIC (2008) reports there is little information in the literature which addresses limiting factors affecting Redbreast Sunfish, although the species appears adaptable to a wide range of environmental conditions. COSEWIC (2008) identifies the shoreline development including seasonal and year-round homes, forestry and agricultural activities, and stream alterations to be the most obvious threat to the species in New Brunswick, although waterbody-specific assessments conducted in that province failed to demonstrate correlations between shore development and water quality parameters to Redbreast Sunfish abundance. Selected as a Regional-SGCN by the 13 Northeastern states in 2014

## Distribution

The Redbreast Sunfish occurs along the Atlantic Slope from New Brunswick to Florida. It is also found in Gulf Coast drainages in Georgia and Florida, north into Kentucky and Arkansas. In Vermont , Redbreast Sunfish are found in the Connecticut River and lakes Morey and Fairlee (Orange County) and the Black River (Windsor County). Historically, the species has been recorded from New York waters within the Lake Champlain drainage (e.g., Lake George and its outlet, the Mettawee River and Little Chazy River) (Greeley 1930); however, no records, past or present, are known from Lake Champlain.

**Distribution by Biophysical Region:**

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

**Distribution by Watershed:**

**Known Watersheds**
Middle Connecticut

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Common Name: **Redbreast Sunfish**
Scientific Name: **Lepomis auritus**
Species Group: **Fish**

West
Upper Connecticut-Mascoma
Black-Ottauquechee

## Habitat Description

Habitat Information is based on the following:

Limited Local Knowledge ☑ Extensive Local Knowledge ☐ Regional Literature ☐ General Literature ☑

This species inhabits the shores of lakes and ponds, and pools of clear streams with little current, but unlike other Vermont sunfishes it is more of a stream-adapted species. Aho et al. (1986) report cover, current velocity, and variables correlated with velocity (e.g., gradient, riffle/pool ratios) to be major factors determining the distribution and abundance of Redbreast Sunfish in riverine systems. Both juveniles and adults are usually found in shallow water near cover, although fish may occupy deeper habitats under warmwater summer conditions and during winter. Important cover include fallen trees, stumps and aquatic vegetation.

These hard structures appear to be important habitat components for spawning site selection. Additionally, hard structures have been attributed to being the substrate producing more than 60% of the food organisms consumed by sunfish species, including Redbreast Sunfish. Scarola (1973) states Redbreast Sunfish can be found over gravelly bottoms with or without vegetation; however, unlike the Pumpkinseed, it does not rely as much on there being aquatic vegetation present. Aho et al. (1986) quantify variables critical to habitat suitability models in both lotic and lentic environments for Redbreast Sunfish. Water temperatures regarded as suitable for growth and survival of adult and juvenile fish are assumed to be in the range of 15-35°C; for spawning and incubation the optimal range is assumed to be 21.1-27.2°C. Nests are generally constructed at depths less than 1.5 m. Water velocities at nest sites are less than 0.06 m/s with an average of 0.02 m/s. Based on available information for other sunfish species, 25-70% hard structure cover is estimated to be most productive for Redbreast Sunfish. This species appears to require a mixture of coarse sand and gravel substrate at spawning sites to be successful.

### Habitat Types:

Aquatic: Fluvial

Aquatic: Lacustrine

## Current Threats

### Habitat Threats:

Habitat Alteration

***Description of habitat threat(s):*** Abundance of hard structures for cover are critical components of Redbreast Sunfish habitat. Removal of such cover or inadequate structure being recruited into lakes and streams (e.g., from forested riparian areas) may negatively affect the suitability of habitat for this species. It may be sensitive to acidity (i.e., long term pH values <4.0 ), but is tolerant of high temperatures (<35°C) (Aho et al. 1987). Rapid reductions in water level of more than 0.9 m during the spawning season may adversely affect embryo development and survival (Aho et al. 1987).

### Non-Habitat Threats:

Pollution

***Description of non-habitat threat(s):*** Aho (1987) identify several potential threats to this species. Low

Common Name: **Redbreast Sunfish**
Scientific Name: **Lepomis auritus**
Species Group: **Fish**

to moderate turbidity levels are suitable to this species; however, excessive levels may impact fish growth and abundance. Pesticide contamination of waters supporting Redbreast Sunfish has been a suspected cause for the observed decline of some populations.

