

Traits Gap Analysis - Utah

The Utah traits table contains information for 272 operational taxonomic units (OTUs). The majority of the OTUs were at the genera- or genera-group level (85%), 12% family-level and the remaining were order-level or higher. 117 families and 32 higher taxonomic groups (generally order-level) are represented in the Utah dataset. The source of the majority of non-temperature traits information was the Poff et al. 2006 traits matrix (**Table 1**). This was mainly supplemented by the USGS traits database (Vieira et al. 2006). Most of the temperature trait information was derived from the weighted average calculations that were performed on a subset of the Utah data. Gaps in temperature trait information were mainly filled using the Traits Matrix (Poff et al. 2006), the USGS traits database (Vieira et al. 2006) and data from Brandt's (2001) and Yuan's (2006) weighted average calculations. Most of the habit and functional feeding group information was taken from the Poff et al. traits 2006 matrix and was supplemented mainly by Wadeable Streams Assessment (WSA), Rapid Bioassessment Protocol (RBP2) and the USGS traits database data (Vieira et al. 2006).

Trait information was available for approximately 50-65% of the OTUs (**Table 2**). Exceptions were the habit and functional feeding group traits, for which 85 and 92% of the OTUs had information, respectively. Numerical temperature trait information was available for about 50% of the taxa and categorical temperature trait information (based on rankings and literature) was available for 68% of the taxa.

Ephemeroptera, Plecoptera and Trichoptera (EPT) taxa generally had more trait information than other taxa (**Table 3**). When tolerance values are excluded, about 80-100% of the EPT taxa have trait information. A large number of taxa in the Utah dataset are EPT taxa: 60 are Trichopterans, 26 are Ephemeropterans and 31 are Plecopterans. Dipterans (58 taxa), Odonates (17 taxa), and Coleopterans (30 taxa) are also well-represented in the dataset. For the Dipterans and Coleopterans, habit and FFG information is available for approximately 90% of the taxa, temperature trait information, 50%, and other trait information is available for about 35-45% of the taxa. Habit and FFG information is available for about 80-90% of the Odonates, while other trait information is available for about 65% of the taxa. Some of the remaining orders (or higher levels) have trait information for all taxa (i.e. Megaloptera, Isopoda, Amphipoda, Hirudinea) but these generally have only one or two taxa in the dataset. On the opposite end of the spectrum, no trait information is available for some OTUs (i.e. Archaeogastropoda, Amphineura, Sepiolida, Unionoida) but these taxa are rare (they comprise less than 0.1% of the total number of individuals in the dataset) and each are only represented by one taxa in the dataset. In terms of overall abundance in the Utah database, the largest number of individuals are Dipterans (overall abundance equals 36%), followed by Ephemeropterans (24%), Trichopterans (12%) and Coleopterans (8%). Only 11 of the OTUs have overall abundances greater than 1%.

SOURCES

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition. EPA 841-B-99-002. U.S. Environmental Protection Agency; Office of Water; Washington, D.C.

Beck, W.M. Jr. 1977. Environmental Requirements and Pollution Tolerance of Common Freshwater Chironomidae. Report EPA-600/4-77-024. U.S. EPA, Washington, D.C. 260 p.

Brandt, Darren. 2001. Temperature Preferences and Tolerances for 137 Common Idaho Macroinvertebrate Taxa. Idaho Department of Environmental Quality. Coeur d'Alene, ID.

Harris, T.L., and T.M. Lawrence. 1978. Environmental Requirements and Pollution Tolerance of Trichoptera. Report No. EPA-600/4-78-063. U.S. EPA, Washington, D.C. 316 p.

Hubbard, M.D., and W.L. Peters. 1978. Environmental Requirements and Pollution Tolerance of Ephemeroptera. Report No. EPA-600/4-78-061. U.S. EPA, Washington, D.C. 468 p.

Poff, N.L., J.D. Olden, N.K.M. Vieira, D.S. Finn, M.P. Simmons, and B.C. Kondratieff. 2006. Functional trait niches of North American lotic insects: traits-based ecological applications in light of phylogenetic relationships. *Journal of the North American Benthological Society* 25(4):730-755

Surdick, R.F., and A.R. Gaufin. 1978. Environmental Requirements and Pollution Tolerance of Plecoptera. Report No. EPA-600/4-78-062. U.S. EPA, Washington, D.C. 423 p.

US EPA. 1990. Freshwater Macroinvertebrate Species List Including Tolerance Values and Functional Feeding Group Designations for Use in Rapid Bioassessment Protocols. Prepared by: EA Mid Atlantic Regional Operations Engineering, Science, and Technology, Inc. Prepared for: U.S. EPA Assessment and Watershed Protection Division Washington, D.C. Report No. 11075.05

US EPA. 2006. Wadeable Streams Assessment: A Collaborative Survey of the Nation's Streams. U.S. Environmental Protection Agency, OWOW, Washington, D.C., EPA 841-B-06-002.

Vieira, N.K.M., N.L. Poff, D.M. Carlisle, S.R. Moulton II, M.K. Koski, and B.C. Kondratieff. 2006. A database of lotic invertebrate traits for North America: U.S. Geological Survey Data Series 187. Available at: <http://pubs.water.usgs.gov/ds187>.

Vermont Department of Environmental Conservation (VT DEC). 2008. Best professional judgement. Contact: Jim Kellogg.

