

AN ANALYSIS OF MERISTIC, MORPHOMETRIC AND BIOCHEMICAL
VARIATION IN THE JOHNNY DARTER, *Etheostoma nigrum* Rafinesque,
IN THE NORTHERN UNITED STATES AND CANADA
WITH BIOGEOGRAPHIC AND SYSTEMATIC CONSIDERATIONS

by

Sam A. Stephenson

A Thesis

Submitted to the Faculty of Graduate Studies in Partial
Fulfilment of the Requirements for the Degree of

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CONCLUSIONS

- 1/ The scaled form of *E. n. nigrum*, *E. n. eulepis*, is considered subspecific because (1) squamation on the nape and breast varies in a consistent manner between diverse geographic locations suggesting it has a genetic basis and is not the result of parallel genetic drift or phenotypic plasticity within many disjunct populations, (2) *E. n. eulepis* exhibits a relatively constant amount of squamation when examined on a temporal basis throughout life history and across generations, (3) increased squamation correlates with additional plesiomorphic characters (complete lateral line and generally higher number of POM pores), (4) new scaled specimens have not been noted in areas previously sampled in which they were unknown, and, (5) the distribution of the scaled form is consistent with known dispersal routes following Wisconsinan glaciation.
- 2/ Specimens of *E. nigrum* from the middle and upper Ohio Basin may qualify for separate subspecific status due to possession of several meristic characters (e.g., five branchiostegal rays, 10-11 pectoral and dorsal rays) which vary in a geographically interpretable manner suggesting a long, unique history separate from that of other populations of *E. nigrum*. These populations require further study to determine the exact geographic distribution of these characters and whether they truly represent a further subspecies.
- 3/ *Etheostoma n. nigrum* exhibits variation in some meristic characters which can be correlated with increasing latitude and longitude. The number of POM

pores suggests the possibility of eastern and western unscaled forms likely separated prior to and during the Wisconsinan. The number of POM pores is partially influenced by habitat which makes a final analysis of eastern and western forms difficult.

- 4/ *Etheostoma n. susanae* is not considered a valid subspecies due to the possibility of the characters being a response to environment, the lack of evidence for genetic control of these traits, the occurrence of several, supposedly distinguishing traits in disjunct areas, and the small sample size on which the decision for subspecific status was made.
- 5/ Both *E. n. nigrum* and *E. n. eulepis* exhibit limited, but equal, amounts of lateral asymmetry which is not correlated with habitat or dispersal history. The lack of increased asymmetry in intergrading specimens refutes the hypothesis of historic separation and differentiation of scaled and unscaled populations.
- 6/ Biochemical analyses for the enzymes examined do not suggest consistent distinguishing differences between *E. n. nigrum* and *E. n. eulepis*. Although the *PGDH**150, *ME-2**125, *GPI-A**91 and *GPI-A**82 alleles are most often found only in the scaled form, some populations of the scaled form lack all of these alleles. Specimens examined from Wisconsin and Ontario are not biochemically distinct.
- 7/ Canonical correlation analyses suggest several trends in meristic and biochemical variables correlated with the environment. Many of the high

correlations do not hold true within all scaled samples and thus there are no definitive means to separate scaled and unscaled specimens. Canonical correlation analysis does provide support for the hypothesis that squamation does not develop as a response to the environment.

- 8/ Discriminant and cluster analyses of scaled and unscaled samples without squamation variables does not result in good separation of the two forms. However, several plesiomorphic meristic characters are more commonly associated with the scaled form than the unscaled form suggesting the *E. n. eulepis* is a true plesiomorphic relict.

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APPENDIX 1

MATERIAL EXAMINED

Appendix 1: The following list is those specimens examined for this study. The material is first grouped by major drainage basin and then by secondary drainages within that basin. Abbreviations of institutions from which material was borrowed follow Leviton *et al.* (1985) with the exception that LU = Lakehead University, Ichthyology Collection, Thunder Bay, Ontario. Collections from LU and MZF are not catalogued by number; these collections can be identified by date only. UMMZ = University of Michigan, Museum of Zoology; ROM = Royal Ontario Museum; JFBM = Bell Museum of Natural History, University of Minnesota; MZF = University of Manitoba, Ichthyology Collection, Winnipeg, Manitoba; and, NMC = National Museum of Canada. PC represents specimens in my own collection. Number examined for meristic and morphometric analyses are in parentheses and does not always reflect the available size of the collection.

Missouri River Basin

Platte River Drainage - UMMZ 61571, CO. South Platte River, Bear Creek (33); UMMZ 86744, NE. Elkhorn River, at Ewing (2); UMMZ 106395, NE. Lodgepole Creek, 2 miles W of Chappell (Deuel Co.) (4); UMMZ 162955, WY. Sloan Lake (Cheyenne City Lake) (Laramie Co.) (7).

Big Sioux Drainage - PC, MN. Rock River (Rock Co.) (11); PC, MN. Kanaranzi Creek (Rock Co.) (12); UMMZ 161934, SD. Big Sioux River, 2 miles E of Volga (Brookings Co.) (3).

Kansas River Drainage - UMMZ 156746, KS. Rock Creek, SE of Topeka (6); UMMZ 122042, KS. Creek S of Cleburne (3).

James River Drainage - UMMZ 189482, ND. James River, near Jamestown (Stutsman Co.) (8); UMMZ 189493, ND. Pipestem Creek, tributary to James River (Stutsman Co.) (11); UMMZ 163822, SD. James River, E of Woonsocket (Sanborn Co.) (6).

UMMZ 114083, IA. Meadow Creek, 2 miles E of Spencer (5); UMMZ 101528, IA. Spirit Lake (Dickinson Co.) (8); UMMZ 148236, MO. Spring Creek, W of Novinger, Chariton River System (5); UMMZ 148036, MO. Silver Fork of Roche Perch Creek (Boone Co.) (7).

Ohio River Basin

Wabash River Drainage - UMMZ 144593, IL. Stony Brook, Route 10, west of Oakwood (2); UMMZ 61966, IN. Clear Creek, near Bloomington (11); UMMZ 138963, IN. Tributary of Six Mile Creek (Wills Co.) (6); UMMZ 81340, IN. Wabash River, at New Harmony (7); UMMZ 66950, IN. Wolf Creek (Bartholomew Co.) (10); UMMZ 63023, IN. Tippecanoe Lake (Kosciusk Co.) (5); PC, IN. Little Vermillion River, near Newport (Vermillion Co.) (1).

Muskingum River Drainage - UMMZ 87830, OH. Walhonding River, tributary of Muskingum River, Newcastle Twp) (4); UMMZ 87774, OH. Muskingum River, at dam 2 (Washington Co.) (5).

Kentucky River Drainage - UMMZ 154425, KY. Quicksand Creek, 3.5 miles NE of Quicksand (10).

Lower Ohio River - UMMZ 118247, KY. Russell Fork, near Praise Levisa Fork of Big Sandy Drainage (9); UMMZ 107751, OH. Indian Guyan Creek (Lawrence Co.) (9); UMMZ 118359, OH. W Fork of Little Beaver Creek (Columbian Co.) (9); UMMZ 86346, OH. Yellow Creek, near Poland (2); UMMZ 110725, PA. Little Bull Creek, tributary to Allegheny River, 3 miles E of Tarentum (10); UMMZ 94648, PA. Tributary of Shenango River, N of Greenville (Mercer Co.) (4); UMMZ 61710, PA. Monongahela River, at Monongahela (Fayette Co.) (13); UMMZ 168442, TN. Eagle Creek, .5 miles E of Holladay, Tennessee River Drainage (Benton Co.) (10); UMMZ 131828, WV. New River, 1 mile above Gauley bridge (Fayette Co.) (4); UMMZ 119357, WV. Kanawha River, at Paint Creek mouth (9).

Mississippi River Basin

Illinois River Drainage - UMMZ 114904, IL. Hickory Creek, near New Lennox (3).

Rock River Drainage - UMMZ 169682, IL. Unnamed Creek, 13 miles east of Freeport on Hwy. 20 (2); UMMZ 77232, WI. Rock River, 4 miles NW of Waupun (Fond Du Lac Co.) (14); UMMZ 77165, WI. Crawfish River, 8 miles N of Watertown (Dodge Co.) (11); UMMZ 77592, WI. Rock River, 2 miles below Ft. Atkinson (Jefferson Co.) (6); LU. WI. Crawfish River, at Hwy "G" (Dodge Co.) (7).

Skunk River Drainage - UMMZ 181099, IA. Squaw Creek, Ames (11).

Minnesota River Drainage - PC, MN. Cottonwood River, SW of Springfield

(Brown Co.) (10); UMMZ 167071, SD. Big Stone Lake (Roberts Co.) (8); UMMZ 166905, SD. Whetstone Creek, near Big Stone City (Grant Co.) (23).

Neosho River Drainage - UMMZ 61462, MO. Tributary to Spring River, Sarcoxie (Jasper Co.) (10); UMMZ 151843, MO. Coon Creek, 1 mile N of Jasper, tributary of N Fork Spring River (2); UMMZ 151814, MO. N Fork of Spring River, 5 miles S of Lamar (Barton Co.) (1); UMMZ 142262, MO. Spring River, at Carthage (Jasper Co.) (1); UMMZ 151794, MO. Muddy Fork, N Fork of Spring River, tributary to Neosho River (6).

Wisconsin River Drainage - UMMZ 73605, WI. Jordan Lake (Adams Co.) (10); UMMZ 77635, WI. Black Earth Creek, 1 mile SE of Mazomanie (Dane Co.) (3); UMMZ 72495, WI. Little Arbor Vitae Lake, Tomahawk River drainage (Vilas Co.) (10); UMMZ 72502, WI. St. Germain Lake (Vilas Co.) (14); UMMZ 73464, WI. French Creek, above mill pond (Columbia Co.) (24); UMMZ 72447, WI. Kawaguesaga Lake, W of Minocqua, Tomahawk River drainage (Oneida Co.) (9); UMMZ 73571, WI. Outlet of Spring Lake, at Pardeeville (Columbia Co.) (5); UMMZ 76390, WI. Tainter Creek, tributary to Kickapoo River, 3 miles N of Gay's Mills (Crawford Co.) (18); UMMZ 78769, WI. Stream, N of Abbotsford (Clark Co.) (4).

St. Croix River Drainage - UMMZ 77812, WI. St. Croix River, 3 miles W of Danbury (Burnett Co.) (14); UMMZ 96219, WI. Yellow River, .5 miles S of Danbury (Burnett Co.) (6); UMMZ 96234, WI. Apple River, at Amery (Polk Co.) (15); UMMZ 96184, WI. Warner Lake, W of Hertel (Burnett Co.) (9).

Chippewa River Drainage - UMMZ 76236, WI. Paint Creek, S of Lake Wissota (Chippewa Co.) (11); UMMZ 95933, WI. Grindstone Lake 10 miles SE of Hayward (Sawyer Co.) (3).

Pecatonica River Drainage - UMMZ 77423, WI. Skinner Creek, 1.5 miles E of Browntown (Greene Co.) (7); UMMZ 76950, WI. Thunder Branch of W Pecatonica River, 7 miles NW of Gratiot (Lafayette Co.) (11).

UMMZ 86570, IL. Quincy (5); UMMZ 105926, IL. Kinkaid Creek near Ava (Jackson Co.) (19); UMMZ 169699, IA. Yellow River, 8 miles N of Pottsville (10); UMMZ 181082, IA. Brush Creek (Jackson Co.) (5); UMMZ 94832, MN. Mississippi River, between Cass Lake and Bemidji (Beltrami Co.) (10); PC, MN. Little Cedar River, W of Adams (Mower Co.) (14); PC, MN. Dobbins Creek, near Austin (Mower Co.) (12); PC, MN. Zumbro River, at Kellogg (Wabasha Co.) (12); PC, MN. Crystal Creek, Root River System (Houston Co.) (12); PC, MN. Deer Creek (Itasca Co.) (4); PC, MN. Cedar River, E of Lansing (Mower Co.) (12); UMMZ 149328, MO. W Fork Cuivre

River, S of Laddonia (Audrian Co.) (3); **UMMZ 148679**, MO. Honey Creek, tributary to Fox River (Clark Co.) (7); **UMMZ 76695**, WI. Blake Fork of Little Grant River, E of Bloomington (Grant Co.) (11); **UMMZ 76260**, WI. Beef Slough, at mouth of Beef River, 3 miles N of Alma (Buffalo Co.) (4).

Hudson Bay-James Bay Basin, Ontario

Severn River Drainage - **ROM 12575**, ON. Ft. Severn, Severn River (2); **ROM 12574**, ON. Ft. Severn, Severn River (1); **ROM 21331**, ON. Big Trout Lake (10).

ROM 22437, ON. Hawley Lake (2); **ROM 12316**, ON. Lake Attawapiskat (10); **ROM 52278**, ON. Mattagami River (9); **LU**, ON. Caribou Lake, NW of Armstrong (12).

Lake Winnipeg-Hudson Bay Basin

Red River Drainage - **UMMZ 118445**, MN. Mud River, near Redby (Beltrami Co.) (5); **PC**, MN. Red Lake River, 25 miles E of Thief River Falls (Pennington Co.) (11); **PC**, MN. Dinner Creek (Becker Co.) (13); **PC**, MN. Otter Tail River (Becker Co.) (11); **UMMZ 161946**, ND. Turtle River, 20 miles W of Grand Forks (3); **UMMZ 94820**, ND. Sheyenne River, at Valley City (Barnes Co.) (4); **UMMZ 61580**, ND. Goose River, near Hillsboro (Traill Co.) (12); **UMMZ 189387**, ND. Sheyenne River, near Pekin (Nelson Co.) (10); **ROM 35917**, ON. (10); **MZF**, MB. Roseau River, SE of Stuartburn (12);

Winnipeg River Drainage - **ROM 52275**, ON. Perch Lake (10); **ROM 26070**, ON. Agnes Lake (10); **ROM 26077**, ON. Shade Lake (10); **LU**, ON. Prelate Lake (8); **MZF**, MB. Lake of the Woods, at Birch Point (11); **MZF**, MB. Whitemouth River, at Hwy 408 (12);

Assiniboine River Drainage - **MZF**, MB. Assiniboine River, Hwy 340 (10); **ROM 19382**, MB. Minnedosa River (11); **MZF**, MB. Souris River, at Hwy 2 (12); **ROM 16634**, SK. Souris River (4); **LU**, MB. Clear Lake, Riding Mountain National Park (14); **LU**, MB. Moon Lake, Riding Mountain National Park (10); **ROM 16624**, SK. Loverin Lake, near Chamberlain (4); **ROM 17830**, SK. Echo Lake, Qu'Appelle Fishing lakes (10); **ROM 16769**, SK. Echo Lake, Qu'Appelle River (4); **NMC 69-273**, SK. Sioux River, Qu'Appelle Valley (1); **NMC 58-188**, SK. Qu'Appelle Valley, E of Regina (1); **NMC 64-878**, SK. Assiniboine River, at Hwy 9 (1).

Nelson River Drainage - **ROM 17480**, MB. Limestone River (5); **ROM**

16747, SK. Amisk Lake (3); **ROM 16748**, SK. Amisk Lake (3); **ROM 17496**, MB. Nine Mile Creek, tributary to Weir River (3)

Lake Winnipegosis - Lake Manitoba Drainage - ROM 19381, MB. Roaring River, at Fullerton farm (10); **ROM 52439**, MB. Steep Rock River (3); **MZF**, MB. Lake Manitoba (12); **MZF**, MB. Lake Manitoba, Delta Marsh (3);

Lake Winnipeg Drainage - UMMZ 180547, MB. Mukatawa River (6).

ROM 19376, MB. Sipiwesk Lake (10); **ROM 19397**, MB. "A" Lake Creek (2)

Great Lakes Basins

Lake Superior Basin

Michigan - UMMZ 68774, MI. Murphy Creek, Tahquamenon River Drainage (Luce Co.) (11); **UMMZ 83979**, MI. Jumbo River, Ontonagon River System (Houghton) (2); **UMMZ 68829**, MI. Muskallonge Lake (Luce Co.) (6); **UMMZ 84290**, MI. Au Train River (Alger Co.) (4); **UMMZ 70002**, MI. W Branch of Sturgeon River, S of Pelkie (Baraga Co.) (7); **UMMZ 131908**, MI. Mouth of Waiska River, at Brimley (Chippewa Co.) (10); **UMMZ 81613**, MI. Rush Lake, Huron Mountains (Marquette Co.) (10); **UMMZ 68697**, MI. Twin Lake, near Newberry (Luce Co.) (12); **UMMZ 133326**, MI. Perch Lake, near Copper Harbor (Keweenaw Co.) (21); **UMMZ 69992**, MI. Otter River, N of Pelkie (Baraga Co.) (15); **UMMZ 133346**, MI. Lake Bailey (Keweenaw Co.) (20); **UMMZ 185412**, MI. Montreal River (Gogebic Co.) (19).

Wisconsin - UMMZ 78502, WI. Stream, 1 mile E of Benoit (Bayfield Co.) (5); **UMMZ 80002**, WI. Gile River, at Gile, tributary to Montreal River (Iron Co.) (13); **UMMZ 78559**, WI. Mud Creek, 0.5 miles S of Morse (Ashland Co.) (3); **UMMZ 80041**, WI. Brule River, near Brule (Douglas Co.) (28).

Minnesota - JFBM 12083, MN. Poplar River (Cook Co.) (2); **JFBM 13370**, MN. Cross River (Lake Co.) (1); **JFBM 11573**, MN. Lester River (St. Louis Co.) (1); **JFBM 24612**, MN. Tributary to Brule River (Lake Co.) (1); **JFBM 24592**, MN. Unnamed Creek, above Cabin Creek (Lake Co.) (3); **JFBM 11574**, MN. Knife River (Lake Co.) (1); **JFBM 11568**, MN. Knife River (Lake Co.) (1); **JFBM 24773**, MN. Schoolhouse Creek (Lake Co.) (5); **JFBM 11576**, MN. Manitou River, at Nine Mile Creek (Lake Co.) (2); **JFBM 12204**, MN. Temperance River (Lake Co.) (1); **JFBM 12107**, MN. Temperance River (Lake Co.) (1); **JFBM 13092**, MN. Temperance River (Lake Co.) (2); **JFBM 12058**, MN. Temperance River (Lake Co.) (1); **JFBM 12265**, MN. Temperance River (Lake Co.) (3); **JFBM 12140**, MN.

Temperance River (Lake Co.) (5); **JFBM 24293**, MN. Sucker River (St. Louis Co.) (6); **JFBM 25006**, MN. Little Isabella River (Lake Co.) (11); **JFBM 14620**, MN. Cloquet River (St. Louis Co.) (17); **JFBM 12481**, MN. St. Louis River (St. Louis Co.) (16).

Ontario - LU, ON. Portage River, Sibley Peninsula (1); **LU, ON.** Joe Boy Creek, Sibley Peninsula (7); **LU, ON.** Boulevard Lake, at City of Thunder Bay (7); **LU, ON.** McVicars Creek, at City of Thunder Bay (10); **LU, ON.** Little Dog Lake (10); **LU, ON.** Roundtable Lake (14); **LU, ON.** Wolf River, at Trans Canada Hwy (8); **LU, ON.** Black River, near Marathon (5); **LU, ON.** McIntyre River, at Thunder Bay (10); **PC, ON.** Mission Marsh, at Thunder Bay (12); **ROM 16705**, ON. Harmony River (10).

Nipigon River Watershed - LU, ON. Nipigon River, at Nipigon (10); **LU, ON.** Lake Nipigon, Ombabika Bay (8); **LU, ON.** Lake Nipigon, Charlie's Harbour (8); **LU, ON.** Kopka Lake (10).

Lake Michigan Basin

UMMZ 114925, IN. Coffee Creek, near Chesterton (48); **UMMZ 163115**, IN. Turkey Creek, 1 mile SE of Mongo, St. Joseph River drainage (3); **UMMZ 213297**, IN. Elkhart River, near Millerburg (2); **UMMZ 84537**, MI. Kelley Creek, Menominee River System (Menominee Co.) (17); **UMMZ 126255**, MI. Little Brevort Lake (Mackinac Co.) (7); **UMMZ 164194**, MI. Big Manistique Lake (Luce Co.) (5); **UMMZ 80676**, MI. Grand River, near Middleville (Barry Co.) (6); **UMMZ 91554**, MI. Manistee Lake (Kalkaska Co.) (10); **UMMZ 167807**, MI. Ford River (N Branch) (Dickinson Co.) (10); **UMMZ 60023**, MI. Houghton Lake, Muskegon River System (Roscommon Co.) (13); **UMMZ 147066**, MI. St. Joseph River, above Buchanan (Berrien Co.) (8); **UMMZ 60319**, MI. Mouth of Platte River (Benzie Co.) (4); **UMMZ 90427**, MI. Little Manistee River (Mason Co.) (5); **UMMZ 80197**, MI. Clam Lake (Antrim Co.) (17); **UMMZ 72950**, WI. Oconto River (Forest Co.) (4); **UMMZ 64886**, WI. Root River, 7 miles W of S Milwaukee (Milwaukee Co.) (14); **UMMZ 74998**, WI. Big Suamico River, near town (Brown Co.) (10).

Fox River Drainage - UMMZ 73810, WI. Grand River, below Kingston dam (Green Lake Co.) (10); **UMMZ 73774**, WI. Tributary of Grand River, 2 miles SE of Markesan (Green Lake Co.) (11); **UMMZ 73415**, WI. Fox River, above tributaries (Columbia Co.) (25); **UMMZ 73563**, WI. Tributary of Neenah Creek (Marquette Co.) (11); **UMMZ 73579**, WI. Old channel below Park Lake dam (Columbia Co.) (23); **UMMZ 74276**, WI. Mill Creek, tributary of Embarrass River (Shawano Co.) (24).

Lake Huron Basin

UMMZ 69001, MI. Valentine Lake, Black River Drainage (Montmorency Co.) (5); UMMZ 72130, MI. Ely Creek, near Alma (Gratiot Co.) (3); UMMZ 83748, MI. Chippewa River, tributary to Tittabawasee River (Isabella Co.) (6); UMMZ 70464, MI. E Branch of Au Sable River (Crawford Co.) (8); UMMZ 70164, MI. Hubbard Lake (Alcona Co.) (11); UMMZ 164271, MI. Bear Creek, Pine River System (Chippewa Co.) (2); UMMZ 55907, MI. Cass River, at Vassar city dam (Tuscola Co.) (7); UMMZ 126344, MI. Cheboygan River, Cheboygan (Cheboygan Co.) (3); UMMZ 91089, MI. Rifle River, at Saginaw Bay (Arenac Co.) (5); UMMZ 117612, ON. St. Mary River, middle of Sugar Island (10); ROM 14961, ON. Spanish River, near Sudbury (5); ROM 4447, ON. McGregor Bay (6); ROM 32226, ON. Parry Sound District (10); ROM 22514, ON. Saugeen River (11).

French River Drainage - ROM 8451, ON. Sand Creek, Lake Nipissing drainage (12); ROM 6775, ON. Lake Nipissing (13); ROM 6690, ON. Shoal Lake (4).

Lake Erie - Lake St. Clair Basins

UMMZ 55231, MI. River Raisin, between Munroe and Dundee (11); UMMZ 81956, MI. Orchard Lake (Oakland Co.) (12); UMMZ 55923, MI. Lake St. Clair, at Fair Haven (McComb Co.) (5); UMMZ 66547, MI. Upper Rouge River, Northville (19); UMMZ 138004, MI. Huron River, 1 mile NW of Rockwood (17); UMMZ 159810, OH. South Bass Island, Squaw Harbor, Lake Erie (11); UMMZ 87482, OH. W Branch of Rocky River (2); UMMZ 107482, OH. E Branch of Rocky River, at Kirtland (Lake Co.) (3); UMMZ 55027, PA. Lake Erie, Erie Harbor (Erie Co.) (4); ROM 14065, ON. Catfish Creek (11); ROM 34906, ON. Cambridge District (10); ROM 24506, ON. Thames River (10); ROM 56930, ON. Sydenham River (14).

Maumee River System - UMMZ 118333, OH. Swan Creek, N Whitehouse Twp (10); UMMZ 107538, OH. 10 Mile Creek (Fulton Co.) (5); UMMZ 107448, OH. Ottawa Creek, tributary of Blanchard River (9); UMMZ 61498, OH. Hicksville (4); UMMZ 121802, OH. Lost Creek (Defiance Co.) (8); UMMZ 118545, OH. Ten Mile Creek (Lucas Co.) (11).

Lake Ontario Basin / St. Lawrence River Drainages

UMMZ 140504, NY. Lake Champlain, first bay N of Plattsburg (11); UMMZ 99153, NY. Stream 4 miles N of Pulaski (26); UMMZ 81282, NY. Oneida Lake, Frober Bay (10); UMMZ 84484, NY. Cayuga Lake (8); ROM 28440, VT. Lake Dunmore (Addison Co.) (15); ROM 21566, PQ. Tributary to

Yamaska River, .5 miles N of Yamaska (13); **ROM 32993**, PQ. Lac Aylmer (36); **ROM 21582**, PQ. Proulx Creek, 3 miles N of Pierreville (17); **ROM 24036**, PQ. River du Nord, on Route 41 (9); **ROM 11138**, ON. Rideau Creek, near Andrews ville (11); **ROM 4935**, ON. Prinyer's Cove (8); **ROM 9197**, ON. Bateau Point, St. Lawrence River (6); **ROM 11693**, ON. Don River, at York Mills (11); **ROM 30611**, ON (14); **ROM 40132**, ON. Niagara River (5); **ROM 22765**, ON. Credit River, at Cheltenham (10).

Ottawa River Drainage - **ROM 28472**, PQ. Lac Caron (13); **ROM 24563**, ON. Aumond Creek (7); **UMMZ 117691**, ON. Lake Timiskaming, N of New Liskeard (16).

Atlantic Slope Watersheds

UMMZ 89271, CT. Scantic River, (Hartford Co.) (7); **ROM 49148**, MD. Rock Creek, near Rockville (9); **ROM 49145**, MD. Rock Creek (20); **UMMZ 113392**, MA. Golden Gate Brook, North Armherst (6); **UMMZ 126712**, NH. Gale River, at Franconia (Grafton Co.) (6); **UMMZ 126705**, NH. Otter Brook, at East Sullivan (Cheshire Co.) (10); **UMMZ 109832**, NJ. S Branch of Raritan River, S of Long Valley (Morris Co.) (11); **UMMZ 175164**, VA. Roanoke River, E of Elliston (Roanoke Co.) (19).

APPENDIX 2

Appendix 2: Locations of sampled darters including museum collection number and number examined (N). Museum abbreviations follow Leviton *et al.* (1985) with the exception that LU = Lakehead University, Ichthyology Collection, Thunder Bay, Ontario. Collections from LU and MZF are not catalogued by number; these collections can be identified by date only. UMMZ = University of Michigan, Museum of Zoology; ROM = Royal Ontario Museum; JFBM = Bell Museum of Natural History, University of Minnesota; MZF = University of Manitoba, Ichthyology Collection, Winnipeg, Manitoba; and, NMC = National Museum of Canada. PC represents specimens in my own collection.