## Research and Monitoring Needs

| Type | Need | Priority | Description |
|---|---|---|---|
| Research | Habitat Requirements | Low | |
| Research | Basic Life History | Low | |
| Research | Distribution and Abundance | High | 1) Determine its distribution in Vermont waters. It may be present in more streams of suitable habitat in the Connecticut Valley than is presently known. 2) The spatial extent of its presence in the Connecticut River and its larger tributaries should also |
| Research | Threats and Their Significance | Low | Evaluate and monitor pesticide levels in known populations of Redbreast Sunfish. |
| Research | Population Genetics | Low | |
| Research | Taxonomy | Low | |
| Research | Other Research | N/A | |
| Monitoring | Population Change | Medium | Monitor known populations. |
| Monitoring | Habitat Change | Low | |
| Monitoring | Range Shifts | N/A | |
| Monitoring | Monitor Threats | Medium | |
| Monitoring | Other Monitoring Needs | N/A | |

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Common Name: **Redbreast Sunfish**
Scientific Name: **Lepomis auritus**
Species Group: **Fish**

## Species Strategies

| Strategy Type | Strategy Priority | Strategy Description | Performance Measure | Potential Partners | Potential Funding Sources |
|---|---|---|---|---|---|
| Awareness Raising and Communications | High | Enhance public awareness of SGCN and threats to Vermont's populations; a greater understanding of the effects of their own actions on SGCN and measures they can take to restore the population to the lake; develop public and professional partnerships to promote stewardship of aquatic habitat through outreach, education, and on-the-ground cooperative efforts. | Number of outreach efforts made to better inform the public . | VFWD, CRWC, TNC | |
| Habitat Restoration | Medium | Monitor habitat conditions & effects of stressors on habitats; restore critical habitats or ameliorate threats when/where opportunities arise to secure/restore numbers of SGCN populations & targeted abundance levels. | Increase and/or maintain available habitat (river-miles or surface acres) in terms of quantity and quality required for all life stages of the SGCN. | VDEC, VFWD, CRWC, TNC | VDEC (ERG, VWG), VFWD (DJ, SWG) |
| Natural Processes Restoration | Medium | Restore flow regimes and/or water levels that support sustainable SGCN population(s) & at targeted abundance levels. | Number of miles of SGCN habitat improved or restored. | VDEC, VFWD, CRWC, TNC, lake associations , dam owners | Lake associations, dam owners |
| Habitat Restoration | High | Enforce and monitor compliance with applicable environmental protection laws & regulations. Monitor habitat conditions & effects of stressors on habitats; restore critical habitats or ameliorate threats when/where opportunities arise to secure/restore numbers of SGCN populations & targeted abundance levels. | Increase and/or maintain available habitat in terms of quantity and quality required for all life stages of the SGCN. | VDEC, VFWD, NHDES, NHFWD, NRCS, USFWS, CRWC, watershed associations , town & regional planning & Cons Comms | VDEC (ERG, VWG, WPAG, VBBRG, 604b), NRCS (EQIP) |

Common Name: **Redbreast Sunfish**
Scientific Name: **Lepomis auritus**
Species Group: **Fish**

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*Wildlife Action Plan - Revision 2015*
*Species Conservation Report*

Common Name: **Eastern Sand Darter**
Scientific Name: **Ammocrypta pellucida**
Species Group: **Fish**

## Conservation Assessment

**Final Assessment:** High Priority

**Global Rank:** G3 **Global Trend:** Unknown
**State Rank:** S1 **State Trend:** Unknown
**Extirpated in VT?** No **Regional SGCN?** Yes

