

APPENDIX B

Data Integration Rules

Maine—Data Integration Rules

Three key questions arose during the data compilation process:

1. If traits data for taxa are available from multiple sources, which source should we use? What if they differ?
2. How do we assign genus-level traits information if only species-level information is available? What if trait states vary among species within the genera?
3. What if traits are co-occurring (more than one trait state is appropriate and is, therefore, listed)? This was particularly relevant for functional feeding group (FFG) and habit traits.

Integration rules were developed to maintain consistency when addressing these issues. For most of the traits, the Poff et al. (2006) Traits Matrix was given top priority. If the Traits Matrix lacked information for certain taxa, the U.S. Geological Survey (USGS) traits database (i.e., Vieira et al., 2006) received next highest priority, followed by the U.S. Environmental Protection Agency's (EPAs) 1970s publications. Weighted-average- and maximum-likelihood calculations received top priority for the temperature preference and tolerance trait assignments. All operational taxonomic units (OTUs) in the state biomonitoring databases, including rare taxa, were included in the Maine traits table. This is because the database is meant to be a living document reflecting user-generated content: individuals using the database can fill in or update information as it becomes available. People using the database are encouraged to check the traits information and customize it as necessary so that the information is more accurate for taxa occurring in their region (in FFG and habit, for which only primary trait state assignments were made).

The traits information that was entered into the Maine traits table came from a number of different sources. Sometimes the sources had slight differences in how traits were categorized and in some of the thresholds that were used when assigning trait states. Another issue was that traits information for certain taxa was available from several different sources, so a decision had to be made about which source to use (sources were generally in agreement, but sometimes slight differences existed). Because of these issues, decisions had to be made during the entry process. One involved interpreting literature in order to get the trait state information into a standardized and usable format for analyses. The other involved deciding which source to use. Rules were

developed for the following trait state entries: voltinism, development, life span, dispersal, armoring, size, rheophily, functional feeding group, habit, tolerance values and thermal preference, and tolerance. They are summarized in Tables B-1 through B-11.

Table B-1. Maine—integration rules that were used when assigning voltinism trait states to taxa

| Trait | Source | Original Trait States | Assigned Trait States |
|-----------|--|------------------------|-----------------------|
| Voltinism | Poff et al. (2006) | Semivoltine | Semivoltine |
| | | Univoltine | Univoltine |
| | | Bi- or multivoltine | Bi- or multivoltine |
| Voltinism | Vieira et al. (2006) | <1 Generation per year | Semivoltine |
| | | 1 Generation per year | Univoltine |
| | | >1 Generation per year | Bi- or multivoltine |
| Rules | <ol style="list-style-type: none"> 1. Use the Poff et al. (2006) entries (for genus-level matches). 2. Use the Vieira et al. (2006) entries. Many of the Vieira et al., 2006 entries went to species-level. If trait states varied among species within a genus, <ol style="list-style-type: none"> a. The trait state that was most frequently recorded was used (= majority rules). b. If different trait states occurred with the same frequency, the Volt_Comments field was referenced. If it mentioned that one state was more typical than another, the more typical state was used. c. If Volt_Comments was not helpful, the trait state with the higher number of generations was chosen. For example, if there was one 'univoltine' entry and one 'semivoltine' entry, the 'univoltine' entry was chosen. | | |

Table B-2. Maine—integration rules that were used when assigning development trait states to taxa

| Trait | Source | Original Trait States | Assigned Trait States |
|-------------|--|-----------------------|-----------------------|
| Development | Poff et al. (2006) | Fast seasonal | Fast |
| | | Slow seasonal | Slow |
| | | Nonseasonal | Non |
| Dev_Speed | Vieira et al. (2006) | Fast seasonal | Fast |
| | | Slow seasonal | Slow |
| | | Nonseasonal | Non |
| Rules | <ol style="list-style-type: none"> 1. Use the Poff et al. (2006) entries (for genus-level matches). 2. Use the Vieira et al. (2006) entries. | | |

Table B-3. Maine—integration rules that were used when assigning life span trait states to taxa

| Trait | Source | Original Trait States | Assigned Trait States |
|-----------------|---|-----------------------|-----------------------|
| Adult Life Span | Poff et al. (2006) | Very short | Very short |
| | | Short | Short |
| | | Long | Long |
| Adult_lifespan | Vieira et al. (2006) | Hours | Very short |
| | | Days | Very short |
| | | Weeks | Short |
| | | Months | Long |
| Rules | <ol style="list-style-type: none"> 1. Use the Poff et al. (2006) entries (for genus-level matches). 2. Use the Vieira et al. (2006) entries (reference Adult_lifespan_comments if necessary). | | |

Table B-4. Maine—integration rules that were used when assigning dispersal trait states to taxa

| Trait | Source | Original Trait States | Assigned Trait States |
|------------------|---|--|-----------------------|
| Female Dispersal | Poff et al. (2006) | Low (<1 km flight before laying eggs) | Low |
| | | High (>1 km flight before laying eggs) | High |
| Adult Dispersal | Vieira et al. (2006) | 1 km or less | Low |
| | | 10 km or less | High |
| | | 10 m or less | NA |
| | | 100 km or less | High |
| Rules | <ol style="list-style-type: none"> 1. Use the Poff et al. (2006) entries (for genus-level matches). 2. Use the Vieira et al. (2006) entries. | | |
| Notes | <p>In the Poff et al. (2006) table, it specifies 'female dispersal.' In the Vieira et al. (2006) traits database, it specifies 'Adult dispersal.' It was assumed that the information was compatible between sources. In Vieira et al. (2006), there is an entry '10 m or less.' It appears that this was a typo (it likely should have been '10 km or less'). Therefore, this category was excluded.</p> | | |