<u>State/Province</u>	<u>Location</u>	<u>Collection</u>	<u>N</u>
1. Colorado	South Platte River	UMMZ 61571	33
1. Connecticut	Scantic River, Connecticut River System	UMMZ 89271	7
1. Illinois	Hickory Creek, near New Lennox	UMMZ 114904	3
2. Illinois	Quincy	UMMZ 86570	5
3. Illinois	Creek, 13 miles east of Freeport on Hwy 20	UMMZ 169682	2
4. Illinois	Stony Brook, Route 10, west of Oakwood	UMMZ 144593	2
5. Illinois	Kinkaid Creek, Jackson County, near Ava	UMMZ 105926	19
1. Indiana	Coffee Creek, near Chesterton	UMMZ 114925	48
2. Indiana	Clear Creek, near Bloomington	UMMZ 61966	11
3. Indiana	Tributary of Six Mile Creek, Wills County	UMMZ 138963	6
4. Indiana	Turkey Creek, 1 mile SE of Mongo	UMMZ 163115	3
5. Indiana	Elkhart River, near Millerburg	UMMZ 213297	2
6. Indiana	Wabash River, near New Harmony	UMMZ 81340	7
7. Indiana	Wolf Creek, Bartholomew County	UMMZ 66950	10
8. Indiana	Tippecanoe Lake, Wabash River System	UMMZ 63023	5
9. Indiana	Little Vermillion River, Hwy. 63, near Newport	PC	2
1. Iowa	Meadow Creek, east of Spencer	UMMZ 114083	5
2. Iowa	Squaw Creek	UMMZ 181099	11
3. Iowa	Yellow River, north of Pottsville	UMMZ 169699	10
4. Iowa	Brush Creek, Jackson County	UMMZ 181082	5
5. Iowa	Spirit Lake	UMMZ 101528	8
1. Kansas	Rock Creek, east of Topeka	UMMZ 156746	6
2. Kansas	Creek, south of Cleburne	UMMZ 122042	3
1. Kentucky	Russell Fork, Big Sandy System	UMMZ 118247	9
2. Kentucky	Quicksand Creek, near Quicksand	UMMZ 154425	10
1. Maryland	Rock Creek	ROM 49148	9

2. Maryland	Rock Creek	ROM 49145	20
1. Massachusetts	Golden Gate Brook, near North Armherst	UMMZ 113392	6
1. Michigan	Valentine Lake, Black River System	UMMZ 69001	5
2. Michigan	Murphey Creek	UMMZ 68774	11
3. Michigan	Kelly Creek, Menominee River System	UMMZ 84537	17
4. Michigan	River Raisin, between Munroe and Dundee	UMMZ 55231	11
5. Michigan	Jumbo River, Ontonagon River System	UMMZ 83979	2
6. Michigan	Little Brevort Lake	UMMZ 126255	7
7. Michigan	Ely Creek, near Alma	UMMZ 72130	3
8. Michigan	Big Manistique Lake	UMMZ 164194	5
9. Michigan	Chippewa River, Tittabawassee River System	UMMZ 83748	6
10. Michigan	Tributary to Thornapple River	UMMZ 80676	6
11. Michigan	Manistee Lake, Tributary to Manistee River	UMMZ 91554	10
12. Michigan	Muskallonge Lake	UMMZ 68829	6
13. Michigan	Ford River	UMMZ 167807	10
14. Michigan	Orchard Lake	UMMZ 81956	12
15. Michigan	Au Train River	UMMZ 84290	4
16. Michigan	Houghton Lake	UMMZ 60023	13
17. Michigan	St. Joseph River	UMMZ 117066	8
18. Michigan	Sturgeon River, south of Pelkie	UMMZ 70002	7
19. Michigan	Au Sable River: east branch	UMMZ 70464	8
20. Michigan	Hubbard Lake, Alcona County	UMMZ 70164	11
21. Michigan	Bear Creek, Pine River System	UMMZ 164271	2
22. Michigan	Platte River at mouth	UMMZ 60319	4
23. Michigan	Waika River at mouth, near Brimley	UMMZ 131908	10
24. Michigan	Little Manistee River	UMMZ 90427	5
25. Michigan	Lake St. Clair, at Fair Haven	UMMZ 55923	5
26. Michigan	Rush Lake; Huron Mountains	UMMZ 81613	10
27. Michigan	Cass River, at Vassar City	UMMZ 55907	7
28. Michigan	Cheboygan River	UMMZ 126344	3
29. Michigan	Upper Rouge River	UMMZ 66547	19
30. Michigan	Rifle River at mouth	UMMZ 91089	5
31. Michigan	Huron River, near Rockwood	UMMZ 138004	17
32. Michigan	Twin Lake, near Newberry	UMMZ 68697	12
33. Michigan	Perch Lake, near Copper Harbor	UMMZ 133326	21
34. Michigan	Clam Lake, Antrim County	UMMZ 80197	17
35. Michigan	Otter River, near Pelkie	UMMZ 69992	15
36. Michigan	Lake Bailey, Keweenaw County	UMMZ 133346	20
37. Michigan	Montreal River	UMMZ 185412	19
1. Minnesota	Mississippi River	UMMZ 94832	10
2. Minnesota	Mud River, near Redby	UMMZ 118445	5
3. Minnesota	Red Lake River, near Thief River Falls	PC	11
4. Minnesota	Dinner Creek	PC	13
5. Minnesota	Little Cedar River, near Adams	PC	14
6. Minnesota	Dobbins Creek, near Austin	PC	12
7. Minnesota	Rock River	PC	11
8. Minnesota	Zumbro River, near Kellogg	PC	12
9. Minnesota	Crystal Creek, Root River System	PC	12

10. Minnesota	Deer Creek	PC	4
11. Minnesota	Cottonwood River, near Springfield	PC	10
12. Minnesota	Otter Tail River	PC	11
13. Minnesota	Kanaranzi River	PC	12
14. Minnesota	Cedar River, near Lansing	PC	12
15. Minnesota	Poplar River, Cook County	JFBM 12083	2
16. Minnesota	Cross River, Lake County	JFBM 13370	1
17. Minnesota	Lester River, St. Louis County	JFBM 11573	1
18. Minnesota	Tributary to Brule River, Lake County	JFBM 24612	1
19. Minnesota	Unnamed tributary above Cabin Creek, Lake Co.	JFBM 24592	3
20. Minnesota	Knife River, Lake County	JFBM 11574	1
	(collected July and August 1940)	JFBM 11568	1
21. Minnesota	Schoolhouse Creek, Lake County	JFBM 24775	5
22. Minnesota	Manitou River at Nine Mile Creek, Lake County	JFBM 11576	2
23. Minnesota	Temperance River, Lake County	JFBM 12204	1
	(collected April and July 1941;	JFBM 12107	1
	(treated as one collection)	JFBM 13092	2
		JFBM 12058	1
		JFBM 12265	3
		JFBM 12140	5
24. Minnesota	Sucker River, St. Louis County	JFBM 24293	6
25. Minnesota	Little Isabella River, Lake County	JFBM 25006	11
26. Minnesota	Cloquet River, St. Louis County	JFBM 14620	17
27. Minnesota	St. Louis River, St. Louis County	JFBM 12481	16
1. Missouri	Spring Creek, near Novinger	UMMZ 148236	5
2. Missouri	Cuivre River, near Laddonia	UMMZ 149328	3
3. Missouri	Sarcoxie, tributary to Spring River	UMMZ 61462	10
4. Missouri	Coon Creek, near Jasper	UMMZ 151843	2
5. Missouri	Spring River, near Lamar	UMMZ 151814	1
6. Missouri	Roche Perch Creek	UMMZ 148036	7
7. Missouri	Spring River, near Carthage	UMMZ 142262	1
8. Missouri	Muddy Fork of Spring River	UMMZ 151794	6
9. Missouri	Honey Creek, near Waylund	UMMZ 148679	7
1. Nebraska	Elkhorn River	UMMZ 86744	2
2. Nebraska	Lodgepole Creek, near Chappell	UMMZ 106395	4
1. New Jersey	Raritan River, near Long Valley	UMMZ 109832	11
1. New Hampshire	Gale River, near Franconia	UMMZ 126712	6
2. New Hampshire	Otter Brook, near East Sullivan	UMMZ 126705	10
1. New York	Lake Champlain	UMMZ 140504	11
2. New York	Stream, near Pulaski	UMMZ 99153	26
3. New York	Oneida Lake at Frober Bay	UMMZ 81282	10
4. New York	Cayuga Lake	UMMZ 84484	8
1. North Dakota	Turtle River, west of Grand Forks	UMMZ 161946	3
2. North Dakota	Sheyenne River, near Valley City	UMMZ 94820	4
3. North Dakota	James River, near Jamestown	UMMZ 189482	8

4. North Dakota	Goose River, near Hillsboro	UMMZ 61580	12
5. North Dakota	Pipestem Creek, James River System	UMMZ 189493	11
6. North Dakota	Sheyenne River, near Pekin	UMMZ 189387	10
1. Ohio	Swan Creek, Maumee River System	UMMZ 118333	10
2. Ohio	Indian Guyan Creek, Ohio River System	UMMZ 107751	9
3. Ohio	Lake Erie on South Bass Island	UMMZ 159810	11
4. Ohio	Rocky River, west branch	UMMZ 87482	2
5. Ohio	Rocky River, east branch near Kirtland	UMMZ 107482	3
6. Ohio	Little Beaver Creek	UMMZ 118359	9
7. Ohio	Walhonding River, Muskingum River System	UMMZ 87830	4
8. Ohio	Muskingum River, Ohio River System	UMMZ 87774	5
9. Ohio	10 Mile Creek	UMMZ 107538	5
10. Ohio	Yellow Creek near Poland	UMMZ 86346	2
11. Ohio	Ottawa Creek, Blanchard River System	UMMZ 107448	9
12. Ohio	near Hicksville	UMMZ 61498	4
13. Ohio	Lost Creek, Defiance County	UMMZ 121802	8
14. Ohio	Ten Mile Creek, Lucas County	UMMZ 118545	11
1. Pennsylvania	Little Bull Creek, near Tarentum	UMMZ 110725	10
2. Pennsylvania	tributary of Shenango River	UMMZ 94648	4
3. Pennsylvania	Lake Erie at Erie Harbor	UMMZ 55027	4
4. Pennsylvania	Monongahela River	UMMZ 61710	13
1. South Dakota	Big Stone Lake	UMMZ 167071	8
2. South Dakota	Big Sioux River, near Volga	UMMZ 161934	3
3. South Dakota	Whetstone Creek, Minnesota River System	UMMZ 166905	23
4. South Dakota	James River, near Woonsocket	UMMZ 163822	6
1. Tennessee	Eagle Creek, near Holladay	UMMZ 168442	10
1. Vermont	Lake Dunmore	ROM 28440	15
1. Virginia	Roanoke River, near Eluston	UMMZ 175164	19
1. Wisconsin	Paint Creek, Chippewa County	UMMZ 76236	11
2. Wisconsin	Little Arbor Vitae Lake, Villas County	UMMZ 72495	10
3. Wisconsin	Jordan Lake, Adams County	UMMZ 73605	10
4. Wisconsin	St. Croix River, 3 miles W of Danbury	UMMZ 77812	14
5. Wisconsin	Yellow River, 0.5 miles S of Danbury	UMMZ 96219	5
6. Wisconsin	Grand River, near Kingston, Green Lake Co.	UMMZ 73810	10
7. Wisconsin	Skinner Creek, 1.5 m E of Browntown	UMMZ 77423	7
8. Wisconsin	tributary to Grand River, near Markesan	UMMZ 73774	11
9. Wisconsin	Oconto River, Forest County	UMMZ 72950	4
10. Wisconsin	Rock River, near Waupun, Fond Du Lac Co.	UMMZ 77232	14
11. Wisconsin	Grindstone Lake, SE of Hayward	UMMZ 95933	3
12. Wisconsin	Black Earth Creek, SE of Mazomanie	UMMZ 77635	3
13. Wisconsin	Stream, near Benoit	UMMZ 78502	5
14. Wisconsin	Little Grant River, near Bloomington	UMMZ 76695	11
15. Wisconsin	St. Germain Lake, Villas County	UMMZ 72502	14
16. Wisconsin	Root River, north branch	UMMZ 64886	14

17. Wisconsin	Apple River, near Amery	UMMZ 96234	15
18. Wisconsin	Fox River, above tributaries	UMMZ 73415	25
19. Wisconsin	French Creek, Columbia County	UMMZ 73464	24
20. Wisconsin	Kawaguesaga Lake, W of Minocqua	UMMZ 72447	9
21. Wisconsin	Spring Lake, near Pardeeville	UMMZ 73571	5
22. Wisconsin	Big Suamico River, Brown County	UMMZ 74998	10
23. Wisconsin	Gile River, near Gile	UMMZ 80002	13
24. Wisconsin	Mud Creek, near Morse, Ashland County	UMMZ 78559	3
25. Wisconsin	Brule River, near Brule	UMMZ 80041	28
26. Wisconsin	Beef River, 3 miles N of Alma	UMMZ 76260	4
27. Wisconsin	tributary of Neenah Creek, Marquette Co.	UMMZ 73563	11
28. Wisconsin	Pecatonica River, Thunder Branch	UMMZ 7690	11
29. Wisconsin	Tainter Creek, Kickapoo River System	UMMZ 76390	18
30. Wisconsin	Crawfish River, 8 miles N of Watertown	UMMZ 77165	11
31. Wisconsin	below Park Lake, Columbia County	UMMZ 73579	23
32. Wisconsin	Rock River, 2 miles below Ft. Atkinson	UMMZ 77592	6
33. Wisconsin	Warner Lake, W of Hertel	UMMZ 96184	4
34. Wisconsin	Mill Creek, Embarrass River System	UMMZ 74276	24
35. Wisconsin	Stream, near Abbotsford, Clark County	UMMZ 78769	9
36. Wisconsin	Crawfish River, Hwy "G", Dodge County	LU	7
1. West Virginia	New River	UMMZ 131828	9
2. West Virginia	Kanawha River at Paint Creek mouth	UMMZ 119357	9
1. Wyoming	Sloan Lake, near Cheyenne City	UMMZ 162955	7
1. Quebec	Richelieu River	ROM 21566	13
2. Quebec	Lac Aylmer	ROM 32993	36
3. Quebec	Proulx Creek, near St. Francois	ROM 21582	17
4. Quebec	Lac Caron, Ottawa River System	ROM 28472	13
5. Quebec	River du Nord	ROM 24036	9
1. Ontario	Rideau Creek	ROM 11138	11
2. Ontario	Ft. Severn	ROM 12575	2
3. Ontario	Prinyer's Cove	ROM 4935	8
4. Ontario	Sand Creek	ROM 8451	12
5. Ontario	Catfish Creek	ROM 14065	11
6. Ontario	Lake Attawapiskat	ROM 12316	10
7. Ontario	Bateau Point, St. Lawrence River	ROM 9197	6
8. Ontario	Lake Nipissing	ROM 6775	13
9. Ontario	Don River, near York Mills	ROM 11693	11
10. Ontario	Shoal Lake, near Lake Nipissing	ROM 6690	4
11. Ontario	Spanish River, near Sudbury	ROM 14961	5
12. Ontario	Hawley Lake	ROM 22437	2
13. Ontario	McGregor Bay	ROM 4447	6
14. Ontario	Severn River, near Ft. Severn	ROM 12574	1
15. Ontario	Lake, Cambridge District	ROM 34906	10
16. Ontario	Big Trout Lake	ROM 21331	10
17. Ontario	Perch Lake	ROM 52275	10
18. Ontario	Thames River	ROM 24506	10
19. Ontario	? 43°47'00"N 79°02'00"W	ROM 30611	14

20. Ontario	Mattagami River	ROM 52278	9
21. Ontario	Niagara River	ROM 40132	5
22. Ontario	Red Lake	ROM 35917	10
23. Ontario	Aumond Creek	ROM 24563	7
24. Ontario	Credit River, near Cheltenham	ROM 22765	10
25. Ontario	? 42°24'00"N 80°03'00"W	ROM 32226	10
26. Ontario	Harmony River	ROM 16705	10
27. Ontario	Sydenham River	ROM 56930	14
28. Ontario	Saugeen River	ROM 22514	11
29. Ontario	Agnes Lake, Rainy River Dist.	ROM 26070	10
30. Ontario	Shade Lake, Rainy River Dist.	ROM 26077	10
31. Ontario	Portage River, Sibley Peninsula	LU	1
32. Ontario	Joe Boy Creek, Sibley Peninsula	LU	7
33. Ontario	Boulevard Lake, Thunder Bay	LU	7
34. Ontario	McVicars Creek, Thunder Bay, at mouth	LU	10
35. Ontario	St. Marys River, Sugar Island	UMMZ 117612	10
36. Ontario	Lake Timiskaming, N of New Liskeard	UMMZ 117691	16
37. Ontario	Little Dog Lake	LU	10
38. Ontario	Caribou Lake, near Armstrong	LU	12
39. Ontario	Prelate Lake	LU	8
40. Ontario	Nipigon River, near town of Nipigon	LU	10
41. Ontario	Round Lake	LU	14
42. Ontario	Ombabika Bay, Lake Nipigon	LU	8
43. Ontario	Charles Harbour, Lake Nipigon	LU	9
44. Ontario	Kopka Lake	LU	10
45. Ontario	Wolf River, at Trans Canada Hwy	LU	8
46. Ontario	Black River, near Marathon	LU	5
47. Ontario	McIntyre River, Thunder Bay	LU	10
48. Ontario	Mission Marsh, near Thunder Bay	PC	12
1. Manitoba	Mukatawa River	UMMZ 180547	5
2. Manitoba	Assiniboine River	MZF	10
3. Manitoba	Delta Marsh, Lake Manitoba	MZF	3
4. Manitoba	Souris River	MZF	12
5. Manitoba	Sipiwesk Lake	ROM 19376	10
6. Manitoba	Nine Mile Creek	ROM 17496	3
7. Manitoba	Creek	ROM 19379	2
8. Manitoba	Roaring River	ROM 19381	10
9. Manitoba	Limestone River	ROM 17480	5
10. Manitoba	Steep Rock River	ROM 52439	3
11. Manitoba	Minnedosa River	ROM 19382	11
12. Manitoba	Lake Manitoba	MZF	12
13. Manitoba	Lake of the Woods, Birch Point	MZF	11
14. Manitoba	Whitemouth River, at Hwy 408	MZF	12
15. Manitoba	Roseau River, SE of Stuartburn	MZF	12
16. Manitoba	Clear Lake, Riding Mtn. Nat. Park	LU	14
17. Manitoba	Moon Lake, Riding Mtn. Nat. Park	LU	10
1. Saskatchewan	Amisk Lake	ROM 16747	3
2. Saskatchewan	Amisk Lake	ROM 16748	3
3. Saskatchewan	Souris River	ROM 16634	4

4. Saskatchewan	Loverin Lake, near Chamberlain	ROM 16624	4
5. Saskatchewan	Echo Lake	ROM 17830	10
6. Saskatchewan	Echo Lake	ROM 16769	4
7. Saskatchewan	Sioux River	NMC 69-273	1
8. Saskatchewan	Qu'Appelle River, E of Regina	NMC 58-188	1
9. Saskatchewan	Assiniboine River, at Hwy 9	NMC 64-878	1

APPENDIX 3

Appendix 3: Stain and buffer formulae used for biochemical analysis.

I/ NAD as coenzyme

For all stains add;

MTT/NBT	10 mg (mixed with 1 ml of de-ionized water)
NAD	5 drops (approximately 2 mg in each)
PMS	1 mg (added just before staining)

ENZYME	SUBSTRATE AND OTHER COMPONENTS	STAIN BUFFER (50 ml)
G3PDH	DL- α -glycerophosphate (500 mg)	pH 8.5
LDH	DL-Na-lactate (2 drops)	pH 8.5
XDH	H Hypoxanthine (8 mg)	pH 8.0

II/ NADP as coenzyme

For all stains add;

MgCl	2 drops
MTT/NBT	10 mg (mixed with 1 ml of de-ionized water)
NADP	1 mg
PMS	1 mg (added just before staining)

ENZYME	SUBSTRATE AND OTHER COMPONENTS	STAIN BUFFER (50 ml)
GPI	Na-fructose-6-phosphate (30 mg) G6PDH (8 drops added just before buffer) * incubate for 15 minutes before adding PMS	pH 8.0
PGM	Glucose-1-phosphate (50 mg) G6PDH (6 drops added just before buffer)	pH 8.0
ME	DL-Na-malate (10 drops)	pH 8.5
IDH	DL-isocitric acid (40 mg)	pH 8.0
IDH/PGDH	DL-isocitric acid (40 mg) 6-phosphogluconic acid (20 mg)	pH 8.0

III/ Additional stains

AAT	50 ml AAT buffer (pH 8.0) 1 mg pyridoxal-5-phosphate (added just before staining) incubate 30 minutes, then add 100 mg Fast Blue BB
EST	50 ml phosphate buffer (pH 6.5) 1 ml 1% α -naphthyl acetate in 1:1, water:acetone (20 drops) incubate 15 minutes, then add 60 mg Fast Blue RR

IV/ Buffers and stock solutions

(weight in grams unless specified otherwise)

AAT stock	Tris/HCL stain buffer (pH 8.0)	0.5 L
	Aspartic acid (monosodium salt)	2.35
	α -ketoglutaric acid	1.0
	(adjust pH with NaOH or HCL)	
Phosphate	$\text{NaH}_2\text{PO}_4 \cdot 2\text{H}_2\text{O}$	9.98
	NaHPO_4	5.11
	H_2O	up to 1000 ml

Sample buffer (pH 7.0)

1.12 Tris
0.37 Na_2EDTA
 H_2O to make up to 1000 ml
HCL to adjust pH to 7.0

Stock Solutions1/ Electro - S (pH 7.1) 1 L

1.	Tris 0.135 M (M.W. 121.1)	16.3485
2.	Citric acid anhydrous 0.043 M (M.W. 192.1)	8.26

Gel S (dilute 1:15 electro - S) (titrate using citric acid)

1. Stock solution: dilute 1:3.75 electro - S (1.067 L buffer + 2.93 L de-ionized water)
2. Gels: dilute 1:4 (110 ml buffer + 330 ml de-ionized water)

(Use for ME^+ , PGM^+ , AAT^+)

2/ Electro - A (pH 8.1) 1 L

- | | | |
|----|--|--------|
| 1. | Lithium hydroxide
0.006 M
(M.W. 23.95) | 1.437 |
| 2. | Boric acid
0.03 M
(M.W. 61.83) | 18.549 |

Gel A (concentrated, dilute 1:4) (titrate using boric acid)

- | | | |
|----|--|--------|
| 1. | Tris
0.03 M
(M.W. 121.1) | 14.532 |
| 2. | Citric acid
0.005 M
(M.W. 192.1) | 3.842 |
| 3. | 1% electro buffer 40 ml | |

(Use for *GPI*^{*}, *EST*^{*}, *XDH*^{*})3/ Electro - B (pH 6.5) 1 L

- | | | |
|----|---|-------|
| 1. | Citric acid anhydrous
0.04 M
(M.W. 192.1) | 7.684 |
| 2. | Aminopropyl morpholine | 10.7 |

Gel B (dilute 1:20 electro - B) (titrate using aminopropyl)

- | | |
|----|--|
| 1. | Stock solution: dilute 1.5 electro - B (0.8 L buffer + 3.2 L de-ionized water) |
| 2. | Gels: dilute 1:4 (110 ml buffer + 330 ml de-ionized water) |

(Use for *IDH*^{*}, *LDH*^{*}, *PGDH*^{*}, *G3PDH*^{*})V/ Destain fixative (10 L)

Ethanol 0.8 L, Acetic acid 0.2 L, De-ionized water 9.0 L

APPENDIX 4

Appendix 4: Date, sample locations run, number of hours of run (hr), volts per hour (VPH), mean volts (V) and mean amperage (current) for 22 sample runs of *Etheostoma nigrum*. All gels were initially set at 350 V and 70 amps, 300 V and 60 amps, and 440 V and 70 amps for gels B, S, and A, respectively.

March 19 - Boulevard Lake.

B Gel	4.41 hr,	1.53 VPH,	350 volts,	47.5 current/amps
S Gel	4.66 hr,	0.85 VPH,	190 volts,	60.0 current/amps
A Gel	4.83 hr,	2.01 VPH,	440 volts,	48.4 current/amps

March 26 - Sandstone Lake.

B Gel	4.60 hr,	1.60 VPH,	350 volts,	47.5 current
S Gel	4.97 hr,	0.89 VPH,	183 volts,	60.0 current
A Gel	5.13 hr,	2.07 VPH,	440 volts,	59.3 current

April 2 - Little Dog Lake.

B Gel	5.35 hr,	1.86 VPH,	350 volts,	48.9 current
S Gel	4.63 hr,	1.00 VPH,	226 volts,	60.0 current
A Gel	4.88 hr,	2.03 VPH,	440 volts,	49.1 current

April 3 - Boulevard Lake.

B Gel	5.51 hr,	2.00 VPH,	375 volts,	56.0 current
S Gel	4.38 hr,	1.01 VPH,	250 volts,	53.8 current
A Gel	5.10 hr,	2.16 VPH,	440 volts,	49.7 current

April 6 - Nipigon River.

B Gel	5.10 hr,	1.76 VPH,	350 volts,	59.6 current
S Gel	4.29 hr,	0.87 VPH,	210 volts,	60.0 current
A Gel	4.51 hr,	1.85 VPH,	440 volts,	51.3 current

April 8 - Prelate Lake.

B Gel	5.37 hr,	1.87 VPH,	350 volts,	49.3 current
S Gel	4.40 hr,	0.77 VPH,	180 volts,	60.0 current
A Gel	4.63 hr,	1.89 VPH,	440 volts,	58.2 current

April 9 - Nipigon River.

B Gel	4.58 hr,	1.11 VPH,	350 volts,	50.9 current
S Gel	5.49 hr,	1.32 VPH,	258 volts,	70.0 current
A Gel	4.86 hr,	2.03 VPH,	440 volts,	45.7 current

April 11 - Boulevard Lake.

B Gel	5.54 hr,	1.87 VPH,	350 volts,	59.8 current
S Gel	4.46 hr,	0.80 VPH,	184 volts,	60.0 current
A Gel	4.79 hr,	1.97 VPH,	440 volts,	55.4 current

April 12 - Little Dog Lake.

B Gel	5.92 hr,	1.94 VPH,	350 volts,	66.2 current
S Gel	4.63 hr,	0.75 VPH,	169 volts,	60.0 current
A Gel	5.33 hr,	2.18 VPH,	440 volts,	65.7 current

April 13 - Sandstone Lake.

B Gel	5.77 hr,	1.96 VPH,	350 volts,	57.5 current
S Gel	4.82 hr,	0.87 VPH,	186 volts,	60.0 current
A Gel	5.22 hr,	2.16 VPH,	440 volts,	46.5 current

April 15 - Nipigon River, McVicars Creek, Little Dog Lake, Round Lake, Prelate Lake, Neebing-McIntyre River.

B Gel	5.78 hr,	1.96 VPH,	350 volts,	65.7 current
S Gel	4.71 hr,	0.81 VPH,	177 volts,	60.0 current
A Gel	4.98 hr,	2.02 VPH,	440 volts,	64.3 current

April 16 - Neebing-McIntyre River.

B Gel	5.76 hr,	1.94 VPH,	350 volts,	63.2 current
S Gel	4.74 hr,	0.82 VPH,	180 volts,	60.0 current
A Gel	5.12 hr,	2.08 VPH,	440 volts,	57.9 current

April 17 - McVicars Creek.