Yuan, Lester. 2006. Estimation and Application of Macroinvertebrate Tolerance Values. Report No. EPA/600/P-04/116F. National Center for Environmental Assessment, Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C.

Zheng, Lei (Tetra Tech). 2008. Weighted average results – Utah database.

Table 1. Summary of the sources that were used to derive trait information for the Utah traits table. The values equal the # of taxa that the source provided information on. NA equals the number of taxa for which no trait information was available.

Traits	Sources										
	Poff et al. 2006	Vieira et al. 2006	Zheng (UT) 2008	Brandt (ID) 2001	Yuan 2006	EPA 1970s	VT DEC	WSA	RBP2 1999	USEPA Draft 1990	NA
Life history											
Voltinism	141	21									110
Development	146	3									123
Synchronization of emergence	146										126
Adult life span	144	11									117
Adult ability to exit	146										126
Ability to survive desiccation	146										126
Mobility											272
Dispersal (adult)	142	9									121
Adult flying strength	146										126
Occurrence in drift	146										126
Maximum crawling rate	146										126
Swimming ability	146										126
Morphology											272
Attachment	146										126
Armoring	142	32									98
Shape	146										126
Respiration	146										126
Size at maturity	142	28									102
Resource acquisition/preference											272
Rheophily	144	14				1	4				109
Habit	125	38						64	4		41
Functional feeding group	128	26						70	20	6	22
Temperature											272
Temperature optimum			104	19	10						139
Temperature tolerance			104	19							139
Rank of temperature optimum	48	2	104	19	10	3					86
Rank of temperature tolerance	48	2	104	19	10	3					86
Rank of temperature optimum-tolerance	48	2	104	19	10	3					86
Tolerance								173	2	5	92

Table 2. Number and percentage of the 272 taxa (at the established OTU level) in the Utah database that have trait information.

Traits	# of taxa with trait information	% of taxa with trait information
Life history		
Voltinism	162	59.6
Development	149	54.8
Synchronization of emergence	146	53.7
Adult life span	155	57
Adult ability to exit	146	53.7
Ability to survive desiccation	146	53.7
Mobility		
Dispersal (adult)	151	55.5
Adult flying strength	146	53.7
Occurrence in drift	146	53.7
Maximum crawling rate	146	53.7
Swimming ability	146	53.7
Morphology		
Attachment	146	53.7
Armoring	174	64
Shape	146	53.7
Respiration	146	53.7
Size at maturity	170	62.5
Resource acquisition/preference		
Rheophily	163	59.9
Habit	231	84.6
Functional feeding group	250	91.9
Temperature		
Temperature optimum	133	48.9
Temperature tolerance	133	48.9
Rank of temperature optimum	186	68.4
Rank of temperature tolerance	186	68.4
Rank of temperature optimum-tolerance	186	68.4
Tolerance	180	66.2

Table 3. Percentage of taxa within each order (or in some cases, higher taxonomic level) that have life history traits information in the Utah traits table.

Order	# of taxa within each order	Abundance (% of Total)	Other Traits (Avg)	Temp Rank	Habit	FFG	Tolerance
Diptera	58	35.7	45.6	50	87.9	91.4	69
Ephemeroptera	26	24.2	88.5	88.5	92.3	96.2	69.2
Trichoptera	60	12.4	78.7	91.7	88.3	90	56.7
Coleoptera	30	7.7	34.5	50	93.3	90	73.3
Isopoda	1	3.1	0	100	100	100	100
Trombidiformes	1	3	0	100	0	100	100
Haplotaxida	3	3	0	33.3	66.7	100	100
Plecoptera	31	2.5	87.3	100	96.8	100	54.8
Neotaenioglossa	5	2.2	16.5	0	60	100	20
Podocopida	1	1.8	0	100	0	100	0
Amphipoda	2	1.4	29.4	100	100	100	100
Tricladida	2	0.7	0	50	50	50	50
Basommatophora	9	0.6	4.6	44.4	77.8	100	100
Diplostraca	1	0.5	0	0	0	100	0
Copepoda (subclass)	1	0.3	0	100	0	100	0
Dorylaimida	1	0.3	0	100	0	100	100
Hirudinea (subclass)	1	0.2	0	100	100	100	100
Pelecypoda (class)	1	0.2	0	100	0	100	0
Odonata	17	0.1	67.5	64.7	82.4	88.2	76.5
Hemiptera	5	0.1	20	40	100	100	100
Lepidoptera	2	0	50	50	100	100	100
Veneroida	3	0	13.7	33.3	66.7	100	100
Megaloptera	2	0	100	100	100	100	100
Archaeogastropoda	1	0	0	0	0	0	0

Table 3. continued...

Order	# of taxa within each order	Abundance (% of Total)	Other Traits (Avg)	Temp Rank	Habit	FFG	Tolerance
Hydroida	1	0	17.6	0	0	100	100
Amphineura (class)	1	0	0	0	0	0	0
Heterostropha	1	0	0	0	0	100	0
Decapoda	1	0	0	100	0	100	100
Sepiolida	1	0	0	0	0	0	0
Nematomorpha (phylum)	1	0	0	0	100	100	100
Lumbriculida	1	0	0	0	100	100	100
Unionoida	1	0	0	0	0	0	0