**Assessment Narrative:**

The number of populations known to occur in Vermont stands at four located in the Missisquoi, Lamoille, Winooski and Poultney rivers (Grandmaison et al. 2004; Langdon 2014), or five if the Winooski River is considered to have two populations separated by the natural fall line (present day Winooski One dam). Vermont populations are disjunct from the species' main distribution which encompasses the Midwestern states. Although populations in the Vermont are presumed to be stable, systematic and temporal assessments have not been conducted to quantify abundance trends. However, there is general agreement that the abundance of the species is declining throughout much of its continental range (Kuehne and Barbour 1983 cited in Grandmaison et al. 2004). Various sources summarized by Grandmaison et al. (2004) speculate that Vermont populations at present appear to be abundant enough to be viable; however, historical data and current monitoring activities are inadequate or lacking from which confident abundance trends can be derived and such conclusions are at best speculative. Grandmaison et al. (2004) present a summary of potential threats to Eastern Sand Darters in nine states within the species range. The most cited threats to the species are habitat destruction or degradation resulting from impoundment, channelization, channel dredging and siltation. Threats identified for Vermont populations are sedimentation resulting from bank erosion and storm water discharges; water quality degradation from livestock manure runoff, and chemicals and other catastrophic spills. The potential for sedimentation to impair critical habitat necessary for Eastern Sand Darters is a persistent problem within its Vermont range given most of the populations lie within drainages with high agricultural and land development activity. Sea Lamprey control measures employing lampricides (e.g. TFM) have also been a concern in Vermont. Bioassay testing on sand darters has determined the maximum no-effect concentration is 1.3 to 1.4 times the minimum lethal concentration of TFM needed to control Sea Lamprey. The range of Eastern Sand Darter encompasses nine states and two Canadian provinces. Of these, it is a species of special concern in two (Indiana, Ohio), threatened in five (Illinois, Michigan, New York, Vermont, Canada) and endangered in one (Pennsylvania) (Grandmaison et al. 2004). Selected as a Regional-SGCN by the 13 Northeastern states in 2014.

## Distribution

Eastern Sand Darters range from the St. Lawrence River drainage, southern Quebec, Vermont and New York; through the Great Lakes and Ohio River basins from western New York to eastern Illinois; and south to Kentucky (Page and Burr 1991). In Vermont, populations are known to occur below the fall line in the Missisquoi, Lamoille, Winooski, and Poultney rivers. There is one recent occurrence of the species being collected from above the fall line on the Winooski River. One individual has also been collected in Lake Champlain at the mouth of the Lamoille River in Malletts Bay. During Lake Sturgeon larval drift sampling downstream of Swanton Dam sand darters have been captured which occurred during a Missisquoi River high flow event (MacKenzie 2015). It is believed that the darters originated from above the dam but were transported downstream by the high water as there is little to no sand darter habitat downstream of the dam. In Vermont, this species is on the eastern edge of its range.

**Distribution by Biophysical Region:**

| | | | |
|---|---|---|---|
| **Champlain Valley** | Confident | **Southern VT Piedmont** | Not Probable |
| **Champlain Hills** | Not Probable | **Vermont Valley** | Not Probable |

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Common Name: **Eastern Sand Darter**
Scientific Name: **Ammocrypta pellucida**
Species Group: **Fish**

| | | | |
|---|---|---|---|
| **Northern Green Mtns** | Not Probable | **Southern Green Mtns** | Not Probable |
| **Northern VT Piedmont** | Not Probable | **Taconic Mtns** | Not Probable |
| **Northeastern Highlands** | Not Probable | | |

**Distribution by Watershed:**

**Known Watersheds**

Lake Champlain

Lamoille River

Missisquoi River

Winooski River

## *Habitat Description*

Habitat Information is based on the following:

Limited Local Knowledge ☑ Extensive Local Knowledge ☐ Regional Literature ☐ General Literature ☑

The Eastern Sand Darter shows a strong preference for sandy areas of rivers and streams with slow to moderate currents, where it spends most of its time burrowed into the sand with only its eyes or head protruding. It has also been reported from sandy shoals in Lake Erie, but has not been reported in Lake Champlain, except for one individual at the mouth of the Lamoille River in Malletts Bay. The Eastern Sand Darter requires medium to fine sand, so water velocity and sedimentation are important factors in habitat suitability. Habitat use and preference studies indicate that the fish use areas with a large percentage of sand particles 0.23 to 1 mm in size. It is quite sensitive to sedimentation and poor water quality.

## *Current Threats*

### Habitat Threats:

Habitat Alteration

Sedimentation

***Description of habitat threat(s):*** The range of the Eastern Sand Darter is believed to be shrinking due to the loss of clean sand habitat caused by increased siltation from soil erosion and agricultural activities. Hydroelectric power generation should be regulated to maintain suitable flows and habitat.