B Gel	5.97 hr,	1.82 VPH,	290 volts,	70.0 current
S Gel	4.56 hr,	0.80 VPH,	183 volts,	60.0 current
A Gel	5.09 hr,	2.03 VPH,	440 volts,	67.2 current

April 18 - Rat River, Roseau River, Lake Winnipeg, Round Lake, McVicars Creek, Prelate Lake, Boulevard Lake, Nipigon River, Neebing-McIntyre River, Little Dog Lake, Sandstone Lake.

B Gel	5.62 hr,	1.88 VPH,	350 volts,	55.6 current
S Gel	5.20 hr,	0.88 VPH,	175 volts,	60.0 current
A Gel	5.38 hr,	2.19 VPH,	440 volts,	55.0 current

April 19 - Prelate Lake, Neebing-McIntyre River.

B Gel	5.64 hr,	1.95 VPH,	350 volts,	56.7 current
S Gel	4.63 hr,	0.84 VPH,	189 volts,	60.0 current
A Gel	5.13 hr,	2.17 VPH,	440 volts,	61.8 current

April 20 - Sandstone Lake, Neebing-McIntyre River.

B Gel	5.45 hr,	1.80 VPH,	337 volts,	70.0 current
S Gel	4.98 hr,	0.83 VPH,	174 volts,	60.0 current
A Gel	5.22 hr,	2.14 VPH,	440 volts,	68.3 current

October 21 - Big Arbor Vitae Lake, McVicars Creek.

B Gel	5.89 hr,	1.76 VPH,	290 volts,	70.0 current
S Gel	5.19 hr,	0.95 VPH,	188 volts,	60.0 current
A Gel	5.63 hr,	2.38 VPH,	440 volts,	59.8 current

October 22 - St. Croix Lake, Rock River, McVicars Creek.

B Gel	5.76 hr,	1.67 VPH,	280 volts,	70.0 current
S Gel	5.16 hr,	1.21 VPH,	240 volts,	60.0 current
A Gel	5.44 hr,	2.31 VPH,	440 volts,	41.1 current

October 23 - Big Arbor Vitae Lake, McVicars Creek, Flambeau River, Silver Falls Creek, Whitefish Lake.

B Gel	5.70 hr,	1.73 VPH,	316 volts,	70.0 current
S Gel	5.16 hr,	1.01 VPH,	200 volts,	60.0 current
A Gel	5.38 hr,	2.23 VPH,	418 volts,	70.0 current

October 24 - Puckaway Lake, Big Arbor Vitae Lake, Rock River, McVicars Creek.

B Gel	5.56 hr,	1.62 VPH,	304 volts,	70.0 current
S Gel	4.80 hr,	1.02 VPH,	217 volts,	60.0 current
A Gel	5.15 hr,	2.16 VPH,	440 volts,	53.3 current

October 25 - McVicars Creek, Big Arbor Vitae Lake, Rock River, St. Croix Lake, Puckaway Lake, Flambeau River.

B Gel	5.51 hr,	1.03 VPH,	323 volts,	70.0 current
S Gel	4.80 hr,	1.03 VPH,	214 volts,	60.0 current
A Gel	5.21 hr,	2.21 VPH,	429 volts,	70.0 current

October 26 - Boulevard Lake, Silver Falls Creek, Big Arbor Vitae Lake, McVicars Creek, Puckaway Lake, Rock River, St. Croix Lake, Flambeau River, Whitefish Lake.

B Gel	5.45 hr,	1.73 VPH,	328 volts,	70.0 current
S Gel	4.98 hr,	1.08 VPH,	220 volts,	60.0 current
A Gel	5.07 hr,	2.13 VPH,	440 volts,	56.3 current

Mean running times (SD)

B Gel	5.46 hr, (0.43)	1.75 VPH, (0.25)	336 volts, (24.97)	61.11 current (8.56)
S Gel	4.80 hr, (0.31)	0.93 VPH, (0.15)	199.7 volts, (25.92)	60.17 current (2.56)
A Gel	5.09 hr, (0.27)	2.11 VPH, (0.13)	438.5 volts, (5.14),	57.01 current (8.37)

APPENDIX 5

Appendix 5: Gel and sample preparation protocol for electrophoretic runs of samples of *Etheostoma nigrum*.

Day 1

1. Boil 1 L of de-ionized water for 3 gels.
2. Measure 55-56 g of hydrolysed starch and place in 1 L Erlenmeyer flask.
3. Add 110 ml of appropriate B, S or A concentrated buffer into Erlenmeyer flask containing starch and mix until all starch is suspended.
4. While agitating flask, pore 330 of boiled water into flask using a funnel and bring to boil over a bunsen burner.
5. Constantly agitate contents of the flask over the bunsen burner until the gel on the bottom begins to boil.
6. Remove from heat and degas mixture with a vacuum pump or aspirator.
7. Degas until the bubbling stops (approximately 40 seconds) and in one motion pour gel into a level gel frame. While this gel is beginning to cool, mix the other two and repeat the process.
8. Before the gels have completely cooled, place a glass plate over the gel ensuring that no air pockets are formed. A glass plate should also be placed under the frame prior to pouring to catch spills.
9. After the gel has cooled for 0.5-1 hour, wrap with plastic wrap (with glass plates on) to prevent desiccation.

Day 2

10. Remove samples 4-6 at a time from freezer and carefully remove a "fillet" of muscle tissue and the liver. Do not include any viscera. Add these tissues to the sample tray which has been cooling in the freezer. Rinse scalpel in distilled water between each cut and change water often.
11. Make a crude homogenate using a glass rod and add tissue buffer if required. Place completed trays in refrigerator.
12. Remove the plastic wrap and glass sheets from the gels. Keep the top glass sheet beside each gel. Cut S and A gels in the same manner. Make horizontal cuts across the gel approximately 85 and 150 mm from the anodal end of the gel. On the B gel, these cuts should be at approximately 70 and 135 mm from the anodal end.
13. Remove the sample trays from the refrigerator. Using a plastic scraper, remove the first two sections of the gel (the smallest sections) and place on glass sheet which formerly covered the top of the gel.

14. Using filter cartridge, dip in liver samples. When removed, ensure that there are no pieces of tissue on filter. Make sure that filter wick only touches gel once.
15. Load filters on gel. Replace next section of gel and repeat with muscle sample.
16. Place divider rods at each end of gel to hold samples in place. Wrap gel smoothly in plastic wrap with a 10 mm straight edge exposed at both anodal and cathodal ends.
17. Take gels to cold room and place on electrophoresis apparatus with circulating coolant (-2.0oC). Place buffer wicks just over exposed part of gel and hold in place with small glass plates.
18. Run samples for approximately 10-15 minutes under power.
19. Pause power and return to lab to remove sample wicks. This is performed in a reverse manner as loading the gels.
20. Rewrap gels and return to cold room. Place buffer wicks back on and place circulating apparatus over top of gels. Take power packs off pause and run for approximately 4.5-5.0 hours (this will vary depending on enzyme).
21. After recording time, VPH, etc, from power pack, remove one gel at a time and prepare to stain (dry ingredients for stains should be prepared in advance).
22. Remove spacer bar from gels and notch gels so that the liver and muscle sections can be identified later.
23. Remove gel sections one at a time and place on gel slicer. Ensure that wires on the gel slicer are clean to prevent distortion. Clean wires between each section and gel with distilled water. Apply slight pressure to top of gel section when cutting.
24. Do not use top or bottom layer of gel for staining. Stain gel as per formulae. Note that certain enzymes are easiest to detect on certain gels. Avoid air bubbles under gels in staining trays as this prevents the detection of some activity.
25. Incubate gels at 35.0oC. Fix gels when dark bands appear suitable for reading. Do not overstain! Attempt scoring of gels as soon as possible after fixing.

APPENDIX 6

Appendix 6A: Number of scales on the nape for examined samples of *Etheostoma nigrum* and *E. olmstedii*. Location number and names correspond to those of Appendix 2.

<u>Location</u>	<u>MODE</u>	<u>UPPER</u>	<u>LOWER</u>	<u>MEAN</u>	<u>SD</u>
1. Colorado	0.0	0.0	0.0	0.000	0.000
1. Connecticut	0.0	4.0	0.0	2.143	2.035
1. Illinois	12.0	33.0	12.0	19.333	11.846
2. Illinois	0.0	3.0	0.0	0.600	1.342
3. Illinois	0.0	12.0	0.0	6.000	8.485
4. Illinois	23.0	38.0	23.0	30.500	10.607
5. Illinois	0.0	0.0	0.0	0.000	0.000
1. Indiana	0.0	57.0	0.0	19.229	20.093
2. Indiana	0.0	2.0	0.0	0.182	0.603
3. Indiana	1.0	13.0	1.0	5.000	5.177
4. Indiana	0.0	4.0	0.0	1.333	2.309
5. Indiana	0.0	4.0	0.0	2.000	2.828
6. Indiana	0.0	3.0	0.0	0.714	1.254
7. Indiana	0.0	5.0	0.0	0.800	1.619
8. Indiana	0.0	0.0	0.0	0.000	0.000
9. Indiana	2.0	5.0	2.0	3.500	2.121
1. Iowa	0.0	38.0	0.0	9.200	16.468
2. Iowa	0.0	0.0	0.0	0.000	0.000
3. Iowa	0.0	0.0	0.0	0.000	0.000
4. Iowa	0.0	10.0	0.0	2.000	4.472
5. Iowa	35.0	58.0	35.0	47.750	10.110
1. Kansas	0.0	17.0	0.0	6.833	6.463
2. Kansas	0.0	0.0	0.0	0.000	0.000
1. Kentucky	0.0	0.0	0.0	0.000	0.000
2. Kentucky	0.0	0.0	0.0	0.000	0.000
1. Maryland	3.0	18.0	0.0	7.444	5.659
2. Maryland	6.0	13.0	0.0	6.300	3.614
1. Massachusetts	4.0	22.0	4.0	10.667	6.439
1. Michigan	0.0	0.0	0.0	0.000	0.000
2. Michigan	0.0	0.0	0.0	0.000	0.000
3. Michigan	0.0	7.0	0.0	0.412	1.698
4. Michigan	0.0	8.0	0.0	2.727	2.724

5. Michigan	2.0	3.0	2.0	2.500	0.707
6. Michigan	0.0	0.0	0.0	0.000	0.000
7. Michigan	7.0	26.0	7.0	16.000	9.539
8. Michigan	0.0	0.0	0.0	0.000	0.000
9. Michigan	0.0	4.0	0.0	0.833	1.602
10. Michigan	16.0	34.0	1.0	16.333	10.857
11. Michigan	0.0	0.0	0.0	0.000	0.000
12. Michigan	0.0	0.0	0.0	0.000	0.000
13. Michigan	0.0	0.0	0.0	0.000	0.000
14. Michigan	0.0	3.0	0.0	0.333	0.888
15. Michigan	0.0	0.0	0.0	0.000	0.000
16. Michigan	0.0	3.0	0.0	0.231	0.832
17. Michigan	0.0	46.0	0.0	7.375	15.838
18. Michigan	0.0	0.0	0.0	0.000	0.000
19. Michigan	0.0	2.0	0.0	0.250	0.707
20. Michigan	0.0	3.0	0.0	0.364	0.924
21. Michigan	9.0	10.0	9.0	9.500	0.707
22. Michigan	0.0	9.0	0.0	3.250	4.272
23. Michigan	0.0	6.0	0.0	1.900	2.025
24. Michigan	0.0	6.0	0.0	2.400	2.608
25. Michigan	30.0	38.0	0.0	20.800	16.709
26. Michigan	0.0	0.0	0.0	0.000	0.000
27. Michigan	0.0	14.0	0.0	6.143	6.309
28. Michigan	0.0	7.0	0.0	2.333	4.041
29. Michigan	6.0	41.0	0.0	12.368	9.873
30. Michigan	0.0	34.0	0.0	9.000	14.353
31. Michigan	37.0	59.0	1.0	31.529	18.080
32. Michigan	0.0	0.0	0.0	0.000	0.000
33. Michigan	0.0	0.0	0.0	0.000	0.000
34. Michigan	0.0	8.0	0.0	0.882	2.497
35. Michigan	0.0	0.0	0.0	0.000	0.000
36. Michigan	0.0	0.0	0.0	0.000	0.000
37. Michigan	0.0	0.0	0.0	0.000	0.000
1. Minnesota	35.0	41.0	0.0	24.200	14.235
2. Minnesota	4.0	45.0	4.0	28.200	15.611
3. Minnesota	0.0	42.0	0.0	19.455	13.419
4. Minnesota	0.0	42.0	0.0	7.923	14.660
5. Minnesota	0.0	8.0	0.0	1.571	2.441
6. Minnesota	0.0	3.0	0.0	0.583	1.165
7. Minnesota	0.0	4.0	0.0	0.364	1.206
8. Minnesota	0.0	20.0	0.0	2.917	6.708
9. Minnesota	0.0	17.0	0.0	1.417	4.907
10. Minnesota	1.0	52.0	1.0	22.500	24.007
11. Minnesota	0.0	10.0	0.0	2.300	4.001
12. Minnesota	40.0	60.0	33.0	42.364	7.788
13. Minnesota	0.0	4.0	0.0	0.583	1.379
14. Minnesota	0.0	17.0	0.0	5.083	6.037
15. Minnesota	0.0	0.0	0.0	0.000	0.000
16. Minnesota	0.0	0.0	0.0	0.000	----
17. Minnesota	0.0	0.0	0.0	0.000	----

18. Minnesota	0.0	0.0	0.0	0.000	-----
19. Minnesota	0.0	0.0	0.0	0.000	0.000
20. Minnesota	0.0	0.0	0.0	0.000	0.000
21. Minnesota	0.0	0.0	0.0	0.000	0.000
22. Minnesota	0.0	0.0	0.0	0.000	0.000
23. Minnesota	0.0	2.0	0.0	0.153	0.554
24. Minnesota	0.0	29.0	0.0	11.333	11.741
25. Minnesota	0.0	0.0	0.0	0.000	0.000
26. Minnesota	0.0	1.0	0.0	0.117	0.332
27. Minnesota	0.0	0.0	0.0	0.000	0.000
1. Missouri	0.0	0.0	0.0	0.000	0.000
2. Missouri	3.0	5.0	3.0	4.000	1.000
3. Missouri	32.0	38.0	23.0	31.300	5.078
4. Missouri	35.0	36.0	35.0	35.500	0.707
5. Missouri	22.0	22.0	22.0	22.000	-----
6. Missouri	0.0	11.0	0.0	2.857	4.413
7. Missouri	35.0	35.0	35.0	35.000	-----
8. Missouri	46.0	50.0	37.0	43.667	5.086
9. Missouri	0.0	6.0	0.0	3.000	2.828
1. Nebraska	0.0	0.0	0.0	0.000	0.000
2. Nebraska	0.0	0.0	0.0	0.000	0.000
1. New Jersey	0.0	14.0	0.0	3.909	4.437
1. New Hampshire	0.0	1.0	0.0	0.167	0.408
2. New Hampshire	0.0	9.0	0.0	1.500	2.953
1. New York	5.0	36.0	1.0	15.091	12.825
2. New York	23.0	53.0	3.0	31.615	13.276
3. New York	9.0	26.0	4.0	15.500	6.786
4. New York	4.0	49.0	4.0	28.125	16.577
1. North Dakota	0.0	0.0	0.0	0.000	0.000
2. North Dakota	0.0	0.0	0.0	0.000	0.000
3. North Dakota	9.0	20.0	0.0	9.625	6.865
4. North Dakota	0.0	13.0	0.0	1.750	4.224
5. North Dakota	7.0	12.0	0.0	6.364	3.957
6. North Dakota	0.0	0.0	0.0	0.000	0.000
1. Ohio	0.0	34.0	0.0	5.500	10.212
2. Ohio	0.0	0.0	0.0	0.000	0.000
3. Ohio	36.0	47.0	32.0	40.727	5.255
4. Ohio	0.0	0.0	0.0	0.000	0.000
5. Ohio	0.0	0.0	0.0	0.000	0.000
6. Ohio	0.0	0.0	0.0	0.000	0.000
7. Ohio	0.0	0.0	0.0	0.000	0.000
8. Ohio	0.0	6.0	0.0	1.600	2.608
9. Ohio	1.0	7.0	1.0	4.200	2.387
10. Ohio	0.0	0.0	0.0	0.000	0.000

11. Ohio	0.0	0.0	0.0	0.000	0.000
12. Ohio	0.0	9.0	0.0	3.750	4.500
13. Ohio	4.0	10.0	3.0	5.125	2.532
14. Ohio	0.0	41.0	0.0	8.182	11.729
1. Pennsylvannia	0.0	0.0	0.0	0.000	0.000
2. Pennsylvannia	0.0	1.0	0.0	0.500	0.577
3. Pennsylvannia	27.0	49.0	27.0	41.750	10.178
4. Pennsylvannia	0.0	0.0	0.0	0.000	0.000
1. South Dakota	51.0	51.0	17.0	39.375	11.612
2. South Dakota	8.0	8.0	1.0	5.667	4.041
3. South Dakota	12.0	46.0	0.0	20.174	14.674
4. South Dakota	9.0	17.0	4.0	8.500	4.637
1. Tennessee	0.0	0.0	0.0	0.000	0.000
1. Vermont	30.0	51.0	10.0	34.400	12.500
1. Virginia	0.0	10.0	0.0	1.684	2.868
1. Wisconsin	0.0	4.0	0.0	0.545	1.293
2. Wisconsin	49.0	56.0	49.0	52.300	2.584
3. Wisconsin	0.0	0.0	0.0	0.000	0.000
4. Wisconsin	0.0	2.0	0.0	0.143	0.535
5. Wisconsin	0.0	38.0	0.0	8.000	14.926
6. Wisconsin	45.0	60.0	33.0	46.300	7.150
7. Wisconsin	0.0	17.0	0.0	8.571	7.345
8. Wisconsin	0.0	53.0	0.0	30.727	17.698
9. Wisconsin	0.0	0.0	0.0	0.000	0.000
10. Wisconsin	40.0	58.0	24.0	42.071	7.927
11. Wisconsin	30.0	50.0	30.0	41.333	10.263
12. Wisconsin	16.0	38.0	16.0	25.333	11.372
13. Wisconsin	0.0	0.0	0.0	0.000	0.000
14. Wisconsin	0.0	0.0	0.0	0.000	0.000
15. Wisconsin	47.0	47.0	0.0	28.643	17.727
16. Wisconsin	4.0	54.0	4.0	16.714	15.122
17. Wisconsin	43.0	53.0	29.0	43.200	6.405
18. Wisconsin	0.0	62.0	0.0	37.920	18.766
19. Wisconsin	44.0	52.0	0.0	30.333	16.110
20. Wisconsin	59.0	61.0	5.0	50.333	17.607
21. Wisconsin	7.0	55.0	7.0	38.400	18.676
22. Wisconsin	0.0	5.0	0.0	0.500	1.581
23. Wisconsin	0.0	0.0	0.0	0.000	0.000
24. Wisconsin	0.0	0.0	0.0	0.000	0.000
25. Wisconsin	0.0	6.0	0.0	0.357	1.339
26. Wisconsin	0.0	10.0	0.0	2.500	5.000
27. Wisconsin	23.0	53.0	4.0	33.455	14.306
28. Wisconsin	0.0	20.0	0.0	3.636	5.971
29. Wisconsin	0.0	14.0	0.0	1.222	3.353
30. Wisconsin	43.0	62.0	43.0	49.818	6.030

31. Wisconsin	0.0	56.0	0.0	36.957	19.061
32. Wisconsin	41.0	59.0	41.0	47.000	7.183
33. Wisconsin	0.0	0.0	0.0	0.000	0.000
34. Wisconsin	0.0	8.0	0.0	0.333	1.633
35. Wisconsin	0.0	0.0	0.0	0.000	0.000
36. Wisconsin	50.0	50.0	19.0	43.143	10.946
1. West Virginia	0.0	0.0	0.0	0.000	0.000
1. Wyoming	0.0	0.0	0.0	0.000	0.000
1. Quebec	16.0	52.0	2.0	21.692	14.562
2. Quebec	37.0	60.0	32.0	42.611	7.200
3. Quebec	0.0	28.0	0.0	9.529	7.609
4. Quebec	0.0	1.0	0.0	0.077	0.277
5. Quebec	0.0	4.0	0.0	0.444	1.333
1. Ontario	0.0	43.0	0.0	11.000	15.531
2. Ontario	0.0	0.0	0.0	0.000	0.000
3. Ontario	20.0	46.0	3.0	25.750	14.220
4. Ontario	0.0	0.0	0.0	0.000	0.000
5. Ontario	0.0	5.0	0.0	0.727	1.555
6. Ontario	0.0	0.0	0.0	0.000	0.000
7. Ontario	4.0	31.0	4.0	19.833	9.283
8. Ontario	0.0	3.0	0.0	0.231	0.832
9. Ontario	0.0	4.0	0.0	0.545	1.214
10. Ontario	0.0	0.0	0.0	0.000	0.000
11. Ontario	0.0	2.0	0.0	1.000	1.000
12. Ontario	0.0	0.0	0.0	0.000	0.000
13. Ontario	8.0	46.0	8.0	29.833	15.855
14. Ontario	0.0	0.0	0.0	0.000	----
15. Ontario	0.0	16.0	0.0	5.300	5.355
16. Ontario	0.0	0.0	0.0	0.000	0.000
17. Ontario	0.0	0.0	0.0	0.000	0.000
18. Ontario	0.0	8.0	0.0	2.500	3.064
19. Ontario	8.0	34.0	0.0	12.714	9.603
20. Ontario	0.0	0.0	0.0	0.000	0.000
21. Ontario	8.0	53.0	8.0	37.400	18.022
22. Ontario	0.0	3.0	0.0	0.300	0.949
23. Ontario	3.0	11.0	0.0	6.286	4.309
24. Ontario	0.0	15.0	0.0	4.300	5.559
25. Ontario	0.0	0.0	0.0	0.000	0.000
26. Ontario	0.0	0.0	0.0	0.000	0.000
27. Ontario	0.0	8.0	0.0	2.333	4.041
28. Ontario	0.0	9.0	0.0	3.545	3.205
29. Ontario	0.0	0.0	0.0	0.000	0.000
30. Ontario	0.0	0.0	0.0	0.000	0.000
31. Ontario	0.0	0.0	0.0	0.000	----
32. Ontario	0.0	0.0	0.0	0.000	0.000
33. Ontario	0.0	7.0	0.0	1.714	2.752
34. Ontario	15.0	44.0	0.0	12.900	13.511

35. Ontario	0.0	11.0	0.0	1.100	3.479
36. Ontario	0.0	0.0	0.0	0.000	0.000
37. Ontario	0.0	0.0	0.0	0.000	0.000
38. Ontario	0.0	0.0	0.0	0.000	0.000
39. Ontario	0.0	0.0	0.0	0.000	0.000
40. Ontario	0.0	0.0	0.0	0.000	0.000
41. Ontario	40.0	48.0	21.0	37.571	8.262
42. Ontario	0.0	0.0	0.0	0.000	0.000
43. Ontario	0.0	0.0	0.0	0.000	0.000
44. Ontario	0.0	0.0	0.0	0.000	0.000
45. Ontario	0.0	0.0	0.0	0.000	0.000
46. Ontario	0.0	0.0	0.0	0.000	0.000
47. Ontario	0.0	35.0	0.0	14.200	12.856
48. Ontario	0.0	26.0	0.0	7.500	8.723
1. Manitoba	0.0	0.0	0.0	0.000	0.000
2. Manitoba	0.0	0.0	0.0	0.000	0.000
3. Manitoba	0.0	1.0	0.0	0.333	0.577
4. Manitoba	0.0	0.0	0.0	0.000	0.000
5. Manitoba	0.0	0.0	0.0	0.000	0.000
6. Manitoba	0.0	0.0	0.0	0.000	0.000
7. Manitoba	0.0	0.0	0.0	0.000	0.000
8. Manitoba	0.0	0.0	0.0	0.000	0.000
9. Manitoba	0.0	0.0	0.0	0.000	0.000
10. Manitoba	0.0	0.0	0.0	0.000	0.000
11. Manitoba	0.0	0.0	0.0	0.000	0.000
12. Manitoba	0.0	4.0	0.0	0.833	1.403
13. Manitoba	0.0	0.0	0.0	0.000	0.000
14. Manitoba	0.0	0.0	0.0	0.000	0.000
15. Manitoba	0.0	0.0	0.0	0.000	0.000
16. Manitoba	0.0	1.0	0.0	0.071	0.267
17. Manitoba	0.0	0.0	0.0	0.000	0.000
1. Saskatchewan	0.0	0.0	0.0	0.000	0.000
2. Saskatchewan	0.0	0.0	0.0	0.000	0.000
3. Saskatchewan	0.0	0.0	0.0	0.000	0.000
4. Saskatchewan	0.0	2.0	0.0	0.750	0.957
5. Saskatchewan	0.0	31.0	0.0	8.400	12.186
6. Saskatchewan	23.0	35.0	23.0	28.750	5.679
7. Saskatchewan	0.0	0.0	0.0	0.000	----
8. Saskatchewan	39.0	39.0	39.0	39.000	----
9. Saskatchewan	0.0	0.0	0.0	0.000	----

Appendix 6B: Number of scales at the nape-parietal juncture for examined samples of *Etheostoma nigrum* and *E. olmstedii*. Location number and names correspond to those of Appendix 2.