Table B-5. Maine—integration rules that were used when assigning armoring trait states to taxa

| Trait | Source | Original Trait States | Assigned Trait States |
|--------------|--|-------------------------------------|-----------------------|
| Armoring | Poff et al. (2006) | None (soft-bodied forms) | None |
| | | Poor (heavily sclerotized) | Poor |
| | | Good (e.g., some cased caddisflies) | Good |
| Armor | Vieira et al. (2006) | Soft | None |
| | | All sclerotized | Poor |
| | | Partly sclerotized | Poor |
| | | Hard shelled | Good |
| Rules | <ol style="list-style-type: none"> 1. Use the Poff et al. (2006) entries (for genus-level matches). 2. Use the Vieira et al. (2006) entries. | | |
| Notes | <p>In the Poff et al. (2006) table, it does not mention 'partly sclerotized.'</p> <p>In the Vieira et al. (2006) table, 'partly sclerotized' and 'all sclerotized' were assigned to the 'poor' category.</p> | | |

Table B-6. Maine—integration rules that were used when assigning size (at maturity) trait states to taxa

| Trait | Source | Original Trait States | Assigned Trait States |
|------------------|--|-------------------------|-----------------------|
| Size at maturity | Poff et al. (2006) | Large (length >16 mm) | Large |
| | | Medium (length 9–16 mm) | Medium |
| | | Small (length <9 mm) | Small |
| Max_Body_Size | Vieira et al. (2006) | Large (length >16 mm) | Large |
| | | Medium (length 9–16 mm) | Medium |
| | | Small (length <9 mm) | Small |
| Rules | <ol style="list-style-type: none"> 1. Use the Poff et al. (2006) entries (for genus-level matches). 2. Use the Vieira et al. (2006) entries. <p>If more than one trait state was assigned (i.e., there was variation among species within a genus):</p> <ol style="list-style-type: none"> a. The category that was most frequently recorded was used (majority rules). b. If different categories were recorded the same number of times, the 'medium' entry was used (i.e., if there was one 'small' entry and one 'medium' entry, the medium entry was used). | | |

Table B-7. Maine—integration rules that were used when assigning rheophily trait states to taxa

| Trait | Source | Original Trait States | Assigned Trait States |
|---------------|---|---|------------------------------|
| Rheophily | Poff et al. (2006) | Depositional only | Depo |
| | | Depositional and erosional | Depo_eros |
| | | Erosional | Eros |
| Rheophily | Vieira et al. (2006) | Current_quiet | Depo |
| | | Current_slow | Depo |
| | | Current_fast_lam | Eros |
| | | Current_fast_turb | Eros |
| | | More than one | If both quiet and slow, depo |
| | | Quiet and slow | Depo |
| | | Quiet and/or slow and fast (either laminar or turbid) | Depo_eros |
| Flow_pref | EPA 1970s | Standing | Depo |
| | | Slight | Depo |
| | | Standing-slight | Depo |
| | | Standing and flowing | Depo_eros |
| | | Moderate | Eros |
| | | Moderate-fast | Eros |
| | | Fast | Eros |
| | | More than one: | |
| | | Some combination of standing and/or slight and moderate and/or fast | Depo_eros |
| Rules: | <ol style="list-style-type: none"> 1. Use the Poff et al. (2006) entries (for genus-level matches). 2. Use the Vieira et al. (2006) entries. 3. Use the EPA 1970s entries. 4. If more than one trait state was assigned (i.e., there was variation among species within a genus), the category that was most frequently recorded was used (majority rules). | | |

Table B-8. Maine—integration rules that were used when assigning (primary) functional feeding group trait states to taxa

| Integration Rules for FFG: |
|---|
| <p>Only one FFG category was assigned to each taxa. The following rules were used:</p> <ol style="list-style-type: none"> 1. Use the Poff et al. (2006) entries (for genus-level matches). 2. Use the Vieira et al. (2006) entry (Feed_mode_prim). 3. Use the WSA entry from the Benthics_Master_Taxa table. 4. Use the RBP2 1999 entry from the Benthics_Master_Taxa table. 5. Use the U.S. EPA (1990) Draft entry from the Benthics_Master_Taxa table. <p>If more than one category was assigned within a genus, the one that occurred most frequently was entered (= majority rules).</p> <p>If different states were recorded the same number of times, the next source was used as a 'tie-breaker' (i.e., if Vieira et al. [2006] had two species listed as clinger [CN] and two as sprawler [SP], and the WSA entry was SP, SP was used).</p> <p>If unable to resolve based on these sources, one was randomly selected.</p> |

WSA = wadeable Streams Assessment.