***Description of non-habitat threat(s):*** Chemical lampricides (TFM and TFM/Niclosamide) are used extensively in the Lake Champlain watershed for the control of Sea Lamprey ammocoetes reducing adult lamprey parasitism rates on other fish species inhabiting the lake, such as Lake trout, Landlocked Atlantic Salmon, Walleye, Lake Sturgeon and whitefish. Non-target impacts on other fishes, including state threatened Eastern Sand darter, have been and continue to be a concern. TFM toxicity tests conducted on adult sand darters show it to be one of the more TFM-resistant darter species (LCFWMC 2001). Nonetheless concerns remain regarding long-term lampricide effects on sand darters at the population level. To date annual assessments of darter populations in treatment streams have not been designed or carried out to demonstrate that darter abundance is being maintained at no-effect levels.

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Common Name: **Eastern Sand Darter**
Scientific Name: **Ammocrypta pellucida**
Species Group: **Fish**

## Research and Monitoring Needs

| Type | Need | Priority | Description |
|---|---|---|---|
| Research | Habitat Requirements | Medium | Determination of optimal microhabitat requirements (e.g., depth, velocity and substrate). |
| Research | Basic Life History | Medium | |
| Research | Distribution and Abundance | High | Increase sampling efforts in rivers with known populations, including sampling beyond known areas of occurrence. |
| Research | Threats and Their Significance | High | Effects of limiting factors (e.g., hydro-generation) on habitat, and possible long term effects of lampricide treatment on populations. |
| Research | Population Genetics | Medium | How closely are Vermont populations linked genetically to one another and to other populations located outside of the state. |
| Research | Taxonomy | Low | |
| Research | Other Research | Low | Diet studies. |
| Monitoring | Population Change | High | |
| Monitoring | Habitat Change | Medium | |
| Monitoring | Range Shifts | N/A | |
| Monitoring | Monitor Threats | High | |
| Monitoring | Other Monitoring Needs | N/A | |

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Common Name: **Eastern Sand Darter**
Scientific Name: **Ammocrypta pellucida**
Species Group: **Fish**

## Species Strategies

| Strategy Type | Strategy Priority | Strategy Description | Performance Measure | Potential Partners | Potential Funding Sources |
|---|---|---|---|---|---|
| Awareness Raising and Communications | High | Enhance public awareness of SGCN and threats to Vermont's populations; a greater understanding of the effects of their own actions on SGCN and measures they can take to restore the population to the lake; develop public and professional partnerships to promote stewardship of aquatic habitat through outreach, education, and on-the-ground cooperative efforts. | Number of outreach efforts made to better inform the public . | VFWD, USFWS, VDEC, TNC, Echo Center, LCBP, LCI | VFWD, USFWS, VDEC, TNC, Echo Center, LCBP, LCI |
| Habitat Restoration | High | Monitor habitat conditions & effects of stressors on habitats; restore critical habitats or ameliorate threats when/where opportunities arise to secure/restore numbers of SGCN populations & targeted abundance levels. | Increase and/or maintain available habitat (river-miles or surface acres) in terms of quantity and quality required for all life stages of the SGCN. | VDEC, VFWD, USFWS, NRCS, LCBP, watershed associations, town & regional planning & Cons Comms | VDEC (ERG, VWG), VFWD (DJ, SWG) |
| Natural Processes Restoration | Medium | Restore/maintain connectivity within aquatic systems supporting sustainable SGCN population(s); provide for safe & efficient up- and downstream SGCN passage at dams & other obstructions. | Based on historic distribution of the SGCN, number of miles of habitat to which access to critical habitat has been restored or maintained. | VDEC, VFWD, USFWS, dam owners | Dam owners |
| Natural Processes Restoration | High | Restore flow regimes and/or water levels that support sustainable SGCN population(s) & at targeted abundance levels. | Number of miles of SGCN habitat improved or restored. | VDEC, VFWD, USFWS, dam owners | Dam owners |
| Habitat Restoration | High | Enforce and monitor compliance with applicable environmental protection laws & regulations. Monitor habitat conditions & effects of stressors on habitats; restore critical habitats or ameliorate threats when/where opportunities arise to secure/restore numbers of SGCN populations & targeted abundance levels. | Increase and/or maintain available habitat in terms of quantity and quality required for all life stages of the SGCN. | VDEC, VFWD, NHDES, NHFWD, NRCS, USFWS, CRWC, watershed associations, town & regional planning & Cons Comms | VDEC (ERG, VWG, WPAG, VBBRG, 604b), NRCS (EQIP) |