<u>Location</u>	<u>MODE</u>	<u>UPPER</u>	<u>LOWER</u>	<u>MEAN</u>	<u>SD</u>
1. Colorado	0.0	0.0	0.0	0.000	0.000
1. Connecticut	0.0	0.0	0.0	0.000	0.000
1. Illinois	3.0	7.0	3.0	4.667	2.082
2. Illinois	0.0	5.0	0.0	1.000	2.236
3. Illinois	3.0	4.0	3.0	3.500	0.707
4. Illinois	5.0	5.0	5.0	5.000	0.000
5. Illinois	0.0	0.0	0.0	0.000	0.000
1. Indiana	4.0	6.0	0.0	2.917	2.082
2. Indiana	0.0	0.0	0.0	0.000	0.000
3. Indiana	1.0	6.0	0.0	2.500	2.429
4. Indiana	2.0	3.0	2.0	2.333	0.577
5. Indiana	1.0	5.0	1.0	3.000	2.828
6. Indiana	0.0	0.0	0.0	0.000	0.000
7. Indiana	0.0	4.0	0.0	1.000	1.700
8. Indiana	0.0	1.0	0.0	0.200	0.447
9. Indiana	3.0	4.0	3.0	3.500	0.707
1. Iowa	0.0	3.0	0.0	1.400	1.342
2. Iowa	0.0	0.0	0.0	0.000	0.000
3. Iowa	0.0	0.0	0.0	0.000	0.000
4. Iowa	0.0	8.0	0.0	3.200	3.347
5. Iowa	4.0	6.0	4.0	4.500	0.756
1. Kansas	0.0	4.0	0.0	0.667	1.633
2. Kansas	0.0	0.0	0.0	0.000	0.000
1. Kentucky	0.0	0.0	0.0	0.000	0.000
2. Kentucky	0.0	0.0	0.0	0.000	0.000
1. Maryland	0.0	0.0	0.0	0.000	0.000
2. Maryland	0.0	3.0	0.0	0.450	0.887
1. Massachusetts	0.0	5.0	0.0	0.833	2.041
1. Michigan	0.0	0.0	0.0	0.000	0.000
2. Michigan	0.0	0.0	0.0	0.000	0.000
3. Michigan	0.0	3.0	0.0	0.235	0.752
4. Michigan	0.0	6.0	0.0	2.273	2.284
5. Michigan	2.0	5.0	2.0	3.500	2.121
6. Michigan	0.0	0.0	0.0	0.000	0.000
7. Michigan	4.0	4.0	2.0	3.333	1.155

8. Michigan	0.0	0.0	0.0	0.000	0.000
9. Michigan	3.0	5.0	0.0	2.667	1.862
10. Michigan	5.0	5.0	4.0	4.667	0.516
11. Michigan	0.0	2.0	0.0	0.400	0.843
12. Michigan	0.0	0.0	0.0	0.000	0.000
13. Michigan	0.0	4.0	0.0	0.900	1.663
14. Michigan	0.0	4.0	0.0	0.667	1.557
15. Michigan	0.0	0.0	0.0	0.000	0.000
16. Michigan	0.0	0.0	0.0	0.000	0.000
17. Michigan	5.0	5.0	2.0	4.250	1.165
18. Michigan	0.0	0.0	0.0	0.000	0.000
19. Michigan	0.0	5.0	0.0	2.625	1.996
20. Michigan	0.0	6.0	0.0	1.818	2.401
21. Michigan	1.0	2.0	1.0	1.500	0.707
22. Michigan	4.0	4.0	2.0	3.250	0.957
23. Michigan	0.0	4.0	0.0	1.400	1.897
24. Michigan	6.0	6.0	2.0	4.600	1.673
25. Michigan	4.0	4.0	0.0	2.600	1.673
26. Michigan	0.0	0.0	0.0	0.000	0.000
27. Michigan	0.0	4.0	0.0	1.714	1.799
28. Michigan	0.0	0.0	0.0	0.000	0.000
29. Michigan	4.0	6.0	0.0	3.632	1.499
30. Michigan	2.0	4.0	0.0	2.400	1.673
31. Michigan	4.0	6.0	2.0	3.824	1.131
32. Michigan	0.0	0.0	0.0	0.000	0.000
33. Michigan	0.0	0.0	0.0	0.000	0.000
34. Michigan	0.0	3.0	0.0	0.765	1.147
35. Michigan	0.0	0.0	0.0	0.000	0.000
36. Michigan	0.0	0.0	0.0	0.000	0.000
37. Michigan	0.0	4.0	0.0	0.474	1.264
1. Minnesota	5.0	6.0	0.0	3.600	1.838
2. Minnesota	4.0	5.0	0.0	3.600	2.074
3. Minnesota	4.0	5.0	0.0	2.909	2.023
4. Minnesota	0.0	5.0	0.0	2.462	2.145
5. Minnesota	5.0	8.0	4.0	5.714	1.383
6. Minnesota	6.0	8.0	1.0	4.417	2.193
7. Minnesota	0.0	3.0	0.0	0.545	1.036
8. Minnesota	0.0	4.0	0.0	0.667	1.557
9. Minnesota	0.0	6.0	0.0	2.000	2.796
10. Minnesota	5.0	7.0	4.0	5.250	1.258
11. Minnesota	0.0	6.0	0.0	1.800	2.201
12. Minnesota	6.0	7.0	4.0	5.273	1.009
13. Minnesota	0.0	5.0	0.0	0.583	1.443
14. Minnesota	5.0	6.0	2.0	4.667	1.073
15. Minnesota	0.0	0.0	0.0	0.000	0.000
16. Minnesota	0.0	0.0	0.0	0.000	----
17. Minnesota	0.0	0.0	0.0	0.000	----
18. Minnesota	0.0	0.0	0.0	0.000	----
19. Minnesota	0.0	0.0	0.0	0.000	0.000
20. Minnesota	0.0	0.0	0.0	0.000	0.000

21. Minnesota	0.0	0.0	0.0	0.000	0.000
22. Minnesota	0.0	0.0	0.0	0.000	0.000
23. Minnesota	0.0	0.0	0.0	0.000	0.000
24. Minnesota	0.0	5.0	0.0	2.666	2.160
25. Minnesota	0.0	0.0	0.0	0.000	0.000
26. Minnesota	0.0	4.0	0.0	0.470	1.124
27. Minnesota	0.0	2.0	0.0	0.125	0.500
1. Missouri	0.0	0.0	0.0	0.000	0.000
2. Missouri	2.0	4.0	2.0	3.000	1.000
3. Missouri	4.0	5.0	2.0	3.900	0.876
4. Missouri	4.0	4.0	4.0	4.000	0.000
5. Missouri	4.0	4.0	4.0	4.000	-----
6. Missouri	0.0	4.0	0.0	1.000	1.732
7. Missouri	4.0	4.0	4.0	4.000	-----
8. Missouri	4.0	5.0	4.0	4.500	0.548
9. Missouri	4.0	10.	0.0	3.429	3.409
1. Nebraska	0.0	0.0	0.0	0.000	0.000
2. Nebraska	0.0	0.0	0.0	0.000	0.000
1. New Jersey	0.0	3.0	0.0	0.273	0.905
1. New Hampshire	0.0	0.0	0.0	0.000	0.000
2. New Hampshire	0.0	1.0	0.0	0.100	0.316
1. New York	0.0	5.0	0.0	1.545	2.162
2. New York	4.0	6.0	0.0	3.654	1.468
3. New York	0.0	4.0	0.0	1.000	1.491
4. New York	0.0	3.0	0.0	1.500	1.309
1. North Dakota	0.0	0.0	0.0	0.000	0.000
2. North Dakota	0.0	0.0	0.0	0.000	0.000
3. North Dakota	4.0	5.0	0.0	3.250	1.581
4. North Dakota	0.0	4.0	0.0	0.333	1.155
5. North Dakota	4.0	4.0	0.0	2.182	1.537
6. North Dakota	0.0	2.0	0.0	0.200	0.632
1. Ohio	2.0	5.0	0.0	2.300	1.829
2. Ohio	0.0	0.0	0.0	0.000	0.000
3. Ohio	4.0	5.0	3.0	4.182	0.751
4. Ohio	0.0	0.0	0.0	0.000	0.000
5. Ohio	0.0	0.0	0.0	0.000	0.000
6. Ohio	0.0	0.0	0.0	0.000	0.000
7. Ohio	0.0	0.0	0.0	0.000	0.000
8. Ohio	0.0	0.0	0.0	0.000	0.000
9. Ohio	0.0	4.0	0.0	1.200	1.789
10. Ohio	0.0	0.0	0.0	0.000	0.000
11. Ohio	0.0	1.0	0.0	0.111	0.333
12. Ohio	0.0	0.0	0.0	0.000	0.000
13. Ohio	4.0	6.0	0.0	2.750	2.121

14. Ohio	0.0	5.0	0.0	1.182	2.040
1. Pennsylvania	0.0	2.0	0.0	0.200	0.632
2. Pennsylvania	0.0	0.0	0.0	0.000	0.000
3. Pennsylvania	5.0	5.0	3.0	4.250	0.957
4. Pennsylvania	0.0	0.0	0.0	0.000	0.000
1. South Dakota	5.0	5.0	2.0	4.125	1.126
2. South Dakota	1.0	3.0	1.0	2.000	1.000
3. South Dakota	4.0	5.0	0.0	3.000	2.000
4. South Dakota	0.0	5.0	0.0	0.833	2.041
1. Tennessee	0.0	0.0	0.0	0.000	0.000
1. Vermont	5.0	5.0	4.0	4.600	0.507
1. Virginia	0.0	0.0	0.0	0.000	0.000
1. Wisconsin	0.0	6.0	0.0	1.545	2.067
2. Wisconsin	5.0	7.0	3.0	4.700	1.059
3. Wisconsin	0.0	0.0	0.0	0.000	0.000
4. Wisconsin	0.0	5.0	0.0	0.857	1.657
5. Wisconsin	0.0	5.0	0.0	1.667	2.251
6. Wisconsin	4.0	5.0	3.0	4.000	0.471
7. Wisconsin	4.0	5.0	3.0	4.286	0.756
8. Wisconsin	4.0	5.0	4.0	4.273	0.467
9. Wisconsin	0.0	0.0	0.0	0.000	0.000
10. Wisconsin	4.0	5.0	3.0	4.214	0.579
11. Wisconsin	4.0	4.0	0.0	2.667	2.309
12. Wisconsin	4.0	4.0	0.0	2.667	2.309
13. Wisconsin	0.0	1.0	0.0	0.200	0.447
14. Wisconsin	0.0	0.0	0.0	0.000	0.000
15. Wisconsin	4.0	5.0	0.0	3.286	1.637
16. Wisconsin	0.0	11.0	0.0	4.000	3.162
17. Wisconsin	4.0	5.0	4.0	4.267	0.458
18. Wisconsin	4.0	6.0	0.0	4.160	1.028
19. Wisconsin	4.0	6.0	0.0	3.750	1.260
20. Wisconsin	4.0	4.0	2.0	3.333	0.866
21. Wisconsin	4.0	4.0	3.0	3.800	0.447
22. Wisconsin	0.0	2.0	0.0	0.600	0.966
23. Wisconsin	0.0	0.0	0.0	0.000	0.000
24. Wisconsin	0.0	1.0	0.0	0.333	0.577
25. Wisconsin	0.0	5.0	0.0	0.821	1.634
26. Wisconsin	0.0	2.0	0.0	1.000	1.155
27. Wisconsin	4.0	6.0	0.0	3.727	1.737
28. Wisconsin	4.0	5.0	0.0	3.909	1.375
29. Wisconsin	0.0	5.0	0.0	1.889	1.906
30. Wisconsin	4.0	6.0	4.0	4.545	0.688
31. Wisconsin	4.0	5.0	0.0	3.957	1.065
32. Wisconsin	4.0	4.0	3.0	3.833	0.408
33. Wisconsin	0.0	0.0	0.0	0.000	0.000
34. Wisconsin	0.0	5.0	0.0	0.708	1.517

35. Wisconsin	0.0	2.0	0.0	0.222	0.667
36. Wisconsin	4.0	5.0	4.0	4.286	0.488
1. West Virginia	0.0	0.0	0.0	0.000	0.000
1. Wyoming	0.0	0.0	0.0	0.000	0.000
1. Quebec	4.0	4.0	0.0	2.615	1.710
2. Quebec	4.0	6.0	4.0	4.472	0.560
3. Quebec	4.0	5.0	0.0	2.647	1.801
4. Quebec	0.0	2.0	0.0	0.154	0.555
5. Quebec	0.0	5.0	0.0	2.333	2.291
1. Ontario	0.0	4.0	0.0	1.091	1.300
2. Ontario	0.0	0.0	0.0	0.000	0.000
3. Ontario	4.0	5.0	0.0	2.875	1.959
4. Ontario	0.0	5.0	0.0	1.917	1.975
5. Ontario	0.0	4.0	0.0	0.727	1.618
6. Ontario	0.0	0.0	0.0	0.000	0.000
7. Ontario	0.0	3.0	0.0	0.833	1.329
8. Ontario	0.0	8.0	0.0	0.615	2.219
9. Ontario	4.0	6.0	0.0	2.273	2.149
10. Ontario	0.0	4.0	0.0	1.000	2.000
11. Ontario	0.0	0.0	0.0	0.000	0.000
12. Ontario	0.0	0.0	0.0	0.000	0.000
13. Ontario	4.0	4.0	4.0	4.000	0.000
14. Ontario	0.0	0.0	0.0	0.000	-----
15. Ontario	0.0	6.0	0.0	1.800	2.201
16. Ontario	0.0	0.0	0.0	0.000	0.000
17. Ontario	0.0	0.0	0.0	0.000	0.000
18. Ontario	0.0	4.0	0.0	0.800	1.398
19. Ontario	0.0	7.0	0.0	2.214	2.517
20. Ontario	0.0	0.0	0.0	0.000	0.000
21. Ontario	4.0	5.0	0.0	3.400	1.949
22. Ontario	0.0	4.0	0.0	0.600	1.350
23. Ontario	5.0	5.0	0.0	2.571	2.370
24. Ontario	0.0	7.0	0.0	2.100	2.807
25. Ontario	0.0	1.0	0.0	0.100	0.316
26. Ontario	0.0	0.0	0.0	0.000	0.000
27. Ontario	0.0	7.0	0.0	2.286	2.268
28. Ontario	0.0	5.0	0.0	0.818	1.601
29. Ontario	0.0	0.0	0.0	0.000	0.000
30. Ontario	0.0	0.0	0.0	0.000	0.000
31. Ontario	0.0	0.0	0.0	0.000	-----
32. Ontario	0.0	1.0	0.0	0.143	0.378
33. Ontario	0.0	0.0	0.0	0.000	0.000
34. Ontario	0.0	4.0	0.0	1.400	1.897
35. Ontario	0.0	4.0	0.0	0.700	1.337
36. Ontario	0.0	0.0	0.0	0.000	0.000
37. Ontario	0.0	0.0	0.0	0.000	0.000
38. Ontario	0.0	0.0	0.0	0.000	0.000

39. Ontario	0.0	0.0	0.0	0.000	0.000
40. Ontario	0.0	0.0	0.0	0.000	0.000
41. Ontario	4.0	6.0	3.0	4.357	0.745
42. Ontario	0.0	0.0	0.0	0.000	0.000
43. Ontario	0.0	0.0	0.0	0.000	0.000
44. Ontario	0.0	0.0	0.0	0.000	0.000
45. Ontario	0.0	0.0	0.0	0.000	0.000
46. Ontario	0.0	0.0	0.0	0.000	0.000
47. Ontario	0.0	4.0	0.0	1.400	1.897
48. Ontario	0.0	4.0	0.0	1.416	1.564
1. Manitoba	0.0	0.0	0.0	0.000	0.000
2. Manitoba	0.0	2.0	0.0	0.300	0.675
3. Manitoba	0.0	0.0	0.0	0.000	0.000
4. Manitoba	0.0	2.0	0.0	0.167	0.577
5. Manitoba	0.0	0.0	0.0	0.000	0.000
6. Manitoba	0.0	0.0	0.0	0.000	0.000
7. Manitoba	0.0	0.0	0.0	0.000	0.000
8. Manitoba	0.0	0.0	0.0	0.000	0.000
9. Manitoba	0.0	0.0	0.0	0.000	0.000
10. Manitoba	0.0	0.0	0.0	0.000	0.000
11. Manitoba	0.0	2.0	0.0	0.364	0.809
12. Manitoba	0.0	4.0	0.0	0.583	1.379
13. Manitoba	0.0	0.0	0.0	0.000	0.000
14. Manitoba	0.0	0.0	0.0	0.000	0.000
15. Manitoba	0.0	4.0	0.0	0.333	1.155
16. Manitoba	0.0	2.0	0.0	0.143	0.535
17. Manitoba	0.0	0.0	0.0	0.000	0.000
1. Saskatchewan	0.0	0.0	0.0	0.000	0.000
2. Saskatchewan	0.0	0.0	0.0	0.000	0.000
3. Saskatchewan	0.0	0.0	0.0	0.000	0.000
4. Saskatchewan	0.0	2.0	0.0	0.750	0.957
5. Saskatchewan	0.0	4.0	0.0	1.600	2.066
6. Saskatchewan	0.0	2.0	0.0	0.750	0.957
7. Saskatchewan	0.0	0.0	0.0	0.000	----
8. Saskatchewan	5.0	5.0	5.0	5.000	----
9. Saskatchewan	0.0	0.0	0.0	0.000	----

Appendix 6C: Number of scales on the breast for examined samples of *Etheostoma nigrum* and *E. olmstedii*. Location number and names correspond to those of Appendix 2.

<u>Location</u>	<u>MODE</u>	<u>UPPER</u>	<u>LOWER</u>	<u>MEAN</u>	<u>SD</u>
1. Colorado	0.0	0.0	0.0	0.000	0.000
1. Connecticut	0.0	3.0	0.0	0.429	1.134
1. Illinois	3.0	13.0	3.0	8.667	5.132
2. Illinois	5.0	5.0	0.0	3.200	2.168
3. Illinois	0.0	5.0	0.0	2.500	3.536
4. Illinois	13.0	27.0	13.0	20.000	9.899
5. Illinois	0.0	0.0	0.0	0.000	0.000
1. Indiana	0.0	109.0	0.0	27.375	31.363
2. Indiana	0.0	0.0	0.0	0.000	0.000
3. Indiana	0.0	4.0	0.0	0.667	1.633
4. Indiana	0.0	0.0	0.0	0.000	0.000
5. Indiana	0.0	0.0	0.0	0.000	0.000
6. Indiana	0.0	0.0	0.0	0.000	0.000
7. Indiana	0.0	0.0	0.0	0.000	0.000
8. Indiana	0.0	0.0	0.0	0.000	0.000
9. Indiana	0.0	0.0	0.0	0.000	0.000
1. Iowa	0.0	93.0	0.0	20.000	40.835
2. Iowa	0.0	1.0	0.0	0.182	0.405
3. Iowa	0.0	0.0	0.0	0.000	0.000
4. Iowa	0.0	1.0	0.0	0.200	0.447
5. Iowa	90.0	129.0	90.0	108.250	12.680
1. Kansas	4.0	9.0	1.0	4.833	3.061
2. Kansas	0.0	0.0	0.0	0.000	0.000
1. Kentucky	0.0	0.0	0.0	0.000	0.000
2. Kentucky	0.0	0.0	0.0	0.000	0.000
1. Maryland	0.0	0.0	0.0	0.000	0.000
2. Maryland	0.0	5.0	0.0	0.900	1.447
1. Massachusetts	6.0	18.0	6.0	13.500	4.506
1. Michigan	0.0	0.0	0.0	0.000	0.000
2. Michigan	0.0	0.0	0.0	0.000	0.000
3. Michigan	0.0	2.0	0.0	0.471	0.874
4. Michigan	0.0	0.0	0.0	0.000	0.000
5. Michigan	0.0	9.0	0.0	4.500	6.364
6. Michigan	0.0	0.0	0.0	0.000	0.000
7. Michigan	0.0	2.0	0.0	0.667	1.155

8. Michigan	0.0	8.0	0.0	3.400	3.435
9. Michigan	0.0	5.0	0.0	0.833	2.041
10. Michigan	0.0	8.0	0.0	2.167	2.994
11. Michigan	0.0	0.0	0.0	0.000	0.000
12. Michigan	0.0	0.0	0.0	0.000	0.000
13. Michigan	0.0	8.0	0.0	0.800	2.530
14. Michigan	0.0	0.0	0.0	0.000	0.000
15. Michigan	0.0	0.0	0.0	0.000	0.000
16. Michigan	0.0	0.0	0.0	0.000	0.000
17. Michigan	0.0	0.0	0.0	0.000	0.000
18. Michigan	0.0	0.0	0.0	0.000	0.000
19. Michigan	0.0	0.0	0.0	0.000	0.000
20. Michigan	0.0	1.0	0.0	0.091	0.302
21. Michigan	4.0	8.0	4.0	6.000	2.828
22. Michigan	0.0	0.0	0.0	0.000	0.000
23. Michigan	0.0	40.0	0.0	9.000	14.522
24. Michigan	0.0	7.0	0.0	4.000	3.674
25. Michigan	0.0	76.0	0.0	37.200	31.792
26. Michigan	0.0	0.0	0.0	0.000	0.000
27. Michigan	0.0	16.0	0.0	5.000	7.594
28. Michigan	0.0	1.0	0.0	0.333	0.577
29. Michigan	0.0	10.0	0.0	1.263	2.579
30. Michigan	0.0	11.0	0.0	2.200	4.919
31. Michigan	2.0	156.0	2.0	53.118	44.048
32. Michigan	0.0	0.0	0.0	0.000	0.000
33. Michigan	0.0	3.0	0.0	0.238	0.768
34. Michigan	0.0	2.0	0.0	0.235	0.664
35. Michigan	0.0	9.0	0.0	0.800	2.336
36. Michigan	0.0	0.0	0.0	0.000	0.000
37. Michigan	0.0	7.0	0.0	0.474	1.645
1. Minnesota	6.0	89.0	6.0	65.900	24.651
2. Minnesota	12.0	100.0	12.0	63.800	34.456
3. Minnesota	22.0	99.0	5.0	54.455	32.782
4. Minnesota	0.0	52.0	0.0	9.692	15.364
5. Minnesota	0.0	3.0	0.0	0.500	0.941
6. Minnesota	0.0	0.0	0.0	0.000	0.000
7. Minnesota	0.0	2.0	0.0	0.727	0.786
8. Minnesota	0.0	10.0	0.0	1.333	2.902
9. Minnesota	0.0	3.0	0.0	0.917	1.165
10. Minnesota	15.0	92.0	15.0	37.000	36.941
11. Minnesota	0.0	7.0	0.0	1.800	2.486
12. Minnesota	77.0	134.0	66.0	89.091	18.950
13. Minnesota	0.0	12.0	0.0	2.083	3.965
14. Minnesota	0.0	2.0	0.0	0.167	0.577
15. Minnesota	0.0	0.0	0.0	0.000	0.000
16. Minnesota	0.0	0.0	0.0	0.000	-----
17. Minnesota	0.0	0.0	0.0	0.000	-----
18. Minnesota	0.0	0.0	0.0	0.000	-----
19. Minnesota	0.0	0.0	0.0	0.000	0.000
20. Minnesota	0.0	0.0	0.0	0.000	0.000

21. Minnesota	0.0	0.0	0.0	0.000	0.000
22. Minnesota	0.0	0.0	0.0	0.000	0.000
23. Minnesota	0.0	9.0	0.0	1.076	2.465
24. Minnesota	0.0	72.0	0.0	28.500	27.609
25. Minnesota	0.0	0.0	0.0	0.000	0.000
26. Minnesota	0.0	2.0	0.0	0.235	0.664
27. Minnesota	0.0	5.0	0.0	0.500	1.414
1. Missouri	0.0	0.0	0.0	0.000	0.000
2. Missouri	2.0	37.0	2.0	14.667	19.399
3. Missouri	51.0	64.0	22.0	46.200	13.164
4. Missouri	53.0	76.0	53.0	64.500	16.263
5. Missouri	46.0	46.0	46.0	46.000	-----
6. Missouri	0.0	4.0	0.0	0.571	1.512
7. Missouri	28.0	28.0	28.0	28.000	-----
8. Missouri	50.0	88.0	50.0	68.167	14.219
9. Missouri	0.0	4.0	0.0	1.143	1.952
1. Nebraska	0.0	10.0	0.0	5.000	7.071
2. Nebraska	0.0	0.0	0.0	0.000	0.000
1. New Jersey	0.0	9.0	0.0	0.818	2.714
1. New Hampshire	0.0	0.0	0.0	0.000	0.000
2. New Hampshire	0.0	9.0	0.0	1.700	2.830
1. New York	0.0	40.0	0.0	10.727	13.595
2. New York	91.0	99.0	0.0	66.846	23.141
3. New York	65.0	90.0	54.0	69.100	9.792
4. New York	33.0	91.0	33.0	66.375	22.142
1. North Dakota	0.0	0.0	0.0	0.000	0.000
2. North Dakota	0.0	2.0	0.0	0.500	1.000
3. North Dakota	19.0	44.0	19.0	29.250	8.242
4. North Dakota	0.0	68.0	0.0	7.000	19.363
5. North Dakota	25.0	27.0	0.0	17.545	8.395
6. North Dakota	0.0	1.0	0.0	0.200	0.422
1. Ohio	0.0	28.0	0.0	3.400	8.847
2. Ohio	0.0	0.0	0.0	0.000	0.000
3. Ohio	73.0	106.0	25.0	77.364	20.554
4. Ohio	0.0	0.0	0.0	0.000	0.000
5. Ohio	0.0	0.0	0.0	0.000	0.000
6. Ohio	0.0	0.0	0.0	0.000	0.000
7. Ohio	0.0	1.0	0.0	0.250	0.500
8. Ohio	0.0	0.0	0.0	0.000	0.000
9. Ohio	0.0	0.0	0.0	0.000	0.000
10. Ohio	0.0	0.0	0.0	0.000	0.000
11. Ohio	0.0	0.0	0.0	0.000	0.000

12. Ohio	0.0	24.0	0.0	6.000	12.000
13. Ohio	0.0	3.0	0.0	1.375	1.408
14. Ohio	0.0	25.0	0.0	2.273	7.538
1. Pennsylvannia	0.0	0.0	0.0	0.000	0.000
2. Pennsylvannia	0.0	0.0	0.0	0.000	0.000
3. Pennsylvannia	85.0	110.0	85.0	98.250	10.532
4. Pennsylvannia	0.0	0.0	0.0	0.000	0.000
1. South Dakota	80.0	105.0	43.0	81.500	18.134
2. South Dakota	15.0	48.0	15.0	26.333	18.771
3. South Dakota	30.0	94.0	3.0	43.087	25.831
4. South Dakota	22.0	22.0	10.0	16.000	5.060
1. Tennessee	0.0	0.0	0.0	0.000	0.000
1. Vermont	40.0	59.0	4.0	29.667	16.096
1. Virginia	0.0	5.0	0.0	0.421	1.216
1. Wisconsin	0.0	11.0	0.0	2.545	4.458
2. Wisconsin	109.0	143.0	105.0	119.900	13.354
3. Wisconsin	0.0	0.0	0.0	0.000	0.000
4. Wisconsin	0.0	15.0	0.0	2.071	4.009
5. Wisconsin	0.0	68.0	0.0	25.167	29.247
6. Wisconsin	91.0	109.0	39.0	83.000	18.123
7. Wisconsin	0.0	9.0	0.0	3.286	3.498
8. Wisconsin	0.0	100.0	0.0	67.273	30.770
9. Wisconsin	0.0	0.0	0.0	0.000	0.000
10. Wisconsin	56.0	98.0	43.0	70.429	19.045
11. Wisconsin	89.0	110.0	89.0	98.667	10.599
12. Wisconsin	12.0	12.0	0.0	8.000	6.928
13. Wisconsin	0.0	0.0	0.0	0.000	0.000
14. Wisconsin	0.0	0.0	0.0	0.000	0.000
15. Wisconsin	65.0	108.0	7.0	65.786	32.622
16. Wisconsin	0.0	26.0	0.0	7.143	9.355
17. Wisconsin	88.0	120.0	74.0	96.267	13.172
18. Wisconsin	0.0	103.0	0.0	58.600	32.117
19. Wisconsin	74.0	110.0	0.0	70.625	28.124
20. Wisconsin	121.0	139.0	50.0	109.667	24.960
21. Wisconsin	19.0	127.0	19.0	82.600	47.253
22. Wisconsin	0.0	18.0	0.0	1.800	5.692
23. Wisconsin	0.0	0.0	0.0	0.000	0.000
24. Wisconsin	0.0	0.0	0.0	0.000	0.000
25. Wisconsin	0.0	27.0	0.0	1.714	5.577
26. Wisconsin	0.0	0.0	0.0	0.000	0.000
27. Wisconsin	23.0	115.0	23.0	82.727	29.489
28. Wisconsin	0.0	10.0	0.0	0.909	3.015
29. Wisconsin	0.0	1.0	0.0	0.056	0.236
30. Wisconsin	54.0	130.0	54.0	94.636	24.643
31. Wisconsin	0.0	85.0	0.0	45.609	28.511