Table B-9. Maine—integration rules that were used when assigning (primary) habit trait states to taxa

| Integration Rules for Habit: |
|--|
| <p>Only one habit category was assigned to each taxa. The following rules were used:</p> <ol style="list-style-type: none">1. Use the Poff et al. (2006) entries (for genus-level matches).2. Use the Vieira et al. (2006) entry (Habit_prim).3. Use the WSA entry from the Benthics_Master_Taxa table.4. Use the RBP2 1999 entry from the Benthics_Master_Taxa table.5. Use the U.S. EPA (1990) Draft entry from the Benthics_Master_Taxa table. <p>If more than one category was assigned within a genus, the one that occurred most frequently was entered (= majority rules).</p> <p>If different states were recorded the same number of times, the next source was used as a 'tie-breaker' (i.e., if Vieira et al. [2006] had two species listed as CN and two as SP, and the WSA entry was SP, SP was used).</p> <p>If unable to resolve based on these sources, one was randomly selected.</p> |

Table B-10. Maine—integration rules that were used when assigning tolerance values to taxa

| Integration Rules for Tolerance: |
|---|
| <p>Only one tolerance value was assigned to each taxa. The following rules were used:</p> <ol style="list-style-type: none">1. Use the WSA entry.2. Use the RBP2 1999 entry.3. Use the U.S. EPA (1990) Draft entry. <p>If there were more than two values from a source, the median value was used.</p> <p>If there were two entries, the higher value was used (i.e., if assigned values were 2 and 3, the 3 was used).</p> <p>NOTE: If state-specific tolerance values were provided, those were also incorporated into the traits table.</p> |

Table B-11. Maine—integration rules that were used when assigning thermal preference and tolerance values to taxa

| Traits | Source | Original Trait States | Assigned Trait States |
|--------------------|---|---|----------------------------|
| Thermal preference | Poff et al. (2006) | Cold_cool | Rank_opt = 3, Rank_tol = 3 |
| | | Cool_warm | Rank_opt = 4, Rank_tol = 5 |
| | | Warm | Rank_opt = 5, Rank_tol = 3 |
| Thermal_pref | Vieira et al. (2006) | Cold stenothermal (<5°C) | Rank_opt = 3, Rank_tol = 3 |
| | | Cold-cool eurythermal (0–15°C) | Rank_opt = 3, Rank_tol = 4 |
| | | Hot eurythermal (>30°C) | Rank_opt = 5, Rank_tol = 3 |
| | | No strong preference | Rank_opt = 4, Rank_tol = 5 |
| | | Warm eurythermal (15–30°C) | Rank_opt = 5, Rank_tol = 4 |
| | | More than one: Combination of colder and warmer categories | Rank_opt = 4, Rank_tol = 5 |
| Thermal preference | EPA 1970s | Eurythermal (≥15°C) | Rank_opt = 5, Rank_tol = 4 |
| | | Eurythermal (>30°C) | Rank_opt = 5, Rank_tol = 3 |
| | | Mesothermal (15–30°C) | Rank_opt = 5, Rank_tol = 4 |
| | | Metathermal (5–15°C) | Rank_opt = 3, Rank_tol = 3 |
| | | Oligothermal (<15°C) | Rank_opt = 3, Rank_tol = 4 |
| | | Stenothermal (≤5°C) | Rank_opt = 3, Rank_tol = 3 |
| Temp_Opt_Rank | EPA 1970s | Wide range—no apparent preference | Rank_opt = 4, Rank_tol = 5 |
| Temp_Tol_Rank | EPA 1970s | More than one: Combination of colder and warmer categories | Rank_opt = 4, Rank_tol = 5 |
| | | | |
| Rules | <ol style="list-style-type: none"> 1. Use the values generated by U.S. EPA (2011) (or from other databases, like Brandt, 2001 and Yuan, 2006). 2. Use the Poff et al. (2006) entries (for genus-level matches). 3. Use the Vieira et al. (2006) entries. 4. Use the EPA 1970s entries. <p>If more than one trait state was assigned (i.e., there was variation among species within a genus), the category that was most frequently recorded was used (majority rules).</p> | | |

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The traits information that was entered into the North Carolina traits table came from a number of different sources. Sometimes the sources had slight differences in how traits were categorized and in some of the thresholds that were used when assigning trait states. Another issue was that traits information for certain taxa was available from several different sources, so a decision had to be made about which source to use (sources were generally in agreement, but sometimes slight differences existed). Because of these issues, decisions had to be made during the entry process. One involved interpreting literature in order to get the trait state information into a standardized and usable format for analyses. The other involved deciding which source to use. Rules were developed for the following trait state entries: voltinism, development, life span, dispersal, armoring, size, rheophily, functional feeding group, habit, tolerance values and thermal preference, and tolerance. They are summarized in Tables B-12 through B-22.