Common Name: **Eastern Sand Darter**
Scientific Name: **Ammocrypta pellucida**
Species Group: **Fish**

| | | | | | |
|---|---|---|---|---|---|
| Invasive Species Control & Prevention | High | Manage potential non-target impacts of the Lake Champlain Sea Lamprey control program on Eastern Sand Darter populations. | Number of existing populations of Eastern Sand Darter protected and sustained. | VFWD, USFWS | USFWS, VFWD |
| Invasive Species Control & Prevention | High | Adopt/implement appropriate actions that minimize the potential for new invasive species introductions of potential threat to SGCN; control in-state invasive species populations when/where opportunities avail. | No increase in numbers of invasive organisms in habitat occupied by the SGCN. | VDEC, USFWS, LCBP | VDEC (ANCG) |

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Common Name: **Channel Darter**
Scientific Name: **Percina copelandi**
Species Group: **Fish**

## Conservation Assessment

**Final Assessment:** High Priority

**Global Rank:** G4 **Global Trend:** Unknown
**State Rank:** S1 **State Trend:** Unknown
**Extirpated in VT?** No **Regional SGCN?** Yes

**Assessment Narrative:**

Four populations are currently known in Vermont. These are located in the Winooski, LaPlatte and Poultney rivers. Little, if anything, is known of the size, structure, and trends of these populations. Channel Darter has very specific habitat requirements and as such populations tend to restricted is size and distribution (COSEWIC 2002). NatureServe (2014) ranks the overall threat to populations to be high with reductions of Channel Darter populations occurring throughout its continental range. Threats to populations include habitat loss and degradation due to siltation, pollution, flow modification, and impoundments; fragmented populations have a reduced likelihood of recovering (COSEWIC 2002; NatureServe 2014). Potential causes of declines in Lake Erie include eutrophication, shoreline modifications from development, and invasive Round Goby (NatureServe 2014). Population declines and extirpation of some populations have been reported from Lake Erie, Ohio, Michigan, Ontario and Quebec (NatureServe 2014). Selected as an Regional-SGCN by the 13 Northeastern states in 2014.

## Distribution

This is a wide ranging species but is highly localized in the St. Lawrence, Great Lakes and Mississippi River drainages from southern Quebec and Vermont, south to northern Louisiana; along the Gulf Slope in Mobile, Pascagoula and Pearl River drainages (Page and Burr 1991). In Vermont, the species is on the eastern edge of its range with populations known to occur below the fall line in the Winooski, LaPlatte and Poultney rivers. There is a historic record from Lake Champlain on the New York side (Greeley 1930); however, no occurrences have been made within the Vermont portion of the lake.

**Distribution by Biophysical Region:**

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

**Distribution by Watershed:**

**Known Watersheds**
Winooski River

## Habitat Description

Habitat Information is based on the following:

Limited Local Knowledge ☑ Extensive Local Knowledge ☐ Regional Literature ☐ General Literature ☑

The Channel Darter is a bottom dweller of gravelly or sandy shoals of warm lakes and rivers. In rivers, it is found in areas with coarse sand and gravel substrate. These areas have low to moderate current, but enough

Common Name: **Channel Darter**
Scientific Name: **Percina copelandi**
Species Group: **Fish**

water velocity to prevent silt deposition. Channel Darters are found in areas with substrates composed of gravel and sand. Preferred habitat is low in sediments and turbidity. Some studies of spawning in rivers and aquaria indicate that Channel Darters require swift currents (0.03-0.04 m/sec) presumably with gravel substrate.

### Habitat Types:

Aquatic: Lacustrine

Aquatic: Lake Champlain

Aquatic: Man-Made Water Bodies

## *Current Threats*

### Habitat Threats:

Habitat Alteration

Sedimentation

***Description of habitat threat(s):*** Channel darters are limited by the loss of clean gravel substrate resulting from increased siltation and turbidity from soil erosion and agricultural activities. Alteration of river flow regimes from hydroelectric power generation may also degrade habitat quality.