32. Wisconsin	53.0	131.0	53.0	93.333	32.148
33. Wisconsin	0.0	0.0	0.0	0.000	0.000
34. Wisconsin	0.0	20.0	0.0	1.083	4.211
35. Wisconsin	0.0	0.0	0.0	0.000	0.000
36. Wisconsin	26.0	85.0	26.0	62.714	20.589
1. West Virginia	0.0	0.0	0.0	0.000	0.000
1. Wyoming	0.0	0.0	0.0	0.000	0.000
1. Quebec	0.0	76.0	0.0	25.692	28.043
2. Quebec	79.0	119.0	31.0	72.722	17.729
3. Quebec	0.0	25.0	0.0	1.941	6.077
4. Quebec	0.0	5.0	0.0	0.538	1.450
5. Quebec	0.0	0.0	0.0	0.000	0.000
1. Ontario	0.0	47.0	0.0	15.636	18.074
2. Ontario	0.0	0.0	0.0	0.000	0.000
3. Ontario	37.0	68.0	37.0	53.125	10.921
4. Ontario	0.0	0.0	0.0	0.000	0.000
5. Ontario	0.0	0.0	0.0	0.000	0.000
6. Ontario	0.0	4.0	0.0	0.800	1.476
7. Ontario	55.0	78.0	55.0	63.667	8.959
8. Ontario	0.0	0.0	0.0	0.000	0.000
9. Ontario	0.0	0.0	0.0	0.000	0.000
10. Ontario	0.0	0.0	0.0	0.000	0.000
11. Ontario	0.0	5.0	0.0	2.200	2.280
12. Ontario	0.0	0.0	0.0	0.000	0.000
13. Ontario	16.0	77.0	16.0	47.000	21.817
14. Ontario	0.0	0.0	0.0	0.000	----
15. Ontario	0.0	0.0	0.0	0.000	0.000
16. Ontario	0.0	0.0	0.0	0.000	0.000
17. Ontario	0.0	0.0	0.0	0.000	0.000
18. Ontario	0.0	0.0	0.0	0.000	0.000
19. Ontario	5.0	53.0	2.0	24.500	17.710
20. Ontario	0.0	0.0	0.0	0.000	0.000
21. Ontario	23.0	95.0	23.0	53.600	27.943
22. Ontario	0.0	0.0	0.0	0.000	0.000
23. Ontario	0.0	2.0	0.0	0.286	0.756
24. Ontario	0.0	0.0	0.0	0.000	0.000
25. Ontario	0.0	0.0	0.0	0.000	0.000
26. Ontario	0.0	0.0	0.0	0.000	0.000
27. Ontario	0.0	0.0	0.0	0.000	0.000
28. Ontario	0.0	0.0	0.0	0.000	0.000
29. Ontario	0.0	0.0	0.0	0.000	0.000
30. Ontario	0.0	0.0	0.0	0.000	0.000
31. Ontario	0.0	0.0	0.0	0.000	----
32. Ontario	0.0	1.0	0.0	0.143	0.378
33. Ontario	0.0	0.0	0.0	0.000	0.000
34. Ontario	0.0	38.0	0.0	16.900	12.414
35. Ontario	0.0	2.0	0.0	0.200	0.632

36. Ontario	0.0	0.0	0.0	0.000	0.000
37. Ontario	0.0	0.0	0.0	0.000	0.000
38. Ontario	0.0	0.0	0.0	0.000	0.000
39. Ontario	0.0	0.0	0.0	0.000	0.000
40. Ontario	0.0	0.0	0.0	0.000	0.000
41. Ontario	92.0	112.0	66.0	92.500	12.708
42. Ontario	0.0	0.0	0.0	0.000	0.000
43. Ontario	0.0	0.0	0.0	0.000	0.000
44. Ontario	0.0	0.0	0.0	0.000	0.000
45. Ontario	0.0	0.0	0.0	0.000	0.000
46. Ontario	0.0	0.0	0.0	0.000	0.000
47. Ontario	49.0	78.0	1.0	41.700	25.564
48. Ontario	0.0	104.0	0.0	43.750	33.575
1. Manitoba	0.0	0.0	0.0	0.000	0.000
2. Manitoba	0.0	0.0	0.0	0.000	0.000
3. Manitoba	0.0	34.0	0.0	13.333	18.148
4. Manitoba	0.0	5.0	0.0	0.500	1.446
5. Manitoba	0.0	0.0	0.0	0.000	0.000
6. Manitoba	0.0	0.0	0.0	0.000	0.000
7. Manitoba	0.0	0.0	0.0	0.000	0.000
8. Manitoba	0.0	0.0	0.0	0.000	0.000
9. Manitoba	0.0	0.0	0.0	0.000	0.000
10. Manitoba	0.0	0.0	0.0	0.000	0.000
11. Manitoba	0.0	0.0	0.0	0.000	0.000
12. Manitoba	31.0	49.0	2.0	27.000	13.177
13. Manitoba	0.0	0.0	0.0	0.000	0.000
14. Manitoba	0.0	7.0	0.0	1.333	2.270
15. Manitoba	0.0	9.0	0.0	1.000	2.594
16. Manitoba	0.0	4.0	0.0	0.286	1.069
17. Manitoba	0.0	0.0	0.0	0.000	0.000
1. Saskatchewan	0.0	0.0	0.0	0.000	0.000
2. Saskatchewan	0.0	0.0	0.0	0.000	0.000
3. Saskatchewan	0.0	0.0	0.0	0.000	0.000
4. Saskatchewan	0.0	18.0	0.0	8.000	7.483
5. Saskatchewan	0.0	69.0	0.0	20.700	27.873
6. Saskatchewan	53.0	79.0	53.0	65.500	13.404
7. Saskatchewan	1.0	1.0	1.0	1.000	-----
8. Saskatchewan	80.0	80.0	80.0	80.000	-----
9. Saskatchewan	0.0	0.0	0.0	0.000	-----

Appendix 6D: Number of scales on the cheek for examined samples of *Etheostoma nigrum* and *E. olmstedii*. Location number and names correspond to those of Appendix 2.

<u>Location</u>	<u>MODE</u>	<u>UPPER</u>	<u>LOWER</u>	<u>MEAN</u>	<u>SD</u>
1. Colorado	0.0	0.0	0.0	0.000	0.000
1. Connecticut	2.0	14.0	2.0	6.143	4.811
1. Illinois	0.0	7.0	0.0	2.667	3.786
2. Illinois	0.0	0.0	0.0	0.000	0.000
3. Illinois	0.0	2.0	0.0	1.000	1.414
4. Illinois	2.0	8.0	2.0	5.000	4.243
5. Illinois	0.0	0.0	0.0	0.000	0.000
1. Indiana	0.0	49.0	0.0	6.708	11.287
2. Indiana	0.0	0.0	0.0	0.000	0.000
3. Indiana	0.0	2.0	0.0	0.333	0.816
4. Indiana	0.0	0.0	0.0	0.000	0.000
5. Indiana	0.0	0.0	0.0	0.000	0.000
6. Indiana	0.0	0.0	0.0	0.000	0.000
7. Indiana	0.0	3.0	0.0	0.500	0.972
8. Indiana	0.0	0.0	0.0	0.000	0.000
9. Indiana	0.0	0.0	0.0	0.000	0.000
1. Iowa	0.0	36.0	0.0	7.800	15.818
2. Iowa	0.0	0.0	0.0	0.000	0.000
3. Iowa	0.0	0.0	0.0	0.000	0.000
4. Iowa	0.0	0.0	0.0	0.000	0.000
5. Iowa	52.0	52.0	28.0	43.750	8.714
1. Kansas	0.0	1.0	0.0	0.167	0.408
2. Kansas	0.0	1.0	0.0	0.333	0.577
1. Kentucky	0.0	0.0	0.0	0.000	0.000
2. Kentucky	0.0	0.0	0.0	0.000	0.000
1. Maryland	4.0	11.0	0.0	4.444	3.575
2. Maryland	3.0	12.0	0.0	3.550	2.685
1. Massachusetts	18.0	34.0	4.0	16.000	10.276
1. Michigan	0.0	0.0	0.0	0.000	0.000
2. Michigan	0.0	0.0	0.0	0.000	0.000
3. Michigan	0.0	0.0	0.0	0.000	0.000
4. Michigan	0.0	0.0	0.0	0.000	0.000
5. Michigan	0.0	0.0	0.0	0.000	0.000
6. Michigan	0.0	0.0	0.0	0.000	0.000
7. Michigan	0.0	3.0	0.0	1.667	1.528

8. Michigan	0.0	0.0	0.0	0.000	0.000
9. Michigan	0.0	1.0	0.0	0.167	0.408
10. Michigan	1.0	8.0	0.0	2.333	2.944
11. Michigan	0.0	0.0	0.0	0.000	0.000
12. Michigan	0.0	0.0	0.0	0.000	0.000
13. Michigan	0.0	0.0	0.0	0.000	0.000
14. Michigan	0.0	0.0	0.0	0.000	0.000
15. Michigan	0.0	0.0	0.0	0.000	0.000
16. Michigan	0.0	0.0	0.0	0.000	0.000
17. Michigan	0.0	0.0	0.0	0.000	0.000
18. Michigan	0.0	0.0	0.0	0.000	0.000
19. Michigan	0.0	5.0	0.0	0.625	1.768
20. Michigan	0.0	1.0	0.0	0.091	0.302
21. Michigan	0.0	1.0	0.0	0.500	0.707
22. Michigan	0.0	0.0	0.0	0.000	0.000
23. Michigan	0.0	12.0	0.0	1.300	3.773
24. Michigan	0.0	7.0	0.0	2.200	2.950
25. Michigan	0.0	19.0	0.0	6.200	8.258
26. Michigan	0.0	0.0	0.0	0.000	0.000
27. Michigan	0.0	3.0	0.0	0.857	1.215
28. Michigan	0.0	0.0	0.0	0.000	0.000
29. Michigan	0.0	6.0	0.0	0.684	1.493
30. Michigan	0.0	1.0	0.0	0.200	0.447
31. Michigan	1.0	42.0	0.0	10.235	11.361
32. Michigan	0.0	0.0	0.0	0.000	0.000
33. Michigan	0.0	0.0	0.0	0.000	0.000
34. Michigan	0.0	0.0	0.0	0.000	0.000
35. Michigan	0.0	0.0	0.0	0.000	0.000
36. Michigan	0.0	0.0	0.0	0.000	0.000
37. Michigan	0.0	0.0	0.0	0.000	0.000
1. Minnesota	5.0	34.0	0.0	13.000	11.963
2. Minnesota	0.0	18.0	0.0	8.600	8.764
3. Minnesota	0.0	34.0	0.0	8.182	11.347
4. Minnesota	0.0	14.0	0.0	1.308	3.860
5. Minnesota	0.0	0.0	0.0	0.000	0.000
6. Minnesota	0.0	0.0	0.0	0.000	0.000
7. Minnesota	0.0	1.0	0.0	0.091	0.302
8. Minnesota	0.0	1.0	0.0	0.083	0.289
9. Minnesota	0.0	0.0	0.0	0.000	0.000
10. Minnesota	0.0	50.0	0.0	13.250	24.514
11. Minnesota	0.0	1.0	0.0	0.300	0.483
12. Minnesota	46.0	46.0	25.0	37.091	7.661
13. Minnesota	0.0	5.0	0.0	0.417	1.443
14. Minnesota	0.0	0.0	0.0	0.000	0.000
15. Minnesota	0.0	0.0	0.0	0.000	0.000
16. Minnesota	0.0	0.0	0.0	0.000	-----
17. Minnesota	0.0	0.0	0.0	0.000	-----
18. Minnesota	0.0	0.0	0.0	0.000	-----
19. Minnesota	0.0	0.0	0.0	0.000	0.000
20. Minnesota	0.0	0.0	0.0	0.000	0.000

21. Minnesota	0.0	0.0	0.0	0.000	0.000
22. Minnesota	0.0	0.0	0.0	0.000	0.000
23. Minnesota	0.0	0.0	0.0	0.000	0.000
24. Minnesota	0.0	5.0	0.0	2.000	2.280
25. Minnesota	0.0	0.0	0.0	0.000	0.000
26. Minnesota	0.0	0.0	0.0	0.000	0.000
27. Minnesota	0.0	0.0	0.0	0.000	0.000
1. Missouri	0.0	0.0	0.0	0.000	0.000
2. Missouri	3.0	8.0	3.0	6.000	2.646
3. Missouri	1.0	9.0	1.0	3.200	2.573
4. Missouri	10.0	12.0	10.0	11.000	1.414
5. Missouri	5.0	5.0	5.0	5.000	----
6. Missouri	0.0	5.0	0.0	0.714	1.890
7. Missouri	0.0	0.0	0.0	0.000	----
8. Missouri	11.0	18.0	5.0	12.167	4.401
9. Missouri	0.0	0.0	0.0	0.000	0.000
1. Nebraska	0.0	0.0	0.0	0.000	0.000
2. Nebraska	0.0	0.0	0.0	0.000	0.000
1. New Jersey	10.0	39.0	2.0	18.909	11.371
1. New Hampshire	2.0	9.0	2.0	5.667	2.805
2. New Hampshire	4.0	12.0	4.0	7.800	2.898
1. New York	0.0	23.0	0.0	7.455	8.745
2. New York	28.0	47.0	23.0	34.346	6.876
3. New York	22.0	42.0	22.0	31.400	6.703
4. New York	20.0	37.0	7.0	23.125	8.610
1. North Dakota	0.0	0.0	0.0	0.000	0.000
2. North Dakota	0.0	0.0	0.0	0.000	0.000
3. North Dakota	0.0	6.0	0.0	1.125	2.031
4. North Dakota	0.0	14.0	0.0	1.167	4.041
5. North Dakota	0.0	2.0	0.0	0.545	0.688
6. North Dakota	0.0	0.0	0.0	0.000	0.000
1. Ohio	0.0	12.0	0.0	1.300	3.773
2. Ohio	0.0	0.0	0.0	0.000	0.000
3. Ohio	24.0	41.0	18.0	27.909	7.622
4. Ohio	0.0	0.0	0.0	0.000	0.000
5. Ohio	0.0	0.0	0.0	0.000	0.000
6. Ohio	0.0	0.0	0.0	0.000	0.000
7. Ohio	0.0	0.0	0.0	0.000	0.000
8. Ohio	0.0	0.0	0.0	0.000	0.000
9. Ohio	0.0	0.0	0.0	0.000	0.000
10. Ohio	0.0	0.0	0.0	0.000	0.000
11. Ohio	0.0	0.0	0.0	0.000	0.000
12. Ohio	0.0	0.0	0.0	0.000	0.000
13. Ohio	0.0	2.0	0.0	0.750	1.035

14. Ohio	0.0	11.0	0.0	1.091	3.300
1. Pennsylvania	0.0	0.0	0.0	0.000	0.000
2. Pennsylvania	0.0	0.0	0.0	0.000	0.000
3. Pennsylvania	12.0	40.0	12.0	25.000	12.193
4. Pennsylvania	0.0	0.0	0.0	0.000	0.000
1. South Dakota	7.0	43.0	7.0	23.250	11.536
2. South Dakota	0.0	6.0	0.0	2.000	3.464
3. South Dakota	0.0	37.0	0.0	11.696	11.182
4. South Dakota	0.0	3.0	0.0	0.833	1.329
1. Tennessee	0.0	0.0	0.0	0.000	0.000
1. Vermont	37.0	52.0	32.0	41.400	5.527
1. Virginia	0.0	3.0	0.0	1.211	1.084
1. Wisconsin	0.0	0.0	0.0	0.000	0.000
2. Wisconsin	26.0	59.0	26.0	41.600	11.057
3. Wisconsin	0.0	0.0	0.0	0.000	0.000
4. Wisconsin	0.0	0.0	0.0	0.000	0.000
5. Wisconsin	0.0	17.0	0.0	5.167	7.441
6. Wisconsin	30.0	32.0	10.0	22.300	7.804
7. Wisconsin	0.0	2.0	0.0	0.429	0.787
8. Wisconsin	0.0	34.0	0.0	12.545	11.605
9. Wisconsin	0.0	0.0	0.0	0.000	0.000
10. Wisconsin	10.0	48.0	3.0	19.571	14.031
11. Wisconsin	40.0	42.0	40.0	40.667	1.155
12. Wisconsin	0.0	0.0	0.0	0.000	0.000
13. Wisconsin	0.0	0.0	0.0	0.000	0.000
14. Wisconsin	0.0	0.0	0.0	0.000	0.000
15. Wisconsin	0.0	23.0	0.0	8.786	7.526
16. Wisconsin	0.0	5.0	0.0	1.000	1.569
17. Wisconsin	40.0	54.0	29.0	38.267	7.045
18. Wisconsin	0.0	34.0	0.0	15.880	11.465
19. Wisconsin	0.0	46.0	0.0	19.667	13.432
20. Wisconsin	2.0	52.0	2.0	27.667	16.132
21. Wisconsin	33.0	40.0	0.0	27.000	15.604
22. Wisconsin	0.0	0.0	0.0	0.000	0.000
23. Wisconsin	0.0	0.0	0.0	0.000	0.000
24. Wisconsin	0.0	0.0	0.0	0.000	0.000
25. Wisconsin	0.0	4.0	0.0	0.143	0.756
26. Wisconsin	0.0	0.0	0.0	0.000	0.000
27. Wisconsin	20.0	39.0	0.0	20.455	11.827
28. Wisconsin	0.0	0.0	0.0	0.000	0.000
29. Wisconsin	0.0	1.0	0.0	0.056	0.236
30. Wisconsin	49.0	66.0	26.0	42.545	11.852
31. Wisconsin	0.0	39.0	0.0	16.261	12.069
32. Wisconsin	45.0	45.0	19.0	36.167	9.827
33. Wisconsin	0.0	0.0	0.0	0.000	0.000

34. Wisconsin	0.0	0.0	0.0	0.000	0.000
35. Wisconsin	0.0	0.0	0.0	0.000	0.000
36. Wisconsin	1.0	41.0	1.0	22.143	14.565
1. West Virginia	0.0	0.0	0.0	0.000	0.000
1. Wyoming	0.0	0.0	0.0	0.000	0.000
1. Quebec	0.0	39.0	0.0	21.000	13.928
2. Quebec	42.0	50.0	31.0	41.000	4.209
3. Quebec	0.0	30.0	0.0	7.941	9.556
4. Quebec	0.0	0.0	0.0	0.000	0.000
5. Quebec	0.0	0.0	0.0	0.000	0.000
1. Ontario	0.0	34.0	0.0	5.909	10.568
2. Ontario	0.0	0.0	0.0	0.000	0.000
3. Ontario	24.0	30.0	0.0	19.750	9.513
4. Ontario	0.0	0.0	0.0	0.000	0.000
5. Ontario	0.0	0.0	0.0	0.000	0.000
6. Ontario	0.0	0.0	0.0	0.000	0.000
7. Ontario	12.0	32.0	12.0	24.167	7.360
8. Ontario	0.0	0.0	0.0	0.000	0.000
9. Ontario	0.0	0.0	0.0	0.000	0.000
10. Ontario	0.0	0.0	0.0	0.000	0.000
11. Ontario	0.0	0.0	0.0	0.000	0.000
12. Ontario	0.0	0.0	0.0	0.000	0.000
13. Ontario	0.0	14.0	0.0	7.500	6.686
14. Ontario	0.0	0.0	0.0	0.000	-----
15. Ontario	0.0	0.0	0.0	0.000	0.000
16. Ontario	0.0	0.0	0.0	0.000	0.000
17. Ontario	0.0	0.0	0.0	0.000	0.000
18. Ontario	0.0	0.0	0.0	0.000	0.000
19. Ontario	31.0	44.0	2.0	24.714	12.168
20. Ontario	0.0	0.0	0.0	0.000	0.000
21. Ontario	0.0	21.0	0.0	7.800	10.330
22. Ontario	0.0	0.0	0.0	0.000	0.000
23. Ontario	0.0	0.0	0.0	0.000	0.000
24. Ontario	0.0	0.0	0.0	0.000	0.000
25. Ontario	0.0	0.0	0.0	0.000	0.000
26. Ontario	0.0	0.0	0.0	0.000	0.000
27. Ontario	0.0	0.0	0.0	0.000	0.000
28. Ontario	0.0	0.0	0.0	0.000	0.000
29. Ontario	0.0	0.0	0.0	0.000	0.000
30. Ontario	0.0	0.0	0.0	0.000	0.000
31. Ontario	0.0	0.0	0.0	0.000	-----
32. Ontario	0.0	0.0	0.0	0.000	0.000
33. Ontario	0.0	0.0	0.0	0.000	0.000
34. Ontario	18.0	28.0	0.0	15.900	10.577
35. Ontario	0.0	0.0	0.0	0.000	0.000
36. Ontario	0.0	0.0	0.0	0.000	0.000
37. Ontario	0.0	0.0	0.0	0.000	0.000

38. Ontario	0.0	0.0	0.0	0.000	0.000
39. Ontario	0.0	0.0	0.0	0.000	0.000
40. Ontario	0.0	0.0	0.0	0.000	0.000
41. Ontario	34.0	34.0	10.0	25.071	7.321
42. Ontario	0.0	0.0	0.0	0.000	0.000
43. Ontario	0.0	0.0	0.0	0.000	0.000
44. Ontario	0.0	0.0	0.0	0.000	0.000
45. Ontario	0.0	0.0	0.0	0.000	0.000
46. Ontario	0.0	0.0	0.0	0.000	0.000
47. Ontario	12.0	46.0	0.0	16.900	14.662
48. Ontario	15.0	43.0	0.0	19.916	13.601
1. Manitoba	0.0	0.0	0.0	0.000	0.000
2. Manitoba	0.0	0.0	0.0	0.000	0.000
3. Manitoba	0.0	1.0	0.0	0.333	0.577
4. Manitoba	0.0	0.0	0.0	0.000	0.000
5. Manitoba	0.0	0.0	0.0	0.000	0.000
6. Manitoba	0.0	0.0	0.0	0.000	0.000
7. Manitoba	0.0	0.0	0.0	0.000	0.000
8. Manitoba	0.0	0.0	0.0	0.000	0.000
9. Manitoba	0.0	0.0	0.0	0.000	0.000
10. Manitoba	0.0	0.0	0.0	0.000	0.000
11. Manitoba	0.0	0.0	0.0	0.000	0.000
12. Manitoba	0.0	3.0	0.0	0.250	0.866
13. Manitoba	0.0	0.0	0.0	0.000	0.000
14. Manitoba	0.0	0.0	0.0	0.000	0.000
15. Manitoba	0.0	0.0	0.0	0.000	0.000
16. Manitoba	0.0	0.0	0.0	0.000	0.000
17. Manitoba	0.0	0.0	0.0	0.000	0.000
1. Saskatchewan	0.0	0.0	0.0	0.000	0.000
2. Saskatchewan	0.0	0.0	0.0	0.000	0.000
3. Saskatchewan	0.0	0.0	0.0	0.000	0.000
4. Saskatchewan	0.0	0.0	0.0	0.000	0.000
5. Saskatchewan	0.0	26.0	0.0	7.400	10.080
6. Saskatchewan	4.0	33.0	4.0	17.750	13.175
7. Saskatchewan	0.0	0.0	0.0	0.000	-----
8. Saskatchewan	22.0	22.0	22.0	22.000	-----
9. Saskatchewan	0.0	0.0	0.0	0.000	-----

Appendix 6E: Number of scales on the opercle for examined samples of *Etheostoma nigrum* and *E. olmstedii*. Location number and names correspond to those of Appendix 2.