Table B-12. North Carolina—integration rules that were used when assigning voltinism trait states to taxa

| Trait | Source | Original Trait States | Assigned Trait States |
|-----------|--|------------------------|-----------------------|
| Voltinism | Poff et al. (2006) | Semivoltine | Semivoltine |
| | | Univoltine | Univoltine |
| | | Bi- or multivoltine | Bi- or multivoltine |
| Voltinism | Vieira et al. (2006) | <1 Generation per year | Semivoltine |
| | | 1 Generation per year | Univoltine |
| | | >1 Generation per year | Bi- or multivoltine |
| Rules | <p>1. Use the Poff et al. (2006) entries (for genus-level matches).</p> <p>2. Use the Vieira et al. (2006) entries.</p> <p>Many of the Vieira entries went to species-level. If trait states varied among species within a genus:</p> <p>a. The trait state that was most frequently recorded was used (= majority rules).</p> <p>b. If different trait states occurred with the same frequency, the Volt_Comments field was referenced. If it mentioned that one state was more typical than another, the more typical state was used.</p> <p>c. If Volt_comments was not helpful, the trait state with the higher number of generations was chosen. For example, if there was one 'univoltine' entry and one 'semivoltine' entry, the 'univoltine' entry was chosen.</p> | | |

Table B-13. North Carolina—integration rules that were used when assigning development trait states to taxa

| Trait | Source | Original Trait States | Assigned Trait States |
|-------------|---|-----------------------|-----------------------|
| Development | Poff et al. (2006) | Fast seasonal | Fast |
| | | Slow seasonal | Slow |
| | | Nonseasonal | Non |
| Dev_Speed | Vieira et al. (2006) | Fast seasonal | Fast |
| | | Slow seasonal | Slow |
| | | Nonseasonal | Non |
| Rules | <p>1. Use the Poff et al. (2006) entries (for genus-level matches).</p> <p>2. Use the Vieira et al. (2006) entries.</p> | | |

Table B-14. North Carolina—integration rules that were used when assigning life span trait states to taxa

| Trait | Source | Original Trait States | Assigned Trait States |
|-----------------|---|-----------------------|-----------------------|
| Adult Life Span | Poff et al. (2006) | Very short | Very short |
| | | Short | Short |
| | | Long | Long |
| Adult_lifespan | Vieira et al. (2006) | Hours | Very short |
| | | Days | Very short |
| | | Weeks | Short |
| | | Months | Long |
| Rules | <ol style="list-style-type: none"> 1. Use the Poff et al. (2006) entries (for genus-level matches). 2. Use the Vieira et al. (2006) entries (reference Adult_lifespan_comments if necessary). | | |

Table B-15. North Carolina—integration rules that were used when assigning dispersal trait states to taxa

| Trait | Source | Original Trait States | Assigned Trait States |
|------------------|---|--|-----------------------|
| Female dispersal | Poff et al. (2006) | Low (<1 km flight before laying eggs) | Low |
| | | High (>1 km flight before laying eggs) | High |
| Adult dispersal | Vieira et al. (2006) | 1 km or less | Low |
| | | 10 km or less | High |
| | | 10 m or less | NA |
| | | 100 km or less | High |
| Rules | <ol style="list-style-type: none"> 1. Use the Poff et al. (2006) entries (for genus-level matches). 2. Use the Vieira et al. (2006) entries. | | |
| Notes | <p>In the Poff et al. (2006) table, it specifies 'female dispersal.' In the Vieira et al. (2006) traits database, it specifies 'Adult dispersal.' It was assumed that the information was compatible between sources. In Vieira et al. (2006), there is an entry '10 m or less.' It appears that this was a typo (it likely should have been '10 km or less'). Therefore, this category was excluded.</p> | | |

Table B-16. North Carolina—integration rules that were used when assigning armoring trait states to taxa

| Trait | Source | Original Trait States | Assigned Trait States |
|----------|--|-------------------------------------|-----------------------|
| Armoring | Poff et al. (2006) | None (soft-bodied forms) | None |
| | | Poor (heavily sclerotized) | Poor |
| | | Good (e.g., some cased caddisflies) | Good |
| Armor | Vieira et al. (2006) | Soft | None |
| | | All sclerotized | Poor |
| | | Partly sclerotized | Poor |
| | | Hard shelled | Good |
| Rules | <ol style="list-style-type: none"> 1. Use the Poff et al. (2006) entries (for genus-level matches). 2. Use the Vieira et al. (2006) entries. | | |
| Notes | <p>In the Poff et al. (2006) table, it does not mention 'partly sclerotized.'</p> <p>In the Vieira et al. (2006) table, 'partly sclerotized' and 'all sclerotized' were assigned to the 'poor' category.</p> | | |

Table B-17. North Carolina—integration rules that were used when assigning size (at maturity) trait states to taxa

| Trait | Source | Original Trait States | Assigned Trait States |
|------------------|--|-------------------------|-----------------------|
| Size at maturity | Poff et al. (2006) | Large (length >16 mm) | Large |
| | | Medium (length 9–16 mm) | Medium |
| | | Small (length <9 mm) | Small |
| Max_Body_Size | Vieira et al. (2006) | Large (length >16 mm) | Large |
| | | Medium (length 9–16 mm) | Medium |
| | | Small (length <9 mm) | Small |
| Rules | <ol style="list-style-type: none"> 1. Use the Poff et al. (2006) entries (for genus-level matches). 2. Use the Vieira et al. (2006) entries. <p>If more than one trait state was assigned (i.e., there was variation among species within a genus):</p> <ol style="list-style-type: none"> a. The category that was most frequently recorded was used (majority rules). b. If different categories were recorded the same number of times, the 'medium' entry was used (i.e., if there was one 'small' entry and one 'medium' entry, the medium entry was used). | | |