***Description of non-habitat threat(s):*** Chemical lampricides (TFM and TFM/Niclosamide) are used extensively in the Lake Champlain watershed for the control of Sea Lamprey ammocoetes reducing adult lamprey parasitism rates on other fish species inhabiting the lake, such as Lake trout, Landlocked Atlantic Salmon, Walleye, Lake Sturgeon and whitefish. Non-target impacts on other fishes, including state endangered Channel Darter, have been and continue to be a concern. TFM toxicity tests conducted on adult Channel Darters show it to be moderately sensitive to TFM (LCFWMC 2001). Concerns remain regarding long-term lampricide effects on Channel Darters at the population level. To date annual assessments of darter populations in treatment streams have not been designed or carried out to demonstrate that darter abundance is being maintained at no-effect levels.

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Common Name: **Channel Darter**
Scientific Name: **Percina copelandi**
Species Group: **Fish**

## Research and Monitoring Needs

| Type | Need | Priority | Description |
|---|---|---|---|
| Research | Habitat Requirements | Medium | |
| Research | Basic Life History | Low | |
| Research | Distribution and Abundance | High | Increase sampling efforts in rivers with known populations, including sampling beyond known areas of occurrence. |
| Research | Threats and Their Significance | High | |
| Research | Population Genetics | Low | |
| Research | Taxonomy | Low | |
| Research | Other Research | N/A | |
| Monitoring | Population Change | High | |
| Monitoring | Habitat Change | High | |
| Monitoring | Range Shifts | N/A | |
| Monitoring | Monitor Threats | High | Monitor impacts of sea lamprey control in the Lake Champlain watershed on channel darter populations. |
| Monitoring | Other Monitoring Needs | N/A | |

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Common Name: **Channel Darter**
Scientific Name: **Percina copelandi**
Species Group: **Fish**

## Species Strategies

| Strategy Type | Strategy Priority | Strategy Description | Performance Measure | Potential Partners | Potential Funding Sources |
|---|---|---|---|---|---|
| Awareness Raising and Communications | High | Enhance public awareness of SGCN and threats to Vermont's populations; a greater understanding of the effects of their own actions on SGCN and measures they can take to restore the population to the lake; develop public and professional partnerships to promote stewardship of aquatic habitat through outreach, education, and on-the-ground cooperative efforts. | Number of outreach efforts made to better inform the public . | VFWD, USFWS, VDEC, TNC, Echo Center, LCBP, LCI | VFWD, USFWS, VDEC, TNC, Echo Center, LCBP, LCI |
| Habitat Restoration | High | Monitor habitat conditions & effects of stressors on habitats; restore critical habitats or ameliorate threats when/where opportunities arise to secure/restore numbers of SGCN populations & targeted abundance levels. | Increase and/or maintain available habitat (river-miles or surface acres) in terms of quantity and quality required for all life stages of the SGCN. | VFWD, VDEC, USFWS, NRCS, LCBP, watershed associations , town & regional planning & Cons Comms | VDEC (ERG, VWG), VFWD (DJ, SWG) |
| Natural Processes Restoration | High | Restore flow regimes and/or water levels that support sustainable SGCN population(s) & at targeted abundance levels. | Number of miles of SGCN habitat improved or restored. | VDEC, VFWD, USFWS, TU, dam owners, watershed associations , town & regional planning & Cons Comms | Dam owners |
| Invasive Species Control & Prevention | High | Manage potential non-target impacts of the Lake Champlain Sea Lamprey control program on Channel Darter populations. | Number of existing populations of Channel Darter protected and sustained. | VFWD, USFWS | USFWS, VFWD |
| Habitat Restoration | High | Enforce and monitor compliance with applicable environmental protection laws & regulations. Monitor habitat conditions & effects of stressors on habitats; restore critical habitats or ameliorate threats when/where opportunities arise to secure/restore numbers of SGCN populations & targeted abundance levels. | Increase and/or maintain available habitat in terms of quantity and quality required for all life stages of the SGCN. | VDEC, VFWD, NHDES, NHFWD, NRCS, USFWS, CRWC, watershed associations , town & regional planning & Cons Comms | VDEC (ERG, VWG, WPAG, VBBRG, 604b), NRCS (EQIP) |

Common Name: **Channel Darter**
Scientific Name: **Percina copelandi**
Species Group: **Fish**

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Common Name: **Sauger**
Scientific Name: **Sander canadense**
Species Group: **Fish**

## Conservation Assessment

**Final Assessment:** High Priority

**Global Rank:** G5 **Global Trend:** Unknown
**State Rank:** S4S5 **State Trend:** Declining
**Extirpated in VT?** No **Regional SGCN?** Yes