<u>Location</u>	<u>MODE</u>	<u>UPPER</u>	<u>LOWER</u>	<u>MEAN</u>	<u>SD</u>
1. Colorado	6.0	15.0	1.0	7.727	3.494
1. Connecticut	3.0	23.0	3.0	12.143	7.690
1. Illinois	17.0	23.0	17.0	19.333	3.215
2. Illinois	8.0	19.0	8.0	12.600	4.037
3. Illinois	5.0	17.0	5.0	11.000	8.485
4. Illinois	16.0	18.0	16.0	17.000	1.414
5. Illinois	12.0	20.0	8.0	12.842	3.287
1. Indiana	10.0	30.0	7.0	16.438	5.283
2. Indiana	8.0	22.0	5.0	12.182	5.173
3. Indiana	14.0	14.0	5.0	11.167	3.817
4. Indiana	13.0	16.0	13.0	14.333	1.528
5. Indiana	9.0	17.0	9.0	13.000	5.657
6. Indiana	4.0	16.0	4.0	10.429	4.429
7. Indiana	20.0	20.0	10.0	16.600	3.596
8. Indiana	4.0	12.0	4.0	7.600	3.362
9. Indiana	18.0	21.0	18.0	19.500	2.121
1. Iowa	13.0	27.0	6.0	15.000	7.649
2. Iowa	16.0	19.0	12.0	15.727	2.284
3. Iowa	10.0	16.0	7.0	11.700	2.983
4. Iowa	4.0	16.0	4.0	9.400	4.336
5. Iowa	28.0	32.0	15.0	26.500	5.318
1. Kansas	17.0	17.0	7.0	12.833	3.817
2. Kansas	6.0	12.0	6.0	9.000	3.000
1. Kentucky	6.0	10.0	5.0	7.556	1.667
2. Kentucky	5.0	10.0	4.0	6.200	2.044
1. Maryland	22.0	25.0	10.0	18.000	5.099
2. Maryland	22.0	30.0	16.0	22.000	3.449
1. Massachusetts	9.0	23.0	9.0	15.667	4.546
1. Michigan	13.0	16.0	12.0	13.600	1.517
2. Michigan	4.0	11.0	2.0	4.727	2.412
3. Michigan	12.0	13.0	6.0	9.941	2.106
4. Michigan	14.0	20.0	11.0	14.909	2.879
5. Michigan	9.0	12.0	9.0	10.500	2.121
6. Michigan	9.0	14.0	6.0	9.286	2.430
7. Michigan	14.0	19.0	14.0	17.000	2.646

8. Michigan	11.0	13.0	10.0	11.400	1.140
9. Michigan	11.0	21.0	9.0	13.833	5.601
10. Michigan	13.0	25.0	13.0	20.000	4.290
11. Michigan	10.0	13.0	7.0	10.300	1.767
12. Michigan	4.0	12.0	4.0	6.833	3.371
13. Michigan	6.0	12.0	5.0	7.700	2.263
14. Michigan	12.0	21.0	7.0	12.583	3.848
15. Michigan	6.0	9.0	6.0	7.000	1.414
16. Michigan	18.0	19.0	9.0	14.846	3.363
17. Michigan	12.0	18.0	12.0	14.500	2.138
18. Michigan	8.0	14.0	8.0	10.429	2.573
19. Michigan	6.0	21.0	6.0	12.375	5.854
20. Michigan	8.0	17.0	4.0	10.545	3.882
21. Michigan	6.0	8.0	6.0	7.000	1.414
22. Michigan	8.0	14.0	8.0	11.250	2.754
23. Michigan	12.0	21.0	8.0	14.000	3.333
24. Michigan	12.0	16.0	12.0	13.200	1.643
25. Michigan	14.0	18.0	2.0	10.800	6.573
26. Michigan	8.0	11.0	5.0	8.100	1.969
27. Michigan	13.0	17.0	4.0	11.571	4.158
28. Michigan	4.0	13.0	4.0	9.000	4.583
29. Michigan	18.0	19.0	11.0	15.263	2.423
30. Michigan	15.0	21.0	15.0	17.600	2.408
31. Michigan	14.0	29.0	10.0	19.000	5.062
32. Michigan	4.0	9.0	2.0	5.083	2.392
33. Michigan	2.0	8.0	2.0	4.571	1.805
34. Michigan	7.0	15.0	4.0	9.882	3.706
35. Michigan	7.0	11.0	4.0	7.800	2.144
36. Michigan	3.0	10.0	2.0	4.700	2.055
37. Michigan	6.0	13.0	3.0	7.474	3.255
1. Minnesota	14.0	22.0	8.0	14.300	3.713
2. Minnesota	8.0	14.0	6.0	9.000	3.000
3. Minnesota	12.0	20.0	7.0	13.364	4.130
4. Minnesota	13.0	14.0	7.0	10.615	2.293
5. Minnesota	10.0	23.0	7.0	11.714	4.304
6. Minnesota	5.0	17.0	5.0	7.917	3.528
7. Minnesota	10.0	17.0	8.0	11.182	2.601
8. Minnesota	12.0	17.0	8.0	12.167	2.552
9. Minnesota	9.0	12.0	7.0	9.333	1.614
10. Minnesota	12.0	30.0	12.0	17.750	8.342
11. Minnesota	11.0	22.0	7.0	13.200	3.994
12. Minnesota	20.0	27.0	12.0	21.091	3.936
13. Minnesota	12.0	17.0	6.0	10.583	2.968
14. Minnesota	15.0	15.0	8.0	12.167	2.517
15. Minnesota	9.0	11.0	9.0	10.000	1.414
16. Minnesota	5.0	5.0	5.0	5.000	----
17. Minnesota	3.0	3.0	3.0	3.000	----
18. Minnesota	8.0	8.0	8.0	8.000	----
19. Minnesota	7.0	8.0	7.0	7.333	0.577
20. Minnesota	8.0	9.0	8.0	8.500	0.707

21. Minnesota	2.0	7.0	2.0	4.600	2.073
22. Minnesota	1.0	9.0	1.0	5.000	5.656
23. Minnesota	8.0	15.0	5.0	9.692	2.750
24. Minnesota	8.0	17.0	8.0	11.166	3.430
25. Minnesota	8.0	13.0	5.0	8.545	2.114
26. Minnesota	11.0	18.0	6.0	10.823	2.855
27. Minnesota	6.0	15.0	4.0	8.312	3.113
1. Missouri	10.0	18.0	8.0	11.400	3.847
2. Missouri	12.0	18.0	12.0	15.333	3.055
3. Missouri	12.0	20.0	8.0	13.700	4.057
4. Missouri	14.0	15.0	14.0	14.500	0.707
5. Missouri	10.0	10.0	10.0	10.000	-----
6. Missouri	9.0	16.0	7.0	10.143	3.024
7. Missouri	16.0	16.0	16.0	16.000	-----
8. Missouri	10.0	19.0	10.0	13.667	4.227
9. Missouri	13.0	18.0	10.0	14.000	2.517
1. Nebraska	9.0	10.0	9.0	9.500	0.707
2. Nebraska	12.0	12.0	6.0	9.500	3.000
1. New Jersey	17.0	27.0	17.0	21.455	3.110
1. New Hampshire	9.0	10.0	4.0	7.333	2.422
2. New Hampshire	4.0	14.0	2.0	7.100	3.695
1. New York	7.0	18.0	0.0	9.455	5.145
2. New York	20.0	32.0	14.0	23.538	4.411
3. New York	15.0	24.0	15.0	19.900	3.213
4. New York	1.0	24.0	1.0	13.375	8.618
1. North Dakota	6.0	9.0	6.0	7.000	1.732
2. North Dakota	2.0	13.0	2.0	7.250	4.573
3. North Dakota	11.0	15.0	10.0	12.625	1.768
4. North Dakota	5.0	14.0	1.0	7.333	3.750
5. North Dakota	12.0	13.0	8.0	11.182	1.722
6. North Dakota	5.0	12.0	5.0	6.400	2.271
1. Ohio	9.0	23.0	5.0	12.300	5.229
2. Ohio	7.0	12.0	7.0	9.222	1.986
3. Ohio	21.0	26.0	15.0	20.909	2.914
4. Ohio	4.0	11.0	4.0	7.500	4.950
5. Ohio	6.0	13.0	6.0	9.333	3.512
6. Ohio	4.0	7.0	1.0	4.444	2.186
7. Ohio	9.0	19.0	9.0	13.750	4.992
8. Ohio	13.0	17.0	12.0	14.000	2.000
9. Ohio	15.0	27.0	11.0	17.200	6.017
10. Ohio	7.0	11.0	7.0	9.000	2.828
11. Ohio	3.0	12.0	2.0	5.111	3.018
12. Ohio	9.0	16.0	9.0	12.750	2.986
13. Ohio	9.0	17.0	7.0	11.250	3.059

14. Ohio	15.0	19.0	12.0	16.000	2.408
1. Pennsylvania	9.0	14.0	6.0	10.200	2.486
2. Pennsylvania	10.0	10.0	5.0	8.500	2.380
3. Pennsylvania	9.0	27.0	9.0	19.500	7.724
4. Pennsylvania	6.0	17.0	6.0	10.308	3.301
1. South Dakota	24.0	33.0	17.0	25.125	5.915
2. South Dakota	9.0	11.0	9.0	10.000	1.000
3. South Dakota	14.0	24.0	4.0	12.435	5.392
4. South Dakota	9.0	18.0	9.0	12.667	3.933
1. Tennessee	7.0	13.0	5.0	8.400	2.503
1. Vermont	26.0	34.0	21.0	27.133	4.051
1. Virginia	15.0	20.0	8.0	15.105	2.424
1. Wisconsin	10.0	16.0	5.0	11.455	2.945
2. Wisconsin	23.0	36.0	21.0	27.300	4.785
3. Wisconsin	9.0	18.0	7.0	12.400	3.718
4. Wisconsin	6.0	15.0	3.0	8.786	3.401
5. Wisconsin	8.0	24.0	8.0	14.333	6.154
6. Wisconsin	19.0	28.0	19.0	23.200	3.190
7. Wisconsin	13.0	19.0	13.0	15.857	2.340
8. Wisconsin	9.0	26.0	9.0	15.636	5.537
9. Wisconsin	5.0	5.0	4.0	4.750	0.500
10. Wisconsin	18.0	35.0	7.0	20.429	6.418
11. Wisconsin	24.0	27.0	24.0	25.333	1.528
12. Wisconsin	11.0	18.0	11.0	14.000	3.606
13. Wisconsin	6.0	6.0	3.0	4.800	1.304
14. Wisconsin	11.0	11.0	5.0	8.909	2.071
15. Wisconsin	13.0	22.0	0.0	14.143	6.419
16. Wisconsin	4.0	25.0	4.0	13.500	6.858
17. Wisconsin	25.0	35.0	18.0	24.867	3.852
18. Wisconsin	14.0	25.0	5.0	17.320	4.956
19. Wisconsin	22.0	24.0	6.0	18.167	4.770
20. Wisconsin	20.0	25.0	15.0	21.333	3.000
21. Wisconsin	26.0	26.0	18.0	23.000	3.317
22. Wisconsin	10.0	18.0	6.0	12.500	3.567
23. Wisconsin	0.0	8.0	0.0	2.462	2.402
24. Wisconsin	6.0	9.0	6.0	7.667	1.528
25. Wisconsin	5.0	18.0	2.0	8.571	3.563
26. Wisconsin	5.0	12.0	5.0	7.750	3.096
27. Wisconsin	23.0	28.0	12.0	21.182	4.834
28. Wisconsin	5.0	22.0	5.0	13.364	5.372
29. Wisconsin	7.0	16.0	4.0	9.389	3.680
30. Wisconsin	27.0	35.0	19.0	27.727	5.255
31. Wisconsin	12.0	30.0	4.0	12.696	6.248
32. Wisconsin	21.0	22.0	18.0	20.500	1.643
33. Wisconsin	3.0	5.0	3.0	3.500	1.000

34. Wisconsin	5.0	13.0	4.0	7.598	2.562
35. Wisconsin	8.0	12.0	3.0	6.667	2.828
36. Wisconsin	20.0	29.0	15.0	21.857	4.525
1. West Virginia	4.0	4.0	0.0	2.750	1.893
1. Wyoming	6.0	8.0	4.0	6.143	1.464
1. Quebec	13.0	21.0	10.0	15.692	3.614
2. Quebec	24.0	33.0	19.0	25.917	3.475
3. Quebec	22.0	22.0	7.0	16.353	4.703
4. Quebec	14.0	16.0	8.0	11.923	2.397
5. Quebec	8.0	20.0	5.0	13.111	6.009
1. Ontario	11.0	20.0	10.0	12.909	3.048
2. Ontario	2.0	3.0	2.0	2.500	0.707
3. Ontario	17.0	18.0	8.0	14.750	3.770
4. Ontario	19.0	19.0	8.0	13.750	4.595
5. Ontario	8.0	10.0	5.0	7.727	1.794
6. Ontario	2.0	5.0	2.0	3.400	1.174
7. Ontario	14.0	22.0	14.0	19.000	2.828
8. Ontario	6.0	20.0	3.0	10.154	4.879
9. Ontario	4.0	17.0	4.0	9.091	4.277
10. Ontario	15.0	18.0	12.0	15.000	2.449
11. Ontario	8.0	10.0	6.0	8.000	1.414
12. Ontario	1.0	1.0	1.0	1.000	0.000
13. Ontario	19.0	21.0	9.0	17.000	4.604
14. Ontario	6.0	6.0	6.0	6.000	----
15. Ontario	10.0	17.0	10.0	12.900	2.767
16. Ontario	2.0	10.0	2.0	5.200	2.440
17. Ontario	3.0	6.0	2.0	4.000	1.414
18. Ontario	6.0	18.0	6.0	12.300	4.785
19. Ontario	26.0	32.0	12.0	22.429	5.801
20. Ontario	6.0	11.0	6.0	8.556	1.944
21. Ontario	13.0	23.0	13.0	18.600	3.647
22. Ontario	4.0	9.0	2.0	5.600	2.066
23. Ontario	11.0	19.0	11.0	13.857	3.078
24. Ontario	17.0	26.0	8.0	17.500	5.421
25. Ontario	7.0	16.0	5.0	8.700	3.268
26. Ontario	9.0	16.0	6.0	10.900	2.998
27. Ontario	10.0	23.0	10.0	16.214	4.807
28. Ontario	11.0	19.0	7.0	12.000	3.577
29. Ontario	8.0	14.0	4.0	7.500	2.915
30. Ontario	8.0	14.0	5.0	8.600	2.591
31. Ontario	6.0	6.0	6.0	6.000	----
32. Ontario	6.0	8.0	3.0	5.857	1.574
33. Ontario	7.0	11.0	6.0	8.429	1.813
34. Ontario	7.0	21.0	5.0	9.300	4.423
35. Ontario	0.0	12.0	0.0	5.400	4.006
36. Ontario	2.0	13.0	0.0	3.000	3.011
37. Ontario	7.0	10.0	5.0	7.200	1.475

38. Ontario	4.0	11.0	1.0	5.333	2.640
39. Ontario	7.0	11.0	6.0	8.375	1.767
40. Ontario	10.0	15.0	3.0	8.700	3.400
41. Ontario	17.0	24.0	9.0	14.357	4.667
42. Ontario	5.0	11.0	4.0	6.625	2.559
43. Ontario	5.0	5.0	0.0	2.875	2.295
44. Ontario	3.0	9.0	3.0	5.500	2.321
45. Ontario	7.0	11.0	5.0	8.500	2.000
46. Ontario	6.0	8.0	6.0	6.600	0.894
47. Ontario	8.0	22.0	8.0	13.300	4.922
48. Ontario	12.0	29.0	7.0	14.166	7.296
1. Manitoba	1.0	10.0	1.0	5.600	3.912
2. Manitoba	7.0	20.0	6.0	12.500	4.649
3. Manitoba	10.0	19.0	10.0	14.000	4.583
4. Manitoba	11.0	18.0	10.0	13.083	2.429
5. Manitoba	2.0	7.0	2.0	3.700	2.003
6. Manitoba	12.0	12.0	6.0	10.000	3.464
7. Manitoba	0.0	0.0	0.0	0.000	0.000
8. Manitoba	5.0	10.0	5.0	7.300	1.889
9. Manitoba	5.0	6.0	3.0	4.600	1.140
10. Manitoba	11.0	12.0	11.0	11.333	0.577
11. Manitoba	10.0	18.0	8.0	12.818	3.311
12. Manitoba	9.0	16.0	9.0	12.500	2.576
13. Manitoba	4.0	13.0	4.0	8.636	3.107
14. Manitoba	12.0	14.0	6.0	10.083	2.314
15. Manitoba	7.0	13.0	1.0	7.583	3.370
16. Manitoba	6.0	13.0	4.0	8.214	2.517
17. Manitoba	4.0	12.0	2.0	7.900	3.510
1. Saskatchewan	3.0	7.0	3.0	5.000	2.000
2. Saskatchewan	1.0	5.0	1.0	3.333	2.082
3. Saskatchewan	10.0	10.0	4.0	7.500	3.000
4. Saskatchewan	7.0	11.0	7.0	9.000	1.826
5. Saskatchewan	6.0	19.0	6.0	11.400	5.816
6. Saskatchewan	22.0	22.0	15.0	18.750	3.775
7. Saskatchewan	7.0	7.0	7.0	7.000	-----
8. Saskatchewan	22.0	22.0	22.0	22.000	-----
9. Saskatchewan	6.0	6.0	6.0	6.000	-----

Appendix 6F: Number of left pectoral rays for examined samples of *Etheostoma nigrum* and *E. olmstedii*. Location number and names correspond to those of Appendix 2.

<u>Location</u>	<u>MODE</u>	<u>UPPER</u>	<u>LOWER</u>	<u>MEAN</u>	<u>SD</u>
1. Colorado	12.0	12.0	11.0	11.758	0.435
1. Connecticut	12.0	13.0	12.0	12.429	0.535
1. Illinois	11.0	12.0	11.0	11.333	0.577
2. Illinois	12.0	12.0	11.0	11.800	0.447
3. Illinois	11.0	12.0	11.0	11.500	0.707
4. Illinois	12.0	12.0	12.0	12.000	0.000
5. Illinois	12.0	13.0	11.0	11.842	0.501
1. Indiana	12.0	12.0	11.0	11.854	0.357
2. Indiana	12.0	12.0	11.0	11.545	0.522
3. Indiana	12.0	12.0	11.0	11.667	0.516
4. Indiana	12.0	12.0	11.0	11.667	0.577
5. Indiana	12.0	12.0	12.0	12.000	0.000
6. Indiana	12.0	12.0	11.0	11.857	0.378
7. Indiana	12.0	12.0	11.0	11.600	0.516
8. Indiana	12.0	12.0	12.0	12.000	0.000
9. Indiana	12.0	12.0	12.0	12.000	0.000
1. Iowa	12.0	12.0	12.0	12.000	0.000
2. Iowa	12.0	12.0	11.0	11.818	0.405
3. Iowa	12.0	12.0	11.0	11.700	0.483
4. Iowa	12.0	12.0	11.0	11.600	0.548
5. Iowa	12.0	13.0	11.0	12.000	0.535
1. Kansas	12.0	12.0	12.0	12.000	0.000
2. Kansas	12.0	12.0	12.0	12.000	0.000
1. Kentucky	11.0	12.0	11.0	11.222	0.441
2. Kentucky	11.0	12.0	11.0	11.200	0.422
1. Maryland	13.0	13.0	12.0	12.556	0.527
2. Maryland	13.0	13.0	12.0	12.550	0.510
1. Massachusetts	13.0	14.0	13.0	13.333	0.516
1. Michigan	12.0	12.0	11.0	11.800	0.447
2. Michigan	12.0	13.0	11.0	11.909	0.539
3. Michigan	12.0	12.0	11.0	11.882	0.332
4. Michigan	12.0	12.0	10.0	11.455	0.688
5. Michigan	12.0	12.0	12.0	12.000	0.000
6. Michigan	12.0	13.0	11.0	11.857	0.690
7. Michigan	12.0	12.0	11.0	11.667	0.577

8. Michigan	12.0	12.0	12.0	12.000	0.000
9. Michigan	12.0	13.0	11.0	12.000	0.632
10. Michigan	12.0	12.0	12.0	12.000	0.000
11. Michigan	12.0	12.0	11.0	11.800	0.422
12. Michigan	12.0	12.0	12.0	12.000	0.000
13. Michigan	12.0	13.0	12.0	12.200	0.422
14. Michigan	11.0	12.0	11.0	11.500	0.522
15. Michigan	11.0	12.0	11.0	11.500	0.577
16. Michigan	12.0	13.0	11.0	11.769	0.599
17. Michigan	11.0	12.0	11.0	11.500	0.535
18. Michigan	12.0	12.0	11.0	11.857	0.378
19. Michigan	12.0	12.0	11.0	11.875	0.354
20. Michigan	12.0	12.0	11.0	11.727	0.467
21. Michigan	12.0	12.0	12.0	12.000	0.000
22. Michigan	12.0	12.0	12.0	12.000	0.000
23. Michigan	12.0	13.0	11.0	11.900	0.568
24. Michigan	12.0	12.0	11.0	11.800	0.447
25. Michigan	12.0	12.0	11.0	11.800	0.447
26. Michigan	12.0	13.0	12.0	12.200	0.422
27. Michigan	11.0	12.0	11.0	11.429	0.535
28. Michigan	12.0	12.0	12.0	12.000	0.000
29. Michigan	12.0	13.0	11.0	11.895	0.459
30. Michigan	12.0	12.0	11.0	11.600	0.548
31. Michigan	12.0	13.0	12.0	12.235	0.437
32. Michigan	12.0	13.0	12.0	12.083	0.289
33. Michigan	12.0	12.0	11.0	11.857	0.359
34. Michigan	11.0	12.0	11.0	11.176	0.393
35. Michigan	12.0	12.0	11.0	11.800	0.414
36. Michigan	12.0	13.0	11.0	12.050	0.394
37. Michigan	12.0	13.0	12.0	12.421	0.507
1. Minnesota	11.0	12.0	11.0	11.300	0.483
2. Minnesota	13.0	13.0	12.0	12.600	0.548
3. Minnesota	12.0	13.0	11.0	12.000	0.447
4. Minnesota	12.0	12.0	11.0	11.692	0.480
5. Minnesota	12.0	12.0	11.0	11.643	0.497
6. Minnesota	12.0	12.0	11.0	11.583	0.515
7. Minnesota	12.0	12.0	10.0	11.545	0.688
8. Minnesota	12.0	12.0	10.0	11.500	0.674
9. Minnesota	12.0	12.0	11.0	11.583	0.515
10. Minnesota	12.0	12.0	12.0	12.000	0.000
11. Minnesota	11.0	12.0	11.0	11.500	0.527
12. Minnesota	12.0	12.0	12.0	12.000	0.000
13. Minnesota	11.0	12.0	11.0	11.500	0.522
14. Minnesota	12.0	13.0	11.0	12.000	0.426
15. Minnesota	12.0	13.0	12.0	12.500	0.707
16. Minnesota	12.0	12.0	12.0	12.000	----
17. Minnesota	12.0	12.0	12.0	12.000	----
18. Minnesota	12.0	12.0	12.0	12.000	----
19. Minnesota	12.0	12.0	12.0	12.000	0.000
20. Minnesota	11.0	12.0	11.0	11.500	0.707

21. Minnesota	12.0	13.0	12.0	12.400	0.547
22. Minnesota	12.0	12.0	12.0	12.000	0.000
23. Minnesota	12.0	13.0	12.0	12.230	0.438
24. Minnesota	12.0	12.0	11.0	11.666	0.516
25. Minnesota	12.0	12.0	12.0	12.000	0.000
26. Minnesota	12.0	13.0	12.0	12.058	0.242
27. Minnesota	12.0	12.0	11.0	11.875	0.341
1. Missouri	12.0	12.0	11.0	11.800	0.447
2. Missouri	11.0	12.0	11.0	11.333	0.577
3. Missouri	12.0	12.0	11.0	11.800	0.422
4. Missouri	12.0	12.0	12.0	12.000	0.000
5. Missouri	12.0	12.0	12.0	12.000	----
6. Missouri	12.0	12.0	11.0	11.571	0.535
7. Missouri	12.0	12.0	12.0	12.000	----
8. Missouri	12.0	13.0	12.0	12.167	0.408
9. Missouri	12.0	12.0	11.0	11.571	0.535
1. Nebraska	12.0	12.0	12.0	12.000	0.000
2. Nebraska	11.0	11.0	11.0	11.000	0.000
1. New Jersey	13.0	13.0	12.0	12.636	0.505
1. New Hampshire	13.0	13.0	13.0	13.000	0.000
2. New Hampshire	13.0	14.0	12.0	13.000	0.471
1. New York	12.0	12.0	11.0	11.818	0.405
2. New York	12.0	14.0	11.0	12.500	0.648
3. New York	12.0	13.0	12.0	12.500	0.527
4. New York	13.0	13.0	12.0	12.625	0.518
1. North Dakota	12.0	12.0	12.0	12.000	0.000
2. North Dakota	11.0	12.0	11.0	11.500	0.577
3. North Dakota	12.0	12.0	11.0	11.750	0.463
4. North Dakota	12.0	12.0	11.0	11.833	0.389
5. North Dakota	12.0	12.0	12.0	12.000	0.000
6. North Dakota	12.0	13.0	11.0	12.100	0.568
1. Ohio	12.0	13.0	11.0	11.800	0.632
2. Ohio	11.0	11.0	10.0	10.778	0.441
3. Ohio	12.0	13.0	12.0	12.182	0.405
4. Ohio	11.0	11.0	11.0	11.000	0.000
5. Ohio	12.0	12.0	12.0	12.000	0.000
6. Ohio	11.0	12.0	11.0	11.333	0.500
7. Ohio	11.0	12.0	11.0	11.500	0.577
8. Ohio	11.0	12.0	11.0	11.200	0.447
9. Ohio	12.0	12.0	11.0	11.800	0.447
10. Ohio	11.0	12.0	11.0	11.500	0.707
11. Ohio	12.0	12.0	11.0	11.667	0.500
12. Ohio	12.0	12.0	12.0	12.000	0.000
13. Ohio	12.0	12.0	11.0	11.875	0.354

14. Ohio	12.0	12.0	11.0	11.818	0.405
1. Pennsylvannia	11.0	12.0	10.0	11.000	0.471
2. Pennsylvannia	11.0	12.0	11.0	11.250	0.500
3. Pennsylvannia	12.0	13.0	12.0	12.250	0.500
4. Pennsylvannia	11.0	11.0	11.0	11.000	0.000
1. South Dakota	12.0	12.0	11.0	11.750	0.463
2. South Dakota	12.0	13.0	12.0	12.333	0.577
3. South Dakota	12.0	12.0	11.0	11.826	0.388
4. South Dakota	12.0	12.0	11.0	11.667	0.516
1. Tennessee	12.0	12.0	12.0	12.000	0.000
1. Vermont	13.0	13.0	12.0	12.800	0.414
1. Virginia	12.0	12.0	11.0	11.737	0.452
1. Wisconsin	12.0	13.0	12.0	12.182	0.405
2. Wisconsin	12.0	13.0	12.0	12.200	0.422
3. Wisconsin	12.0	12.0	12.0	12.000	0.000
4. Wisconsin	12.0	12.0	11.0	11.643	0.497
5. Wisconsin	12.0	12.0	11.0	11.833	0.408
6. Wisconsin	12.0	12.0	11.0	11.800	0.422
7. Wisconsin	12.0	12.0	11.0	11.714	0.488
8. Wisconsin	11.0	12.0	11.0	11.273	0.467
9. Wisconsin	12.0	12.0	11.0	11.750	0.500
10. Wisconsin	12.0	12.0	11.0	11.857	0.363
11. Wisconsin	12.0	12.0	11.0	11.667	0.577
12. Wisconsin	11.0	12.0	11.0	11.333	0.577
13. Wisconsin	12.0	12.0	11.0	11.800	0.447
14. Wisconsin	11.0	12.0	11.0	11.455	0.522
15. Wisconsin	12.0	12.0	11.0	11.714	0.469
16. Wisconsin	12.0	13.0	11.0	12.000	0.392
17. Wisconsin	12.0	12.0	11.0	11.733	0.458
18. Wisconsin	12.0	13.0	12.0	12.160	0.374
19. Wisconsin	12.0	13.0	11.0	11.833	0.482
20. Wisconsin	12.0	13.0	12.0	12.111	0.333
21. Wisconsin	12.0	12.0	12.0	12.000	0.000
22. Wisconsin	12.0	12.0	11.0	11.700	0.483
23. Wisconsin	12.0	12.0	11.0	11.692	0.480
24. Wisconsin	12.0	12.0	12.0	12.000	0.000
25. Wisconsin	12.0	12.0	11.0	11.893	0.315
26. Wisconsin	12.0	13.0	12.0	12.250	0.500
27. Wisconsin	12.0	12.0	11.0	11.636	0.505
28. Wisconsin	12.0	12.0	11.0	11.727	0.467
29. Wisconsin	11.0	12.0	11.0	11.500	0.514
30. Wisconsin	12.0	12.0	11.0	11.636	0.505
31. Wisconsin	12.0	13.0	11.0	12.087	0.515
32. Wisconsin	12.0	12.0	11.0	11.667	0.516
33. Wisconsin	12.0	12.0	12.0	12.000	0.000

34. Wisconsin	12.0	13.0	11.0	11.875	0.448
35. Wisconsin	12.0	12.0	12.0	12.000	0.000
36. Wisconsin	12.0	12.0	11.0	11.571	0.535
1. West Virginia	12.0	12.0	11.0	11.750	0.500
1. Wyoming	12.0	12.0	10.0	11.571	0.787
1. Quebec	13.0	13.0	12.0	12.615	0.506
2. Quebec	12.0	13.0	12.0	12.361	0.487
3. Quebec	12.0	13.0	12.0	12.353	0.493
4. Quebec	12.0	13.0	12.0	12.077	0.277
5. Quebec	12.0	12.0	12.0	12.000	0.000
1. Ontario	13.0	13.0	12.0	12.636	0.505
2. Ontario	12.0	12.0	12.0	12.000	0.000
3. Ontario	12.0	13.0	12.0	12.500	0.535
4. Ontario	12.0	13.0	11.0	12.167	0.718
5. Ontario	11.0	12.0	11.0	11.364	0.505
6. Ontario	12.0	12.0	11.0	11.800	0.422
7. Ontario	12.0	13.0	12.0	12.167	0.408
8. Ontario	12.0	13.0	11.0	11.846	0.555
9. Ontario	12.0	12.0	11.0	11.636	0.505
10. Ontario	12.0	12.0	12.0	12.000	0.000
11. Ontario	12.0	12.0	11.0	11.600	0.548
12. Ontario	12.0	13.0	12.0	12.500	0.707
13. Ontario	12.0	13.0	12.0	12.167	0.408
14. Ontario	12.0	12.0	12.0	12.000	-----
15. Ontario	12.0	12.0	11.0	11.700	0.483
16. Ontario	12.0	12.0	12.0	12.000	0.000
17. Ontario	12.0	12.0	12.0	12.000	0.000
18. Ontario	11.0	12.0	11.0	11.400	0.516
19. Ontario	12.0	13.0	11.0	12.143	0.663
20. Ontario	12.0	12.0	12.0	12.000	0.000
21. Ontario	12.0	13.0	12.0	12.200	0.447
22. Ontario	12.0	13.0	12.0	12.200	0.422
23. Ontario	11.0	11.0	11.0	11.000	0.000
24. Ontario	12.0	12.0	11.0	11.700	0.483
25. Ontario	12.0	12.0	12.0	12.000	0.000
26. Ontario	12.0	13.0	12.0	12.100	0.316
27. Ontario	11.0	12.0	11.0	11.500	0.519
28. Ontario	12.0	12.0	11.0	11.545	0.522
29. Ontario	13.0	13.0	12.0	12.700	0.483
30. Ontario	12.0	13.0	12.0	12.500	0.527
31. Ontario	12.0	12.0	12.0	12.000	-----
32. Ontario	12.0	12.0	12.0	12.000	0.000
33. Ontario	12.0	12.0	12.0	12.000	0.000
34. Ontario	12.0	13.0	12.0	12.300	0.483
35. Ontario	12.0	12.0	11.0	11.600	0.516
36. Ontario	12.0	13.0	10.0	11.688	0.704
37. Ontario	12.0	13.0	12.0	12.100	0.316
38. Ontario	12.0	12.0	11.0	11.883	0.389

39. Ontario	12.0	13.0	12.0	12.375	0.517
40. Ontario	12.0	12.0	12.0	12.000	0.000
41. Ontario	11.0	12.0	11.0	11.357	0.497
42. Ontario	12.0	13.0	12.0	12.125	0.353
43. Ontario	12.0	12.0	11.0	11.875	0.353
44. Ontario	12.0	12.0	12.0	12.000	0.000
45. Ontario	12.0	12.0	12.0	12.000	0.000
46. Ontario	12.0	12.0	11.0	11.800	0.447
47. Ontario	12.0	13.0	11.0	11.900	0.567
48. Ontario	12.0	13.0	11.0	12.166	0.717
1. Manitoba	12.0	12.0	12.0	12.000	0.000
2. Manitoba	12.0	13.0	12.0	12.100	0.316
3. Manitoba	12.0	12.0	12.0	12.000	0.000
4. Manitoba	12.0	13.0	12.0	12.167	0.389
5. Manitoba	12.0	12.0	12.0	12.000	0.000
6. Manitoba	12.0	12.0	12.0	12.000	0.000
7. Manitoba	12.0	12.0	12.0	12.000	0.000
8. Manitoba	12.0	13.0	12.0	12.100	0.316
9. Manitoba	12.0	12.0	12.0	12.000	0.000
10. Manitoba	12.0	13.0	12.0	12.333	0.577
11. Manitoba	12.0	12.0	11.0	11.636	0.505
12. Manitoba	12.0	14.0	12.0	12.417	0.669
13. Manitoba	12.0	12.0	12.0	12.000	0.000
14. Manitoba	12.0	12.0	11.0	11.750	0.452
15. Manitoba	12.0	12.0	11.0	11.667	0.492
16. Manitoba	12.0	13.0	11.0	12.000	0.392
17. Manitoba	12.0	12.0	12.0	12.000	0.000
1. Saskatchewan	12.0	12.0	12.0	12.000	0.000
2. Saskatchewan	12.0	12.0	12.0	12.000	0.000
3. Saskatchewan	12.0	12.0	12.0	12.000	0.000
4. Saskatchewan	11.0	12.0	11.0	11.500	0.577
5. Saskatchewan	12.0	12.0	12.0	12.000	0.000
6. Saskatchewan	12.0	13.0	12.0	12.250	0.500
7. Saskatchewan	13.0	13.0	13.0	13.000	----
8. Saskatchewan	13.0	13.0	13.0	13.000	----
9. Saskatchewan	12.0	12.0	12.0	12.000	----

Appendix 6G: Number of dorsal spines for examined samples of *Etheostoma nigrum* and *E. olmstedii*. Location number and names correspond to those of Appendix 2.