Table B-18. North Carolina—integration rules that were used when assigning rheophily trait states to taxa

| Trait | Source | Original Trait States | Assigned Trait States |
|-----------|----------------------|---|--|
| Rheophily | Poff et al. (2006) | Depositional only | Depo |
| | | Depositional and erosional | Depo_eros |
| | | Erosional | Eros |
| Rheophily | Vieira et al. (2006) | Current_quiet | Depo |
| | | Current_slow | Depo |
| | | Current_fast_lam | Eros |
| | | Current_fast_turb | Eros |
| | | More than one: Quiet and slow | If both quiet and slow, depo |
| | | Quiet and/or slow and fast (either lam or turb) | Depo_eros |
| Flow_pref | EPA 1970s | Standing | Depo |
| | | Slight | Depo |
| | | Standing-slight | Depo |
| | | Standing and flowing | Depo_eros |
| | | Moderate | Eros |
| | | Moderate-fast | Eros |
| | | Fast | Eros |
| | | More than one: Some combination of standing and/or slight and moderate and/or fast | Depo_eros |
| | | Rules | 1. Use the Poff et al. (2006) entries (for genus-level matches). 2. Use the Vieira et al. (2006) entries. 3. Use the EPA 1970s entries. If more than one trait state was assigned (i.e., there was variation among species within a genus), the category that was most frequently recorded was used (majority rules). |

Table B-19. North Carolina—integration rules that were used when assigning (primary) functional feeding group trait states to taxa

| Integration Rules for FFG: |
|--|
| <p>Only one FFG category was assigned to each taxa. The following rules were used:</p> <ol style="list-style-type: none"> 1. Use the Poff et al. (2006) entries (for genus-level matches). 2. Use the Vieira et al. (2006) entry (Feed_mode_prim). 3. Use the WSA entry from the Benthics_Master_Taxa table. 4. Use the RBP2 1999 entry from the Benthics_Master_Taxa table. 5. Use the U.S. EPA (1990) Draft entry from the Benthics_Master_Taxa table. <p>If more than one category was assigned within a genus, the one that occurred most frequently was entered (= majority rules).</p> <p>If different states were recorded the same number of times, the next source was used as a 'tie-breaker' (i.e., if Vieira et al. (2006) had two species listed as CN and two as SP, and the WSA entry was SP, SP was used).</p> <p>If unable to resolve based on these sources, one was randomly selected.</p> |

Table B-20. North Carolina—integration rules that were used when assigning (primary) habit trait states to taxa

| Integration Rules for Habit: |
|--|
| <p>Only one habit category was assigned to each taxa. The following rules were used:</p> <ol style="list-style-type: none"> 1. Use the Poff et al. (2006) entries (for genus-level matches). 2. Use the Vieira et al. (2006) entry (Habit_prim). 3. Use the WSA entry from the Benthics_Master_Taxa table. 4. Use the RBP2 1999 entry from the Benthics_Master_Taxa table. 5. Use the U.S. EPA (1990) Draft entry from the Benthics_Master_Taxa table. <p>If more than one category was assigned within a genus, the one that occurred most frequently was entered (= majority rules).</p> <p>If different states were recorded the same number of times, the next source was used as a 'tie-breaker' (i.e., if Vieira et al. (2006) had two species listed as CN and two as SP, and the WSA entry was SP, SP was used).</p> <p>If unable to resolve based on these sources, one was randomly selected.</p> |

Table B-21. North Carolina—integration rules that were used when assigning tolerance values to taxa

| Integration Rules for Tolerance: |
|---|
| <p>Only one tolerance value was assigned to each taxa. The following rules were used:</p> <ol style="list-style-type: none"> 1. Use the WSA entry. 1. Use the RBP2 1999 entry. 2. Use the U.S. EPA (1990) Draft entry. <p>If there were more than two values from a source, the median value was used.</p> <p>If there were two entries, the higher value was used (i.e., if assigned values were 2 and 3, the 3 was used).</p> <p>NOTE: if state-specific tolerance values were provided, those were also incorporated into the traits table.</p> |

Table B-22. North Carolina—integration rules that were used when assigning thermal preference and tolerance values to taxa