**Assessment Narrative:**

Lake Champlain supports the only Sauger population in Vermont, where the species is on the eastern edge of its continental range. In Lake Champlain, historically they were more abundant in the southern than northern portion of the lake (Halnon 1963). Once described as common in Lake Champlain (Anderson 1978), Saugers have been rarely seen during the last 20 years (MacKenzie 2014) and has apparently declined to the point that it eluded detection by New York and Vermont fisheries biologists from 1994 (Nettles et al. 2005) until 2010 (NYDEC 2013). The species was once widely distributed in New York but is now extirpated from much of its historic range with exception of Lake Champlain. Sauger has declined in abundance and distribution across its range (Rawson and Scholl 1978; Hesse 1994; Pegg et al. 1997). Threats to the species include angler harvest, channelization, water flow fluctuations, migration barriers, loss of spawning and rearing habitat, and environmental degradation (Rawson and Scholl 1978; Hesse 1994; Pegg et al. 1997). Selected as an Regional-SGCN by the 13 Northeastern states in 2014.

## Distribution

The distribution of sauger in North America is from the St. Lawrence-Lake Champlain system south, west of the Appalachian Mountains to Tennessee River in Alabama, southwest to northern Louisiana, northwest through eastern Oklahoma to central Montana and central Alberta east below James Bay to Quebec (Scott and Crossman 1998). The distribution of Sauger in Vermont is limited to Lake Champlain, where it may have been more numerous in the southern portion of the lake. Anderson (1978) reported Sauger to be present in all sections of the lake except for the Main Lake.

**Distribution by Biophysical Region:**

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

**Distribution by Watershed:**

**Known Watersheds**
Lake Champlain

## Habitat Description

Habitat Information is based on the following:

Limited Local Knowledge ☑ Extensive Local Knowledge ☐ Regional Literature ☐ General Literature ☑

Many of the general habitat requirements are similar between Sauger and walleye; however, Sauger habitat preferences are for large, shallow sections of lakes which are turbid with colloidal clay suspension, as well as

Common Name: **Sauger**
Scientific Name: **Sander canadense**
Species Group: **Fish**

large, turbid, slow flowing rivers (Anderson 1978; Scott and Crossman 1978). Scott and Crossman (1978) considered Sauger "less adaptable" than walleye because of these preferences. Walleye and Sauger may utilize the same shoals or gravel to rubble in large turbid lakes for spawning (Scott and Crossman 1978). Preferred spawning habitats are shallow shoreline and shoals of lakes and riffles in rivers, including areas immediately below dams providing there is rocky substrate and good water circulation from wave action and river currents (McMahon et al. 1984). Sauger have been found to be highly selective for spawning sites and in some parts of their range have been shown to be reliant on access to a few discrete areas in large tributaries (Nelson 1968; Gardner and Steward 1987; Penkal 1992; Jaeger 2004). Sauger fry must reach their initial feeding grounds within 3-5 days before yolk-sac absorption or they will perish from lack of food (McMahon et al. 1984).

### Habitat Types:

Aquatic: Fluvial

Aquatic: Lacustrine

Aquatic: Lake Champlain

## *Current Threats*

### Habitat Threats:

Habitat Alteration

Habitat Fragmentation

Invasion by Exotic Species

***Description of habitat threat(s):*** Sauger are considered to be the most migratory percid and are heavily dependent dependent throughout their life history on unimpeded access to a wide diversity of physical habitats (Collette 1977; Jaeger 2004). The historic spawning grounds of Sauger in Lake Champlain are not well known. Undoubtedly, dams have decreased their accessibility to many of the historical spawning grounds in the basin. For example, recent Lake Sturgeon and Walleye habitat assessments conducted on the Missisquoi River indicate most of the quality spawning habitat occurs above Swanton Dam (Madeline Lyttle, U. S. Fish and Wildlife Service, personal communication). Sauger also appear to be sensitive to changes in water quality. Sauger may be more dominant than Walleye under very turbid water conditions where they co- occur; however, dominance may shift with changing water quality (Scott and Crossman 1998). Improvements in Lake Champlain water quality may explain the perceived reduction in Sauger abundance, but this needs to be investigated.