<u>Location</u>	<u>MODE</u>	<u>UPPER</u>	<u>LOWER</u>	<u>MEAN</u>	<u>SD</u>
1. Colorado	8.0	9.0	8.0	8.455	0.506
1. Connecticut	9.0	10.0	8.0	9.143	0.690
1. Illinois	9.0	9.0	8.0	8.667	0.577
2. Illinois	9.0	9.0	8.0	8.800	0.447
3. Illinois	9.0	9.0	9.0	9.000	0.000
4. Illinois	9.0	9.0	9.0	9.000	0.000
5. Illinois	9.0	9.0	8.0	8.737	0.452
1. Indiana	9.0	10.0	7.0	8.917	0.577
2. Indiana	9.0	9.0	8.0	8.636	0.505
3. Indiana	9.0	10.0	8.0	9.000	0.632
4. Indiana	9.0	9.0	8.0	8.667	0.577
5. Indiana	8.0	10.0	8.0	9.000	1.414
6. Indiana	9.0	9.0	8.0	8.714	0.488
7. Indiana	9.0	10.0	8.0	8.800	0.632
8. Indiana	8.0	10.0	8.0	9.000	1.000
9. Indiana	9.0	9.0	9.0	9.000	0.000
1. Iowa	9.0	9.0	8.0	8.800	0.447
2. Iowa	9.0	9.0	9.0	9.000	0.000
3. Iowa	8.0	9.0	8.0	8.500	0.527
4. Iowa	9.0	9.0	9.0	9.000	0.000
5. Iowa	8.0	9.0	8.0	8.500	0.535
1. Kansas	9.0	9.0	9.0	9.000	0.000
2. Kansas	9.0	9.0	9.0	9.000	0.000
1. Kentucky	9.0	9.0	8.0	8.667	0.500
2. Kentucky	8.0	9.0	8.0	8.400	0.516
1. Maryland	9.0	10.0	9.0	9.111	0.333
2. Maryland	9.0	10.0	8.0	8.950	0.686
1. Massachusetts	9.0	9.0	8.0	8.833	0.408
1. Michigan	8.0	9.0	8.0	8.400	0.548
2. Michigan	8.0	10.0	8.0	8.636	0.674
3. Michigan	9.0	10.0	8.0	8.882	0.485
4. Michigan	9.0	10.0	9.0	9.273	0.467
5. Michigan	8.0	9.0	8.0	8.500	0.707
6. Michigan	9.0	9.0	9.0	9.000	0.000
7. Michigan	9.0	9.0	9.0	9.000	0.000

8. Michigan	8.0	9.0	8.0	8.400	0.548
9. Michigan	9.0	9.0	8.0	8.833	0.408
10. Michigan	9.0	10.0	8.0	9.000	0.632
11. Michigan	9.0	10.0	9.0	9.100	0.316
12. Michigan	9.0	9.0	8.0	8.833	0.408
13. Michigan	9.0	9.0	8.0	8.600	0.516
14. Michigan	9.0	10.0	9.0	9.417	0.515
15. Michigan	8.0	9.0	8.0	8.500	0.577
16. Michigan	9.0	10.0	8.0	9.000	0.408
17. Michigan	9.0	9.0	8.0	8.625	0.518
18. Michigan	9.0	10.0	8.0	9.000	0.577
19. Michigan	9.0	9.0	7.0	8.375	0.744
20. Michigan	8.0	9.0	8.0	8.273	0.467
21. Michigan	9.0	9.0	9.0	9.000	0.000
22. Michigan	8.0	9.0	8.0	8.500	0.577
23. Michigan	9.0	10.0	9.0	9.400	0.516
24. Michigan	8.0	10.0	8.0	9.000	1.000
25. Michigan	9.0	9.0	9.0	9.000	0.000
26. Michigan	9.0	10.0	9.0	9.300	0.483
27. Michigan	9.0	9.0	8.0	8.857	0.378
28. Michigan	9.0	9.0	8.0	8.667	0.577
29. Michigan	9.0	9.0	8.0	8.895	0.315
30. Michigan	9.0	10.0	9.0	9.400	0.548
31. Michigan	9.0	10.0	8.0	9.118	0.600
32. Michigan	8.0	10.0	8.0	9.000	0.853
33. Michigan	9.0	9.0	8.0	8.952	0.218
34. Michigan	9.0	10.0	8.0	8.824	0.636
35. Michigan	9.0	10.0	7.0	8.867	0.834
36. Michigan	9.0	10.0	8.0	8.700	0.657
37. Michigan	9.0	9.0	8.0	8.842	0.375
1. Minnesota	9.0	9.0	8.0	8.600	0.516
2. Minnesota	9.0	10.0	8.0	9.200	0.837
3. Minnesota	9.0	10.0	9.0	9.273	0.467
4. Minnesota	9.0	10.0	8.0	8.846	0.555
5. Minnesota	9.0	9.0	8.0	8.857	0.363
6. Minnesota	9.0	9.0	8.0	8.750	0.452
7. Minnesota	9.0	9.0	7.0	8.636	0.674
8. Minnesota	9.0	9.0	7.0	8.583	0.669
9. Minnesota	9.0	10.0	8.0	9.083	0.515
10. Minnesota	9.0	10.0	8.0	9.000	0.816
11. Minnesota	9.0	9.0	8.0	8.900	0.316
12. Minnesota	9.0	10.0	8.0	9.091	0.539
13. Minnesota	9.0	9.0	8.0	8.750	0.452
14. Minnesota	9.0	9.0	7.0	8.583	0.669
15. Minnesota	8.0	9.0	8.0	8.500	0.707
16. Minnesota	8.0	8.0	8.0	8.000	----
17. Minnesota	8.0	8.0	8.0	8.000	----
18. Minnesota	9.0	9.0	9.0	9.000	----
19. Minnesota	8.0	9.0	8.0	8.333	0.577
20. Minnesota	9.0	9.0	9.0	9.000	0.000

21. Minnesota	8.0	9.0	8.0	8.400	0.547
22. Minnesota	8.0	9.0	8.0	8.500	0.707
23. Minnesota	9.0	9.0	8.0	8.923	0.277
24. Minnesota	9.0	10.0	9.0	9.166	0.408
25. Minnesota	9.0	9.0	8.0	8.818	0.404
26. Minnesota	9.0	9.0	8.0	8.764	0.437
27. Minnesota	9.0	9.0	8.0	8.750	0.447
1. Missouri	9.0	9.0	8.0	8.800	0.447
2. Missouri	8.0	9.0	8.0	8.333	0.577
3. Missouri	9.0	9.0	8.0	8.600	0.516
4. Missouri	8.0	9.0	8.0	8.500	0.707
5. Missouri	9.0	9.0	9.0	9.000	-----
6. Missouri	9.0	9.0	8.0	8.571	0.535
7. Missouri	9.0	9.0	9.0	9.000	-----
8. Missouri	9.0	9.0	9.0	9.000	0.000
9. Missouri	9.0	10.0	8.0	9.143	0.690
1. Nebraska	8.0	8.0	8.0	8.000	0.000
2. Nebraska	8.0	8.0	8.0	8.000	0.000
1. New Jersey	9.0	9.0	6.0	8.636	0.924
1. New Hampshire	9.0	9.0	8.0	8.667	0.516
2. New Hampshire	9.0	9.0	9.0	9.000	0.000
1. New York	9.0	10.0	8.0	9.000	0.632
2. New York	9.0	9.0	8.0	8.923	0.272
3. New York	9.0	10.0	9.0	9.100	0.316
4. New York	9.0	10.0	8.0	9.250	0.707
1. North Dakota	9.0	9.0	9.0	9.000	0.000
2. North Dakota	9.0	9.0	8.0	8.750	0.500
3. North Dakota	9.0	9.0	8.0	8.750	0.463
4. North Dakota	9.0	9.0	8.0	8.750	0.452
5. North Dakota	9.0	9.0	8.0	8.909	0.302
6. North Dakota	8.0	9.0	8.0	8.300	0.483
1. Ohio	9.0	10.0	8.0	9.100	0.738
2. Ohio	9.0	10.0	8.0	8.889	0.601
3. Ohio	9.0	10.0	8.0	9.091	0.539
4. Ohio	9.0	9.0	9.0	9.000	0.000
5. Ohio	8.0	10.0	8.0	9.000	1.000
6. Ohio	8.0	9.0	8.0	8.333	0.500
7. Ohio	8.0	9.0	8.0	8.250	0.500
8. Ohio	9.0	9.0	9.0	9.000	0.000
9. Ohio	9.0	10.0	9.0	9.200	0.447
10. Ohio	8.0	9.0	8.0	8.500	0.707
11. Ohio	8.0	10.0	8.0	8.556	0.726
12. Ohio	8.0	9.0	8.0	8.500	0.577
13. Ohio	9.0	10.0	8.0	8.875	0.641

14. Ohio	9.0	10.0	8.0	9.000	0.447
1. Pennsylvannia	8.0	9.0	8.0	8.300	0.483
2. Pennsylvannia	8.0	9.0	8.0	8.250	0.500
3. Pennsylvannia	9.0	10.0	9.0	9.500	0.577
4. Pennsylvannia	9.0	10.0	8.0	8.923	0.494
1. South Dakota	8.0	10.0	8.0	8.750	0.886
2. South Dakota	9.0	9.0	8.0	8.667	0.577
3. South Dakota	8.0	10.0	8.0	8.565	0.590
4. South Dakota	8.0	9.0	8.0	8.333	0.516
1. Tennessee	9.0	9.0	8.0	8.800	0.422
1. Vermont	9.0	9.0	8.0	8.933	0.258
1. Virginia	8.0	10.0	7.0	8.474	0.697
1. Wisconsin	9.0	10.0	8.0	8.909	0.539
2. Wisconsin	9.0	10.0	9.0	9.400	0.516
3. Wisconsin	9.0	9.0	8.0	8.900	0.316
4. Wisconsin	9.0	9.0	8.0	8.929	0.267
5. Wisconsin	9.0	9.0	8.0	8.833	0.408
6. Wisconsin	9.0	10.0	8.0	9.000	0.471
7. Wisconsin	9.0	9.0	8.0	8.714	0.488
8. Wisconsin	9.0	9.0	8.0	8.999	0.302
9. Wisconsin	9.0	9.0	9.0	9.000	0.000
10. Wisconsin	9.0	9.0	8.0	8.857	0.363
11. Wisconsin	10.0	10.0	9.0	9.667	0.577
12. Wisconsin	9.0	9.0	8.0	8.667	0.577
13. Wisconsin	9.0	10.0	9.0	9.400	0.548
14. Wisconsin	9.0	10.0	8.0	9.182	0.603
15. Wisconsin	9.0	10.0	8.0	9.214	0.579
16. Wisconsin	9.0	9.0	8.0	8.714	0.469
17. Wisconsin	9.0	9.0	8.0	8.800	0.414
18. Wisconsin	9.0	9.0	8.0	8.600	0.500
19. Wisconsin	9.0	10.0	8.0	8.833	0.637
20. Wisconsin	10.0	10.0	9.0	9.556	0.527
21. Wisconsin	9.0	10.0	9.0	9.200	0.447
22. Wisconsin	9.0	10.0	9.0	9.200	0.422
23. Wisconsin	9.0	10.0	8.0	9.077	0.494
24. Wisconsin	9.0	9.0	9.0	9.000	0.000
25. Wisconsin	9.0	10.0	8.0	9.071	0.604
26. Wisconsin	9.0	9.0	9.0	9.000	0.000
27. Wisconsin	8.0	10.0	8.0	8.636	0.674
28. Wisconsin	9.0	9.0	8.0	8.545	0.522
29. Wisconsin	9.0	10.0	8.0	9.000	0.485
30. Wisconsin	8.0	10.0	8.0	8.727	0.786
31. Wisconsin	9.0	9.0	8.0	8.826	0.388
32. Wisconsin	9.0	10.0	8.0	9.000	0.632
33. Wisconsin	9.0	10.0	9.0	9.250	0.500

34. Wisconsin	9.0	10.0	8.0	8.875	0.537
35. Wisconsin	9.0	10.0	9.0	9.444	0.527
36. Wisconsin	9.0	9.0	8.0	8.571	0.535
1. West Virginia	8.0	9.0	8.0	8.250	0.500
1. Wyoming	8.0	9.0	7.0	7.857	0.690
1. Quebec	9.0	10.0	7.0	8.692	0.855
2. Quebec	9.0	10.0	8.0	9.222	0.485
3. Quebec	9.0	10.0	8.0	8.941	0.659
4. Quebec	9.0	10.0	8.0	9.077	0.494
5. Quebec	8.0	9.0	8.0	8.333	0.500
1. Ontario	9.0	10.0	8.0	8.909	0.539
2. Ontario	8.0	9.0	8.0	8.500	0.707
3. Ontario	8.0	9.0	8.0	8.250	0.463
4. Ontario	9.0	9.0	8.0	8.833	0.389
5. Ontario	9.0	9.0	7.0	8.636	0.674
6. Ontario	9.0	9.0	9.0	9.000	0.000
7. Ontario	8.0	9.0	8.0	8.500	0.548
8. Ontario	9.0	10.0	8.0	9.154	0.689
9. Ontario	9.0	9.0	8.0	8.727	0.467
10. Ontario	9.0	9.0	8.0	8.750	0.500
11. Ontario	9.0	9.0	9.0	9.000	0.000
12. Ontario	8.0	9.0	8.0	8.500	0.707
13. Ontario	9.0	10.0	9.0	9.333	0.516
14. Ontario	9.0	9.0	9.0	9.000	-----
15. Ontario	9.0	9.0	8.0	8.600	0.516
16. Ontario	9.0	10.0	9.0	9.200	0.422
17. Ontario	9.0	10.0	9.0	9.100	0.316
18. Ontario	8.0	9.0	8.0	8.300	0.483
19. Ontario	9.0	9.0	6.0	8.357	0.929
20. Ontario	9.0	9.0	8.0	8.889	0.333
21. Ontario	10.0	10.0	9.0	9.600	0.548
22. Ontario	9.0	10.0	8.0	8.900	0.568
23. Ontario	9.0	9.0	8.0	8.714	0.488
24. Ontario	8.0	9.0	8.0	8.200	0.422
25. Ontario	9.0	10.0	9.0	9.200	0.422
26. Ontario	9.0	9.0	8.0	8.800	0.422
27. Ontario	9.0	9.0	8.0	8.786	0.426
28. Ontario	8.0	9.0	7.0	8.273	0.646
29. Ontario	9.0	10.0	7.0	8.600	0.843
30. Ontario	9.0	9.0	8.0	8.700	0.483
31. Ontario	9.0	9.0	9.0	9.000	-----
32. Ontario	9.0	10.0	9.0	9.143	0.378
33. Ontario	8.0	9.0	8.0	8.429	0.535
34. Ontario	9.0	10.0	8.0	9.200	0.632
35. Ontario	9.0	10.0	9.0	9.300	0.483
36. Ontario	9.0	10.0	8.0	9.125	0.619
37. Ontario	9.0	10.0	8.0	9.000	0.666
38. Ontario	9.0	10.0	9.0	9.083	0.288

39. Ontario	10.0	10.0	8.0	9.375	0.744
40. Ontario	9.0	10.0	9.0	9.500	0.527
41. Ontario	9.0	9.0	8.0	8.857	0.363
42. Ontario	10.0	10.0	8.0	9.375	0.744
43. Ontario	9.0	9.0	8.0	8.750	0.462
44. Ontario	8.0	9.0	8.0	8.500	0.527
45. Ontario	9.0	10.0	9.0	9.125	0.353
46. Ontario	9.0	9.0	8.0	8.800	0.447
47. Ontario	9.0	10.0	8.0	9.100	0.567
48. Ontario	9.0	11.0	8.0	9.166	0.937
1. Manitoba	10.0	10.0	9.0	9.800	0.447
2. Manitoba	8.0	9.0	8.0	8.400	0.516
3. Manitoba	9.0	9.0	8.0	8.667	0.577
4. Manitoba	9.0	10.0	8.0	9.000	0.603
5. Manitoba	9.0	10.0	8.0	8.900	0.568
6. Manitoba	9.0	10.0	9.0	9.333	0.577
7. Manitoba	9.0	9.0	9.0	9.000	0.000
8. Manitoba	8.0	9.0	8.0	8.500	0.527
9. Manitoba	9.0	9.0	9.0	9.000	0.000
10. Manitoba	8.0	9.0	8.0	8.333	0.577
11. Manitoba	9.0	10.0	8.0	8.909	0.539
12. Manitoba	9.0	10.0	8.0	8.917	0.515
13. Manitoba	9.0	10.0	9.0	9.455	0.522
14. Manitoba	9.0	10.0	8.0	9.250	0.622
15. Manitoba	9.0	10.0	8.0	9.000	0.603
16. Manitoba	9.0	10.0	8.0	8.857	0.535
17. Manitoba	9.0	10.0	8.0	9.000	0.471
1. Saskatchewan	8.0	10.0	8.0	9.000	1.000
2. Saskatchewan	8.0	9.0	8.0	8.333	0.577
3. Saskatchewan	9.0	9.0	9.0	9.000	0.000
4. Saskatchewan	9.0	9.0	8.0	8.750	0.500
5. Saskatchewan	8.0	9.0	8.0	8.300	0.483
6. Saskatchewan	8.0	10.0	8.0	8.500	1.000
7. Saskatchewan	9.0	9.0	9.0	9.000	-----
8. Saskatchewan	8.0	8.0	8.0	8.000	-----
9. Saskatchewan	8.0	8.0	8.0	8.000	-----

Appendix 6H: Number of dorsal rays (DR1) for examined samples of *Etheostoma nigrum* and *E. olmstedii*. Location number and names correspond to those of Appendix 2.

<u>Location</u>	<u>MODE</u>	<u>UPPER</u>	<u>LOWER</u>	<u>MEAN</u>	<u>SD</u>
1. Colorado	12.0	13.0	11.0	12.242	0.708
1. Connecticut	13.0	13.0	12.0	12.571	0.535
1. Illinois	12.0	12.0	11.0	11.667	0.577
2. Illinois	12.0	12.0	12.0	12.000	0.000
3. Illinois	11.0	12.0	11.0	11.500	0.707
4. Illinois	12.0	12.0	12.0	12.000	0.000
5. Illinois	12.0	13.0	11.0	11.737	0.653
1. Indiana	12.0	13.0	11.0	11.646	0.635
2. Indiana	11.0	12.0	11.0	11.273	0.467
3. Indiana	12.0	12.0	11.0	11.833	0.408
4. Indiana	11.0	12.0	11.0	11.333	0.577
5. Indiana	12.0	13.0	12.0	12.500	0.707
6. Indiana	12.0	12.0	12.0	12.000	0.000
7. Indiana	11.0	12.0	10.0	11.200	0.632
8. Indiana	12.0	12.0	9.0	11.200	1.304
9. Indiana	12.0	12.0	12.0	12.000	0.000
1. Iowa	12.0	12.0	11.0	11.600	0.548
2. Iowa	12.0	12.0	11.0	11.545	0.522
3. Iowa	12.0	13.0	11.0	12.000	0.471
4. Iowa	12.0	12.0	12.0	12.000	0.000
5. Iowa	12.0	13.0	11.0	12.125	0.641
1. Kansas	12.0	14.0	11.0	12.333	1.033
2. Kansas	12.0	12.0	12.0	12.000	0.000
1. Kentucky	11.0	13.0	10.0	11.333	0.866
2. Kentucky	11.0	11.0	10.0	10.800	0.422
1. Maryland	13.0	14.0	13.0	13.111	0.333
2. Maryland	13.0	14.0	12.0	13.150	0.671
1. Massachusetts	13.0	14.0	13.0	13.333	0.516
1. Michigan	11.0	11.0	10.0	10.600	0.548
2. Michigan	12.0	13.0	11.0	11.909	0.539
3. Michigan	12.0	14.0	11.0	12.059	0.748
4. Michigan	11.0	12.0	10.0	11.182	0.751
5. Michigan	11.0	12.0	11.0	11.500	0.707
6. Michigan	12.0	12.0	11.0	11.714	0.488
7. Michigan	12.0	12.0	11.0	11.667	0.577

8. Michigan	13.0	13.0	12.0	12.600	0.548
9. Michigan	11.0	13.0	10.0	11.500	1.049
10. Michigan	11.0	12.0	10.0	11.167	0.753
11. Michigan	11.0	12.0	10.0	11.000	0.667
12. Michigan	12.0	13.0	12.0	12.500	0.548
13. Michigan	12.0	12.0	11.0	11.700	0.483
14. Michigan	11.0	12.0	10.0	10.917	0.669
15. Michigan	12.0	13.0	12.0	12.250	0.500
16. Michigan	11.0	12.0	11.0	11.231	0.439
17. Michigan	12.0	13.0	11.0	12.125	0.835
18. Michigan	12.0	13.0	12.0	12.143	0.378
19. Michigan	11.0	12.0	11.0	11.250	0.463
20. Michigan	11.0	12.0	10.0	10.727	0.647
21. Michigan	11.0	11.0	11.0	11.000	0.000
22. Michigan	11.0	12.0	11.0	11.250	0.500
23. Michigan	11.0	12.0	10.0	11.100	0.738
24. Michigan	12.0	13.0	11.0	12.200	0.837
25. Michigan	12.0	13.0	10.0	11.600	1.140
26. Michigan	12.0	13.0	12.0	12.500	0.527
27. Michigan	11.0	12.0	11.0	11.286	0.488
28. Michigan	12.0	12.0	11.0	11.667	0.577
29. Michigan	11.0	14.0	10.0	11.316	0.820
30. Michigan	12.0	13.0	11.0	12.000	0.707
31. Michigan	11.0	12.0	11.0	11.176	0.393
32. Michigan	12.0	13.0	12.0	12.167	0.389
33. Michigan	12.0	13.0	12.0	12.095	0.301
34. Michigan	11.0	13.0	10.0	11.471	0.717
35. Michigan	12.0	13.0	11.0	12.000	0.756
36. Michigan	12.0	13.0	10.0	11.750	0.639
37. Michigan	12.0	12.0	11.0	11.895	0.315
1. Minnesota	12.0	12.0	11.0	11.700	0.483
2. Minnesota	13.0	13.0	12.0	12.600	0.548
3. Minnesota	12.0	13.0	12.0	12.091	0.302
4. Minnesota	12.0	13.0	11.0	11.769	0.599
5. Minnesota	12.0	13.0	11.0	11.857	0.663
6. Minnesota	12.0	13.0	11.0	12.167	0.718
7. Minnesota	12.0	14.0	11.0	12.091	0.831
8. Minnesota	12.0	12.0	11.0	11.833	0.389
9. Minnesota	12.0	13.0	10.0	11.833	0.835
10. Minnesota	12.0	12.0	11.0	11.750	0.500
11. Minnesota	12.0	12.0	10.0	11.400	0.699
12. Minnesota	12.0	12.0	11.0	11.727	0.467
13. Minnesota	12.0	13.0	11.0	12.000	0.603
14. Minnesota	12.0	14.0	12.0	12.250	0.622
15. Minnesota	12.0	12.0	12.0	12.000	0.000
16. Minnesota	12.0	12.0	12.0	12.000	----
17. Minnesota	13.0	13.0	13.0	13.000	----
18. Minnesota	12.0	12.0	12.0	12.000	----
19. Minnesota	12.0	13.0	12.0	12.333	0.577
20. Minnesota	11.0	12.0	11.0	11.500	0.707