| Traits | Source | Original Trait States | Assigned Trait States |
|--------------------|---|---|----------------------------|
| Thermal preference | Poff et al. (2006) | Cold_cool | Rank_opt = 3, Rank_tol = 3 |
| | | Cool_warm | Rank_opt = 4, Rank_tol = 5 |
| | | Warm | Rank_opt = 5, Rank_tol = 3 |
| Thermal_pref | Vieira et al. (2006) | Cold stenothermal (<5°C) | Rank_opt = 3, Rank_tol = 3 |
| | | Cold-cool eurythermal (0–15°C) | Rank_opt = 3, Rank_tol = 4 |
| | | Hot eurythermal (>30°C) | Rank_opt = 5, Rank_tol = 3 |
| | | No strong preference | Rank_opt = 4, Rank_tol = 5 |
| | | Warm eurythermal (15–30°C) | Rank_opt = 5, Rank_tol = 4 |
| | | More than one: Combination of colder and warmer categories | Rank_opt = 4, Rank_tol = 5 |
| Thermal preference | EPA 1970s | Eurythermal (≥15°C) | Rank_opt = 5, Rank_tol = 4 |
| | | Eurythermal (>30°C) | Rank_opt = 5, Rank_tol = 3 |
| | | Mesothermal (15–30°C) | Rank_opt = 5, Rank_tol = 4 |
| | | Metathermal (5–15°C) | Rank_opt = 3, Rank_tol = 3 |
| | | Oligothermal (<15°C) | Rank_opt = 3, Rank_tol = 4 |
| | | Stenothermal (≤5°C) | Rank_opt = 3, Rank_tol = 3 |
| Temp_Opt_Rank | EPA 1970s | Wide range—no apparent preference | Rank_opt = 4, Rank_tol = 5 |
| Temp_Tol_Rank | EPA 1970s | More than one: Combination of colder and warmer categories | Rank_opt = 4, Rank_tol = 5 |
| | | | |
| Rules | <ol style="list-style-type: none"> 1. Use the values generated by U.S. EPA (2011) (or from other databases, like Brandt, 2001 and Yuan, 2006). 2. Use the Poff et al. (2006) entries (for genus-level matches). 3. Use the Vieira et al. (2006) entries. 4. Use the EPA 1970s entries. <p>If more than one trait state was assigned (i.e., there was variation among species within a genus), the category that was most frequently recorded was used (majority rules).</p> | | |

Utah—Data Integration Rules

Three key questions arose during the data compilation process:

1. If traits data for taxa are available from multiple sources, which source should we use? What if they differ?
2. How do we assign genus-level traits information if only species-level information is available? What if trait states vary among species within the genera?
3. What if traits are co-occurring (more than one trait state is appropriate and is, therefore, listed)? This was particularly relevant for functional feeding group and habit traits.

Integration rules were developed to maintain consistency when addressing these issues. For most of the traits, the Poff et al. (2006) Traits Matrix was given top priority. If the Traits Matrix lacked information for certain taxa, the USGS traits database (i.e., Vieira et al., 2006) received next highest priority, followed by the EPA's 1970s publications. Weighted-average and maximum-likelihood calculations received top priority for the temperature preference and tolerance trait assignments. All OTUs in the state biomonitoring databases, including rare taxa, were included in the Utah traits table. This is because the database is meant to be a living document; the intent is that people using the database can fill in or update information as it becomes available. People using the database are encouraged to check the traits information and customize it as necessary so that the information is more accurate for taxa occurring in their region (in particular FFG and habit, for which only primary trait state assignments were made).

The traits information that was entered into the Utah traits table came from a number of different sources. Sometimes the sources had slight differences in how traits were categorized and in some of the thresholds that were used when assigning trait states. Another issue was that traits information for certain taxa was available from several different sources, so a decision had to be made about which source to use (sources were generally in agreement, but sometimes slight differences existed). Because of these issues, decisions had to be made during the entry process. One involved interpreting literature in order to get the trait state information into a standardized and usable format for analyses. The other involved deciding which source to use. Rules were developed for the following trait state entries: voltinism, development, life span, dispersal,

armoring, size, rheophily, functional feeding group, habit, tolerance values and thermal preference, and tolerance. They are summarized in Tables B-23 through B-33.

Table B-23. Utah—integration rules that were used when assigning voltinism trait states to taxa

| Trait | Source | Original Trait States | Assigned Trait States |
|---------------|---|------------------------|-----------------------|
| Voltinism | Poff et al. (2006) | Semivoltine | Semivoltine |
| | | Univoltine | Univoltine |
| | | Bi- or multivoltine | Bi- or multivoltine |
| Voltinism | Vieira et al. (2006) | <1 Generation per year | Semivoltine |
| | | 1 Generation per year | Univoltine |
| | | >1 Generation per year | Bi- or multivoltine |
| Rules: | <p>1. Use the Poff et al. (2006) entries (for genus-level matches).</p> <p>2. Use the Vieira et al. (2006) entries.</p> <p>Many of the Vieira entries went to species-level. If trait states varied among species within a genus,</p> <p>a. The trait state that was most frequently recorded was used (= majority rules).</p> <p>b. If different trait states occurred with the same frequency, the Volt_Comments field was referenced. If it mentioned that one state was more typical than another, the more typical state was used.</p> <p>c. If Volt_comments was not helpful, the trait state with the higher number of generations was chosen For example, if there was one 'univoltine' entry and one 'semivoltine' entry, the 'univoltine' entry was chosen.</p> | | |

Table B-24. Utah—integration rules that were used when assigning development trait states to taxa

| Trait | Source | Original Trait States | Assigned Trait States |
|-------------|---|-----------------------|-----------------------|
| Development | Poff et al. (2006) | Fast seasonal | Fast |
| | | Slow seasonal | Slow |
| | | Nonseasonal | Non |
| Dev_Speed | Vieira et al. (2006) | Fast seasonal | Fast |
| | | Slow seasonal | Slow |
| | | Nonseasonal | Non |
| Rules | <p>1. Use the Poff et al. (2006) entries (for genus-level matches).</p> <p>2. Use the Vieira et al. (2006) entries.</p> | | |