### Non-Habitat Threats:

Competition

***Description of non-habitat threat(s):*** The Sauger population was once abundant in portions of Lake Champlain and were captured in considerable numbers as recently as the 1980s. Recent surveys of the South Bay, where Sauger was formerly abundant, failed to produce even in a single capture. Predation by native species, such as Smallmouth Bass (Johnson and Hale 1977) have been found to influence recruitment of walleye, a close relative to Sauger, in natural systems (as referenced in Quist et al. 2003). Others have speculated that native piscivorous predators, such Northern Pike, Smallmouth Bass, Lake Trout, Burbot and Atlantic Salmon, can be a major source of mortality for age-0 Walleye in Lake Champlain (Frater 2002). We would expect these interactions to be as important, if not more so, for Sauger. For example, the introduction of Black Crappie in Black Lake (New York) was believed to have caused successive Walleye year-class failures (Schiavone 1983). While Black Crappies are believed to be native to Lake Champlain, its cogener the White Crappie is not. It too has been found to be a significant walleye fry predator in some

Common Name: **Sauger**
Scientific Name: **Sander canadense**
Species Group: **Fish**

systems (Quist et al. 2003). White crappies are known to occur in large numbers in areas where Sauger were historically abundant, e.g. South Bay (David Nettles, U. S. Fish and Wildlife Service, personal communication). Another exotic in Lake Champlain, the White Perch, has been found to be an important predator of Walleye eggs (Roseman et al. 1996; Schaeffer and Margraf 1987). White Perch have become or are becoming one of the most dominant species in the fish assemblage in some areas of the lake, e.g. Missisquoi Bay (Pierre Bilodeau, Quebec Parks and Wildlife, personnel communication).

## Research and Monitoring Needs

| Type | Need | Priority | Description |
|---|---|---|---|
| Research | Habitat Requirements | Medium | |
| Research | Basic Life History | Low | |
| Research | Distribution and Abundance | High | Determine the current population status of Sauger in Lake Champlain (Vermont and New York sections), and identify critical spawning and juvenile habitats. |
| Research | Threats and Their Significance | High | 1) Determine the effect of recent invasions of non-indigenous species (e.g., White Crappie, White Perch, Zebra Mussel) on Sauger in Lake Champlain. 2) Determine the effect, if any, changing water quality may have on the Sauger population. |
| Research | Population Genetics | Low | |
| Research | Taxonomy | Low | |
| Research | Other Research | N/A | |
| Monitoring | Population Change | High | |
| Monitoring | Habitat Change | Low | |
| Monitoring | Range Shifts | N/A | |
| Monitoring | Monitor Threats | Medium | |
| Monitoring | Other Monitoring Needs | N/A | |

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Common Name: **Sauger**
Scientific Name: **Sander canadense**
Species Group: **Fish**

## Species Strategies

| Strategy Type | Strategy Priority | Strategy Description | Performance Measure | Potential Partners | Potential Funding Sources |
|---|---|---|---|---|---|
| Awareness Raising and Communications | | Enhance public awareness of SGCN and threats to Vermont's populations; a greater understanding of the effects of their own actions on SGCN and measures they can take to restore the population to the lake; develop public and professional partnerships to promote stewardship of aquatic habitat through outreach, education, and on-the-ground cooperative efforts. | Number of outreach efforts made to better inform the public . | VFWD, USFWS, VDEC, TNC, Echo Center, LCBP, LCI | VFWD, USFWS, VDEC, TNC, Echo Center, LCBP, LCI |
| Habitat Restoration | Medium | Enforce and monitor compliance with applicable environmental protection laws & regulations. Monitor habitat conditions & effects of stressors on habitats; restore critical habitats or ameliorate threats when/where opportunities arise to secure/restore numbers of SGCN populations & targeted abundance levels. | Increase and/or maintain available habitat in terms of quantity and quality required for all life stages of the SGCN. | VDEC, VFWD, NHDES, NHFWD, NRCS, USFWS, CRWC, watershed associations , town & regional planning & Cons Comms | VDEC (ERG, VWG, WPAG, VBBRG, 604b), NRCS (EQIP) |
| Habitat Restoration | High | Increase and/or maintain available habitat (river-miles or surface acres) in terms of quantity and quality required for all life stages of the SGCN. | Change in habitat quantify and quality | USFWS, NRCS, DEC, VT Rivers Conservanc y | ANR, DEC, NRCS, FSA |

Common Name: **Sauger**
Scientific Name: **Sander canadense**
Species Group: **Fish**

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