Table B-25. Utah—integration rules that were used when assigning life span trait states to taxa

| Trait | Source | Original Trait States | Assigned Trait States |
|-----------------|---|-----------------------|-----------------------|
| Adult Life Span | Poff et al. (2006) | Very short | Very short |
| | | Short | Short |
| | | Long | Long |
| Adult_lifespan | Vieira et al. (2006) | Hours | Very short |
| | | Days | Very short |
| | | Weeks | Short |
| | | Months | Long |
| Rules | <ol style="list-style-type: none"> 1. Use the Poff et al. (2006) entries (for genus-level matches). 2. Use the Vieira et al. (2006) entries (reference Adult_lifespan_comments if necessary). | | |

Table B-26. Utah—integration rules that were used when assigning dispersal trait states to taxa

| Trait | Source | Original Trait States | Assigned Trait States |
|------------------|--|--|-----------------------|
| Female dispersal | Poff et al. (2006) | Low (<1 km flight before laying eggs) | Low |
| | | High (>1 km flight before laying eggs) | High |
| Adult dispersal | Vieira et al. (2006) | 1 km or less | Low |
| | | 10 km or less | High |
| | | 10 m or less | NA |
| | | 100 km or less | High |
| Rules | <ol style="list-style-type: none"> 1. Use the Poff et al. (2006) entries (for genus-level matches). 2. Use the Vieira et al. (2006) entries. | | |
| Notes | <p>In the Poff et al. (2006) table, it specifies 'female dispersal.' In the Vieira et al. (2006) traits database, it specifies 'Adult dispersal.' It was assumed that the information was compatible between sources. In Vieira et al. (2006) there is an entry '10 m or less.' It appears that this was a typo (it likely should have been '10 km or less'). Therefore, this category was excluded.</p> | | |

Table B-27. Utah—integration rules that were used when assigning armoring trait states to taxa

| Trait | Source | Original Trait States | Assigned Trait States |
|----------|--|-------------------------------------|-----------------------|
| Armoring | Poff et al. (2006) | None (soft-bodied forms) | None |
| | | Poor (heavily sclerotized) | Poor |
| | | Good (e.g., some cased caddisflies) | Good |
| Armor | Vieira et al. (2006) | Soft | None |
| | | All sclerotized | Poor |
| | | Partly sclerotized | Poor |
| | | Hard shelled | Good |
| Rules | <ol style="list-style-type: none"> 1. Use the Poff et al. (2006) entries (for genus-level matches). 2. Use the Vieira et al. (2006) entries. | | |
| Notes | <p>In the Poff et al. (2006) table, it does not mention 'partly sclerotized.'</p> <p>In the Vieira et al. (2006) table, 'partly sclerotized' and 'all sclerotized' were assigned to the 'poor' category.</p> | | |

Table B-28. Utah—integration rules that were used when assigning size (at maturity) trait states to taxa

| Trait | Source | Original Trait States | Assigned Trait States |
|------------------|--|-------------------------|-----------------------|
| Size at maturity | Poff et al. (2006) | Large (length >16 mm) | Large |
| | | Medium (length 9–16 mm) | Medium |
| | | Small (length <9 mm) | Small |
| Max_Body_Size | Vieira et al. (2006) | Large (length >16 mm) | Large |
| | | Medium (length 9–16 mm) | Medium |
| | | Small (length <9 mm) | Small |
| Rules | <ol style="list-style-type: none"> 1. Use the Poff et al. (2006) entries (for genus-level matches). 2. Use the Vieira et al. (2006) entries. <p>If more than one trait state was assigned (i.e., there was variation among species within a genus):</p> <ol style="list-style-type: none"> a. The category that was most frequently recorded was used (majority rules). b. If different categories were recorded the same number of times, the 'medium' entry was used (i.e., if there was one 'small' entry and one 'medium' entry, the medium entry was used). | | |

Table B-29. Utah—integration rules that were used when assigning rheophily trait states to taxa

| Trait | Source | Original Trait States | Assigned Trait States |
|---|---|---|------------------------------|
| Rheophily | Poff et al. (2006) | Depositional only | Depo |
| | | Depositional and erosional | Depo_eros |
| | | Erosional | Eros |
| Rheophily | Vieira et al. (2006) | Current_quiet | Depo |
| | | Current_slow | Depo |
| | | Current_fast_lam | Eros |
| | | Current_fast_turb | Eros |
| | | More than one: | If both quiet and slow, depo |
| | | Quiet and slow | Depo |
| Quiet and/or slow and fast (either lam or turb) | Depo_eros | | |
| Flow_pref | EPA 1970s | Standing | Depo |
| | | Slight | Depo |
| | | Standing-slight | Depo |
| | | Standing and flowing | Depo_eros |
| | | Moderate | Eros |
| | | Moderate-fast | Eros |
| | | Fast | Eros |
| | | More than one: | |
| | | Some combination of standing and/or slight and moderate and/or fast | Depo_eros |
| Rules | <p>1. Use the Poff et al. (2006) entries (for genus-level matches). 2. Use the Vieira et al. (2006) entries. 3. Use the EPA 1970s entries. If more than one trait state was assigned (i.e., there was variation among species within a genus), the category that was most frequently recorded was used (majority rules).</p> | | |

Table B-30. Utah—integration rules that were used when assigning (primary) functional feeding group trait states to taxa.

| Integration Rules for FFG: |
|---|
| <p>Only one FFG category was assigned to each taxa. The following rules were used:</p> <ol style="list-style-type: none"> 1. Use the Poff et al. (2006) entries (for genus-level matches). 2. Use the Vieira et al. (2006) entry (Feed_mode_prim). 3. Use the WSA entry from the Benthics_Master_Taxa table. 4. Use the RBP2 1999 entry from the Benthics_Master_Taxa table. 5. Use the U.S. EPA (1990) Draft entry from the Benthics_Master_Taxa table. <p>If more than one category was assigned within a genus, the one that occurred most frequently was entered (= majority rules).</p> <p>If different states were recorded the same number of times, the next source was used as a 'tie-breaker' (i.e., if Vieira et al. [2006] had two species listed as CN and two as SP, and the WSA entry was SP, SP was used)</p> <p>If unable to resolve based on these sources, one was randomly selected.</p> |

Table B-31. Utah—integration rules that were used when assigning (primary) habit trait states to taxa.

| Integration Rules for Habit: |
|--|
| <p>Only one habit category was assigned to each taxa. The following rules were used:</p> <ol style="list-style-type: none"> 1. Use the Poff et al. (2006) entries (for genus-level matches). 2. Use the Vieira et al. (2006) entry (Habit_prim). 3. Use the WSA entry from the Benthics_Master_Taxa table. 4. Use the RBP2 1999 entry from the Benthics_Master_Taxa table. 5. Use the U.S. EPA (1990) Draft entry from the Benthics_Master_Taxa table. <p>If more than one category was assigned within a genus, the one that occurred most frequently was entered (= majority rules).</p> <p>If different states were recorded the same number of times, the next source was used as a 'tie-breaker' (i.e., if Vieira et al. (2006) had two species listed as CN and two as SP, and the WSA entry was SP, SP was used).</p> <p>If unable to resolve based on these sources, one was randomly selected.</p> |

Table B-32. Utah—integration rules that were used when assigning tolerance values to taxa.

| Integration Rules for Tolerance: |
|---|
| <p>Only one tolerance value was assigned to each taxa. The following rules were used:</p> <ol style="list-style-type: none"> 1. Use the WSA entry. 2. Use the RBP2 1999 entry. 3. Use the U.S. EPA (1990) Draft entry. <p>If there were more than two values from a source, the median value was used.</p> <p>If there were two entries, the higher value was used (i.e., if assigned values were 2 and 3, the 3 was used).</p> <p>NOTE: If state-specific tolerance values were provided, those were also incorporated into the traits table.</p> |

Table B-33. Utah—integration rules that were used when assigning thermal preference and tolerance values to taxa.

| Traits | Source | Original Trait States | Assigned Trait States |
|--------------------|--|---|-------------------------------|
| Thermal preference | Poff et al. (2006) | Cold_cool | Rank_opt = 3, Rank_tol = 3 |
| | | Cool_warm | Rank_opt = 4, Rank_tol = 5 |
| | | Warm | Rank_opt = 5, Rank_tol = 3 |
| Thermal_pref | Vieira et al. (2006) | Cold stenothermal (<5°C) | Rank_opt = 3, Rank_tol = 3 |
| | | Cold-cool eurythermal (0–15°C) | Rank_opt = 3, Rank_tol = 4 |
| | | Hot eurythermal (>30°C) | Rank_opt = 5, Rank_tol = 3 |
| | | No strong preference | Rank_opt = 4, Rank_tol = 5 |
| | | Warm eurythermal (15–30°C) | Rank_opt = 5, Rank_tol = 4 |
| | | More than one: Combination of colder and warmer categories | Rank_opt = 4, Rank_tol = 5 |
| Thermal preference | EPA 1970s | Eurythermal (≥15°C) | Rank_opt = 5, Rank_tol = 4 |
| | | Euthermal (>30°C) | Rank_opt = 5, Rank_tol = 3 |
| | | Mesothermal (15–30°C) | Rank_opt = 5, Rank_tol = 4 |
| | | Metathermal (5–15°C) | Rank_opt = 3, Rank_tol = 3 |
| | | Oligothermal (<15°C) | Rank_opt = 3, Rank_tol = 4 |
| | | Stenothermal (≤5°C) | Rank_opt = 3, Rank_tol = 3 |
| Temp_Opt_Rank | EPA 1970s | Wide range—no apparent preference | Rank_opt = 4, Rank_tol = 5 |
| Temp_Tol_Rank | EPA 1970s | More than one: | |
| | | Combination of colder and warmer categories | Rank_opt = 4, Rank_tol = 5 |
| Rules | <ol style="list-style-type: none"> 1. Use the values generated by U.S. EPA (2011) (or from other databases, like Brandt,2001 and Yuan, 2006). 2. Use the Poff et al. (2006) entries (for genus-level matches). 3. Use the Vieira et al. (2006) entries. 4. Use the EPA 1970s entries. <p>If more than one trait state was assigned (i.e., there was variation among species within a genus), the category that was most frequently recorded was used (majority rules).</p> | | |