21. Minnesota	12.0	12.0	12.0	12.000	0.000
22. Minnesota	12.0	12.0	12.0	12.000	0.000
23. Minnesota	12.0	13.0	11.0	12.307	0.630
24. Minnesota	11.0	12.0	11.0	11.333	0.516
25. Minnesota	12.0	13.0	11.0	12.000	0.632
26. Minnesota	12.0	13.0	11.0	11.882	0.696
27. Minnesota	12.0	13.0	11.0	11.812	0.543
1. Missouri	11.0	12.0	11.0	11.400	0.548
2. Missouri	11.0	12.0	11.0	11.333	0.577
3. Missouri	11.0	12.0	10.0	11.100	0.738
4. Missouri	11.0	12.0	11.0	11.500	0.707
5. Missouri	12.0	12.0	12.0	12.000	-----
6. Missouri	12.0	13.0	12.0	12.143	0.378
7. Missouri	11.0	11.0	11.0	11.000	-----
8. Missouri	11.0	11.0	11.0	11.000	0.000
9. Missouri	11.0	14.0	11.0	11.714	1.113
1. Nebraska	11.0	12.0	11.0	11.500	0.707
2. Nebraska	12.0	14.0	12.0	12.750	0.957
1. New Jersey	13.0	13.0	12.0	12.545	0.522
1. New Hampshire	13.0	14.0	13.0	13.500	0.548
2. New Hampshire	13.0	15.0	12.0	13.300	0.949
1. New York	14.0	15.0	12.0	13.455	0.934
2. New York	14.0	15.0	12.0	13.615	0.697
3. New York	14.0	14.0	13.0	13.800	0.422
4. New York	14.0	15.0	13.0	14.000	0.756
1. North Dakota	12.0	13.0	12.0	12.333	0.577
2. North Dakota	11.0	12.0	11.0	11.500	0.577
3. North Dakota	12.0	13.0	11.0	12.125	0.641
4. North Dakota	12.0	13.0	11.0	11.750	0.622
5. North Dakota	12.0	13.0	12.0	12.273	0.467
6. North Dakota	12.0	12.0	11.0	11.600	0.516
1. Ohio	12.0	13.0	10.0	11.400	0.966
2. Ohio	11.0	12.0	10.0	10.889	0.601
3. Ohio	12.0	12.0	9.0	11.364	0.924
4. Ohio	11.0	11.0	11.0	11.000	0.000
5. Ohio	10.0	13.0	10.0	11.333	1.528
6. Ohio	11.0	12.0	10.0	11.000	0.500
7. Ohio	10.0	11.0	10.0	10.500	0.577
8. Ohio	11.0	13.0	10.0	11.200	1.095
9. Ohio	11.0	13.0	11.0	11.800	0.837
10. Ohio	11.0	11.0	11.0	11.000	0.000
11. Ohio	12.0	12.0	10.0	11.222	0.833
12. Ohio	11.0	12.0	10.0	11.000	0.816
13. Ohio	11.0	13.0	11.0	11.625	0.916

14. Ohio	11.0	12.0	11.0	11.364	0.505
1. Pennsylvania	11.0	13.0	10.0	11.200	0.789
2. Pennsylvania	12.0	12.0	11.0	11.750	0.500
3. Pennsylvania	11.0	12.0	11.0	11.500	0.577
4. Pennsylvania	11.0	12.0	10.0	11.154	0.555
1. South Dakota	11.0	13.0	8.0	11.250	1.488
2. South Dakota	11.0	12.0	11.0	11.333	0.577
3. South Dakota	12.0	13.0	11.0	12.043	0.638
4. South Dakota	12.0	13.0	11.0	12.000	0.632
1. Tennessee	10.0	11.0	10.0	10.500	0.527
1. Vermont	13.0	14.0	12.0	13.067	0.704
1. Virginia	11.0	12.0	10.0	11.105	0.459
1. Wisconsin	12.0	13.0	12.0	12.273	0.467
2. Wisconsin	13.0	13.0	11.0	12.400	0.699
3. Wisconsin	12.0	13.0	11.0	12.200	0.632
4. Wisconsin	12.0	13.0	11.0	12.071	0.616
5. Wisconsin	12.0	12.0	12.0	12.000	0.000
6. Wisconsin	12.0	13.0	10.0	11.700	0.949
7. Wisconsin	12.0	12.0	11.0	11.571	0.535
8. Wisconsin	11.0	12.0	10.0	11.364	0.674
9. Wisconsin	13.0	13.0	11.0	12.250	0.957
10. Wisconsin	11.0	13.0	11.0	11.571	0.852
11. Wisconsin	12.0	13.0	12.0	12.333	0.577
12. Wisconsin	11.0	12.0	11.0	11.333	0.577
13. Wisconsin	12.0	13.0	11.0	12.000	0.707
14. Wisconsin	12.0	13.0	12.0	12.182	0.405
15. Wisconsin	12.0	13.0	11.0	11.929	0.475
16. Wisconsin	12.0	13.0	11.0	11.857	0.770
17. Wisconsin	12.0	13.0	11.0	12.067	0.704
18. Wisconsin	12.0	12.0	10.0	11.520	0.586
19. Wisconsin	11.0	13.0	8.0	11.375	0.924
20. Wisconsin	13.0	13.0	12.0	12.556	0.527
21. Wisconsin	12.0	12.0	11.0	11.800	0.447
22. Wisconsin	12.0	12.0	11.0	11.600	0.516
23. Wisconsin	12.0	12.0	10.0	11.615	0.650
24. Wisconsin	12.0	12.0	12.0	12.000	0.000
25. Wisconsin	12.0	13.0	11.0	11.750	0.585
26. Wisconsin	13.0	13.0	12.0	12.750	0.500
27. Wisconsin	12.0	13.0	10.0	11.727	0.905
28. Wisconsin	11.0	12.0	11.0	11.364	0.505
29. Wisconsin	12.0	13.0	10.0	11.444	0.784
30. Wisconsin	12.0	14.0	11.0	12.364	0.809
31. Wisconsin	12.0	13.0	11.0	11.826	0.650
32. Wisconsin	11.0	12.0	11.0	11.333	0.516
33. Wisconsin	12.0	12.0	12.0	12.000	0.000

34. Wisconsin	12.0	13.0	11.0	12.042	0.550
35. Wisconsin	12.0	12.0	11.0	11.778	0.441
36. Wisconsin	12.0	12.0	11.0	11.857	0.378
1. West Virginia	11.0	12.0	10.0	11.000	0.816
1. Wyoming	12.0	13.0	10.0	11.429	1.134
1. Quebec	14.0	14.0	12.0	13.077	0.862
2. Quebec	13.0	14.0	12.0	13.306	0.668
3. Quebec	13.0	15.0	13.0	13.471	0.624
4. Quebec	13.0	13.0	12.0	12.769	0.439
5. Quebec	12.0	14.0	12.0	12.556	0.726
1. Ontario	12.0	13.0	12.0	12.455	0.522
2. Ontario	13.0	13.0	13.0	13.000	0.000
3. Ontario	14.0	15.0	12.0	13.750	0.886
4. Ontario	12.0	12.0	10.0	11.167	0.835
5. Ontario	11.0	13.0	11.0	11.636	0.674
6. Ontario	13.0	13.0	12.0	12.700	0.483
7. Ontario	13.0	13.0	12.0	12.833	0.408
8. Ontario	11.0	12.0	11.0	11.462	0.519
9. Ontario	12.0	13.0	11.0	11.909	0.539
10. Ontario	12.0	12.0	11.0	11.750	0.500
11. Ontario	12.0	12.0	11.0	11.800	0.447
12. Ontario	13.0	13.0	13.0	13.000	0.000
13. Ontario	12.0	12.0	12.0	12.000	0.000
14. Ontario	13.0	13.0	13.0	13.000	-----
15. Ontario	12.0	12.0	10.0	11.400	0.843
16. Ontario	12.0	13.0	11.0	12.000	0.667
17. Ontario	12.0	13.0	11.0	12.100	0.568
18. Ontario	12.0	13.0	11.0	11.900	0.737
19. Ontario	13.0	15.0	12.0	13.286	0.825
20. Ontario	12.0	13.0	11.0	12.111	0.601
21. Ontario	11.0	13.0	11.0	11.800	0.837
22. Ontario	12.0	13.0	11.0	11.700	0.675
23. Ontario	12.0	12.0	11.0	11.714	0.488
24. Ontario	11.0	12.0	11.0	11.500	0.527
25. Ontario	11.0	11.0	11.0	11.000	0.000
26. Ontario	12.0	13.0	11.0	11.900	0.568
27. Ontario	12.0	13.0	11.0	12.214	0.699
28. Ontario	11.0	13.0	10.0	11.272	0.786
29. Ontario	13.0	14.0	12.0	13.000	0.667
30. Ontario	12.0	13.0	12.0	12.100	0.316
31. Ontario	12.0	12.0	12.0	12.000	-----
32. Ontario	12.0	13.0	10.0	11.857	0.900
33. Ontario	12.0	13.0	11.0	12.143	0.690
34. Ontario	13.0	14.0	11.0	12.800	0.919
35. Ontario	12.0	12.0	12.0	12.000	0.000
36. Ontario	12.0	13.0	11.0	12.000	0.632
37. Ontario	13.0	13.0	12.0	12.700	0.483
38. Ontario	12.0	13.0	11.0	11.916	0.514

39. Ontario	12.0	13.0	12.0	12.375	0.517
40. Ontario	12.0	12.0	11.0	11.800	0.421
41. Ontario	11.0	12.0	10.0	11.000	0.392
42. Ontario	12.0	13.0	11.0	11.750	0.707
43. Ontario	12.0	12.0	10.0	11.500	0.755
44. Ontario	11.0	13.0	11.0	11.800	0.788
45. Ontario	12.0	12.0	11.0	11.875	0.353
46. Ontario	12.0	12.0	10.0	11.400	0.894
47. Ontario	12.0	14.0	12.0	12.300	0.674
48. Ontario	13.0	14.0	12.0	12.833	0.577
1. Manitoba	12.0	12.0	11.0	11.600	0.548
2. Manitoba	12.0	12.0	11.0	11.600	0.516
3. Manitoba	12.0	12.0	12.0	12.000	0.000
4. Manitoba	11.0	12.0	11.0	11.417	0.515
5. Manitoba	12.0	13.0	12.0	12.200	0.422
6. Manitoba	12.0	12.0	12.0	12.000	0.000
7. Manitoba	11.0	11.0	11.0	11.000	0.000
8. Manitoba	11.0	13.0	11.0	11.600	0.699
9. Manitoba	12.0	12.0	11.0	11.600	0.548
10. Manitoba	12.0	12.0	11.0	11.667	0.577
11. Manitoba	11.0	12.0	11.0	11.455	0.522
12. Manitoba	12.0	13.0	11.0	11.833	0.577
13. Manitoba	12.0	12.0	11.0	11.636	0.505
14. Manitoba	12.0	13.0	11.0	11.750	0.622
15. Manitoba	12.0	12.0	11.0	11.583	0.515
16. Manitoba	12.0	13.0	12.0	12.286	0.469
17. Manitoba	12.0	12.0	11.0	11.700	0.483
1. Saskatchewan	10.0	12.0	10.0	11.000	1.000
2. Saskatchewan	11.0	12.0	11.0	11.333	0.577
3. Saskatchewan	11.0	12.0	11.0	11.500	0.577
4. Saskatchewan	11.0	12.0	10.0	11.000	0.816
5. Saskatchewan	11.0	12.0	11.0	11.500	0.527
6. Saskatchewan	11.0	12.0	11.0	11.250	0.500
7. Saskatchewan	12.0	12.0	12.0	12.000	----
8. Saskatchewan	11.0	11.0	11.0	11.000	----
9. Saskatchewan	12.0	12.0	12.0	12.000	----

Appendix 6I: Mean snout, pectoral and predorsal lengths expressed as percent of standard length followed by standard deviation for examined samples of *Etheostoma nigrum* and *E. olmstedii*. Location number and names correspond to those of Appendix 2.

<u>Location</u>		<u>Snout Length</u>		<u>Pectoral Length</u>		<u>Predorsal Length</u>
1. Colorado	5.32	0.308	26.69	1.058	33.58	0.804
1. Connecticut	4.99	0.242	25.37	1.672	33.57	0.878
1. Illinois	5.50	0.502	24.80	1.212	33.50	1.014
2. Illinois	4.84	0.508	24.62	0.641	31.18	0.732
3. Illinois	5.61	0.346	27.70	1.272	34.60	0.989
4. Illinois	4.94	0.509	25.40	0.282	33.35	0.636
5. Illinois	5.06	0.268	25.26	1.010	34.02	2.344
1. Indiana	5.47	0.406	26.36	1.383	34.12	0.929
2. Indiana	4.86	0.462	26.04	1.237	32.85	0.782
3. Indiana	5.76	0.548	26.53	0.928	33.98	0.655
4. Indiana	5.76	0.337	26.00	0.700	33.00	0.964
5. Indiana	5.49	0.982	26.90	1.555	32.70	0.565
6. Indiana	5.77	0.514	25.35	1.276	34.12	1.071
7. Indiana	5.47	0.396	24.82	0.787	33.91	0.808
8. Indiana	4.52	0.580	23.82	1.056	32.56	1.092
9. Indiana	5.30	0.028	23.60	0.707	33.20	0.707
1. Iowa	5.25	0.256	25.80	0.674	33.58	0.858
2. Iowa	5.39	0.269	25.40	1.202	33.25	0.933
3. Iowa	5.65	0.396	25.99	1.185	33.97	1.171
4. Iowa	5.88	0.233	26.80	1.282	34.78	0.719
5. Iowa	5.33	0.225	24.93	0.947	34.85	0.437
1. Kansas	5.22	0.261	25.51	1.264	34.05	0.954
2. Kansas	4.75	0.415	25.30	0.264	33.90	1.216
1. Kentucky	4.86	0.286	24.67	1.100	33.37	0.717
2. Kentucky	5.09	0.256	25.55	0.953	32.94	0.836
1. Maryland	4.82	0.427	26.87	1.359	33.32	0.987
2. Maryland	4.89	0.429	29.53	1.252	32.19	0.678
1. Massachusetts	5.14	0.240	25.36	0.847	32.88	0.462
1. Michigan	5.56	0.222	24.80	0.717	34.00	0.255
2. Michigan	5.05	0.202	25.64	1.151	34.61	0.638
3. Michigan	5.44	0.535	24.76	0.807	34.65	1.054
4. Michigan	5.28	0.327	26.23	0.894	32.07	0.828
5. Michigan	5.38	0.728	25.30	0.141	31.85	0.636
6. Michigan	5.65	0.359	24.35	1.034	34.15	0.665
7. Michigan	5.67	0.255	25.90	0.360	31.90	0.529

8. Michigan	5.40	0.267	23.52	1.710	33.34	0.409
9. Michigan	5.63	0.302	26.66	1.342	33.28	1.101
10. Michigan	5.59	0.478	26.48	0.470	32.73	0.686
11. Michigan	5.12	0.416	23.21	0.853	33.90	0.800
12. Michigan	5.29	0.237	22.01	0.893	33.68	0.549
13. Michigan	5.40	0.234	27.43	1.044	33.68	0.948
14. Michigan	4.99	0.290	24.61	0.848	33.45	0.709
15. Michigan	5.29	0.254	24.82	0.750	35.07	0.298
16. Michigan	5.21	0.337	24.81	1.412	33.13	0.570
17. Michigan	4.86	0.349	23.52	0.620	32.97	0.890
18. Michigan	5.52	0.180	26.52	1.038	33.80	0.828
19. Michigan	4.90	0.374	25.55	1.050	33.15	0.798
20. Michigan	5.29	0.424	23.57	0.635	32.67	0.810
21. Michigan	4.76	0.523	25.30	1.979	34.05	1.343
22. Michigan	5.17	0.432	25.17	1.678	34.25	1.826
23. Michigan	5.35	0.494	24.78	1.023	34.22	1.242
24. Michigan	5.33	0.256	26.10	0.509	33.66	0.498
25. Michigan	4.84	0.380	24.58	2.242	34.38	0.957
26. Michigan	5.27	0.339	23.07	1.323	34.50	1.154
27. Michigan	5.27	0.374	22.64	0.848	33.25	0.479
28. Michigan	4.98	0.575	25.20	1.652	33.40	0.300
29. Michigan	5.38	0.418	25.25	0.872	33.04	0.693
30. Michigan	5.21	0.572	26.28	1.329	32.10	0.833
31. Michigan	5.54	0.376	26.37	1.233	33.08	0.674
32. Michigan	5.20	0.413	24.09	1.111	33.34	0.827
33. Michigan	5.19	0.387	23.81	1.261	35.13	0.901
34. Michigan	4.92	0.315	24.95	1.174	33.89	2.280
35. Michigan	5.66	0.313	26.80	1.037	34.64	1.020
36. Michigan	5.43	0.500	24.41	1.216	35.55	1.258
37. Michigan	5.13	0.315	26.76	0.784	34.01	0.829
1. Minnesota	5.51	0.367	25.54	1.234	35.05	0.572
2. Minnesota	5.34	0.879	27.04	1.420	37.38	0.892
3. Minnesota	5.71	0.422	25.04	1.336	35.78	0.737
4. Minnesota	5.40	0.269	26.83	0.934	35.20	0.734
5. Minnesota	5.41	0.369	26.34	0.974	34.80	1.100
6. Minnesota	5.23	0.289	24.57	0.771	34.02	0.595
7. Minnesota	5.54	0.405	26.16	1.042	34.19	1.044
8. Minnesota	5.38	0.364	25.65	1.275	34.18	1.054
9. Minnesota	5.48	0.114	26.99	1.052	34.92	0.532
10. Minnesota	5.16	0.387	26.95	0.655	35.00	0.424
11. Minnesota	5.48	0.525	25.42	0.840	34.41	0.833
12. Minnesota	5.31	0.369	26.25	0.995	35.22	0.490
13. Minnesota	5.70	0.331	26.15	0.750	34.70	0.680
14. Minnesota	5.80	0.466	25.98	0.969	34.77	0.708
15. Minnesota	4.86	0.189	23.72	0.669	34.98	0.858
16. Minnesota	5.61	-----	26.20	-----	34.22	-----
17. Minnesota	5.57	-----	23.09	-----	34.91	-----
18. Minnesota	5.19	-----	26.78	-----	34.44	-----
19. Minnesota	5.18	0.329	26.59	0.654	33.39	0.716
20. Minnesota	5.62	0.068	25.04	0.262	34.82	1.217

21. Minnesota	4.72	0.548	25.95	1.356	35.02	1.210
22. Minnesota	5.33	0.189	24.97	0.173	34.37	0.332
23. Minnesota	5.22	0.328	25.16	0.963	33.75	0.636
24. Minnesota	5.10	0.401	26.29	0.745	35.25	1.197
25. Minnesota	4.83	0.429	25.46	0.468	33.64	0.501
26. Minnesota	4.91	0.421	25.04	0.986	33.09	1.356
27. Minnesota	4.83	0.465	24.86	0.784	32.58	2.090
1. Missouri	5.37	0.283	23.86	0.904	34.34	0.512
2. Missouri	5.43	0.235	23.50	0.200	32.66	0.152
3. Missouri	4.98	0.352	23.76	1.043	32.63	0.875
4. Missouri	5.23	0.268	21.95	0.212	32.05	0.495
5. Missouri	4.74	-----	21.90	-----	32.30	-----
6. Missouri	5.33	0.391	25.67	1.133	33.22	0.782
7. Missouri	3.70	-----	20.20	-----	29.90	-----
8. Missouri	4.99	0.291	22.75	0.924	32.80	0.451
9. Missouri	5.10	0.382	24.21	0.575	33.92	0.576
1. Nebraska	5.12	0.311	25.70	0.565	32.50	1.979
2. Nebraska	6.02	0.450	26.22	1.090	34.62	0.822
1. New Hampshire	5.28	0.171	26.33	1.076	33.31	0.828
2. New Hampshire	5.50	0.502	26.76	0.884	24.88	0.731
1. New Jersey	5.36	0.246	27.70	1.109	34.81	1.344
1. New York	5.48	0.330	23.56	0.833	33.92	0.477
2. New York	5.29	0.336	24.95	1.037	33.92	0.838
3. New York	5.19	0.286	23.82	0.921	34.63	0.764
4. New York	4.94	0.225	23.52	1.331	32.21	0.753
1. North Dakota	5.71	0.141	25.70	0.435	34.73	0.577
2. North Dakota	5.37	0.539	24.95	0.759	35.52	0.818
3. North Dakota	5.45	0.421	27.68	1.060	35.02	0.779
4. North Dakota	5.13	0.536	23.95	0.944	33.82	0.765
5. North Dakota	5.77	0.425	26.52	0.829	34.97	0.527
6. North Dakota	5.54	0.391	26.68	0.871	36.02	1.041
1. Ohio	5.61	0.507	24.25	1.000	33.46	0.893
2. Ohio	5.10	0.413	26.05	1.325	34.56	0.927
3. Ohio	5.73	0.274	25.97	0.773	33.94	1.015
4. Ohio	4.74	0.021	26.15	0.212	34.00	1.697
5. Ohio	5.02	0.568	27.53	1.350	32.86	0.709
6. Ohio	4.89	0.412	24.43	1.237	34.11	0.882
7. Ohio	5.33	0.448	24.55	1.126	33.72	0.763
8. Ohio	4.95	0.348	24.16	1.176	33.14	1.281
9. Ohio	5.68	0.335	25.82	0.920	33.82	0.701
10. Ohio	5.32	0.466	23.90	0.848	33.30	0.707
11. Ohio	5.44	0.378	23.80	0.868	33.38	1.025
12. Ohio	5.00	0.206	25.42	0.822	31.47	0.685
13. Ohio	5.63	0.494	25.16	0.994	32.67	1.113

14. Ohio	5.95	0.556	25.71	0.925	34.48	0.998
1. Pennsylvania	5.42	0.267	26.45	1.092	34.44	0.594
2. Pennsylvania	5.21	0.457	27.32	1.046	34.00	0.820
3. Pennsylvania	4.52	0.288	21.85	0.785	32.32	1.117
4. Pennsylvania	4.77	0.321	24.53	1.992	32.41	1.141
1. South Dakota	5.27	0.246	24.70	0.769	33.88	0.439
2. South Dakota	5.43	0.514	26.03	0.896	35.90	0.692
3. South Dakota	5.31	0.369	26.26	1.175	34.36	0.879
4. South Dakota	5.44	0.317	26.06	0.760	33.70	0.619
1. Tennessee	5.03	0.389	23.39	0.515	32.02	0.418
1. Vermont	4.76	0.393	26.41	0.631	34.02	0.828
1. Virginia	5.33	0.359	27.15	0.866	33.93	1.086
1. Wisconsin	5.29	0.531	24.89	0.998	34.05	1.553
2. Wisconsin	5.66	0.268	25.04	0.794	33.84	0.870
3. Wisconsin	5.41	0.301	24.44	0.738	34.02	0.625
4. Wisconsin	5.10	0.485	24.86	1.165	33.49	0.703
5. Wisconsin	6.04	0.232	25.91	1.036	35.61	1.534
6. Wisconsin	5.41	0.314	24.09	0.667	34.48	0.225
7. Wisconsin	5.04	0.563	24.67	1.189	33.30	0.688
8. Wisconsin	5.49	0.420	26.15	1.066	34.22	1.104
9. Wisconsin	4.83	0.953	24.82	0.822	35.32	0.386
10. Wisconsin	5.22	0.351	27.24	0.518	33.93	1.977
11. Wisconsin	5.28	0.448	23.90	1.311	34.10	0.556
12. Wisconsin	5.52	0.825	25.40	0.264	33.76	1.434
13. Wisconsin	5.54	0.220	26.42	0.822	34.30	0.547
14. Wisconsin	5.10	0.780	24.14	1.483	35.62	1.435
15. Wisconsin	5.31	0.334	24.00	1.376	33.75	0.752
16. Wisconsin	5.17	0.324	25.03	1.405	33.72	0.850
17. Wisconsin	5.15	0.413	24.75	1.117	34.22	1.012
18. Wisconsin	5.06	0.493	25.66	1.205	34.30	1.073
19. Wisconsin	5.25	0.351	25.61	1.123	33.40	0.828
20. Wisconsin	4.93	0.411	24.70	1.071	33.81	0.575
21. Wisconsin	5.15	0.277	23.98	0.657	32.48	2.742
22. Wisconsin	5.46	0.413	24.22	0.700	33.86	0.616
23. Wisconsin	5.02	0.393	24.26	1.579	34.72	0.968
24. Wisconsin	5.18	0.380	24.93	3.667	34.36	0.577
25. Wisconsin	5.19	0.350	25.11	0.957	34.19	0.828
26. Wisconsin	5.28	0.153	23.80	1.790	33.82	1.081
27. Wisconsin	4.94	0.268	24.85	0.992	33.56	1.232
28. Wisconsin	4.78	0.490	25.38	1.160	33.41	1.465
29. Wisconsin	5.23	0.332	25.62	0.825	34.04	0.966
30. Wisconsin	5.03	0.309	24.46	0.884	34.35	0.686
31. Wisconsin	5.18	0.480	23.41	1.038	34.38	0.996
32. Wisconsin	4.97	0.397	22.11	1.360	34.23	0.995
33. Wisconsin	5.42	0.510	26.15	0.310	35.40	1.779

34. Wisconsin	5.58	0.426	25.65	1.355	34.50	0.747
35. Wisconsin	5.75	0.434	25.63	1.057	34.61	0.666
36. Wisconsin	5.44	0.475	25.00	0.914	34.88	0.696
1. West Virginia	4.59	0.261	25.85	0.608	33.50	0.583
1. Wyoming	5.65	0.550	25.71	0.729	33.72	0.585
1. Quebec	4.85	0.571	26.20	2.491	33.18	1.689
2. Quebec	4.92	0.386	27.20	1.317	35.03	0.760
3. Quebec	5.04	0.585	26.71	1.714	32.07	1.086
4. Quebec	4.49	0.378	25.10	1.142	34.95	0.833
5. Quebec	4.71	0.439	24.94	0.918	32.40	1.316
1. Ontario	4.84	0.491	26.88	1.032	33.89	1.359
2. Ontario	4.59	0.622	26.35	0.777	35.35	0.212
3. Ontario	4.74	0.323	25.82	1.853	34.87	0.768
4. Ontario	4.74	0.364	24.43	1.295	32.39	0.860
5. Ontario	4.55	0.293	24.96	0.937	32.43	0.864
6. Ontario	4.67	0.502	26.82	1.051	34.83	1.413
7. Ontario	4.24	0.424	26.53	1.238	34.41	0.556
8. Ontario	4.89	0.300	24.97	0.704	33.01	0.913
9. Ontario	4.44	0.728	25.73	0.729	33.98	1.182
10. Ontario	5.38	0.095	24.85	0.953	33.00	0.605
11. Ontario	4.61	0.443	25.52	0.497	35.08	0.928
12. Ontario	5.24	0.551	25.80	2.121	35.70	0.424
13. Ontario	4.26	0.269	24.46	1.105	34.13	0.875
14. Ontario	5.18	-----	25.80	-----	33.70	-----
15. Ontario	4.83	0.534	25.53	1.324	33.94	0.772
16. Ontario	5.24	0.356	25.13	1.149	35.45	0.831
17. Ontario	4.78	0.545	24.44	1.153	35.63	0.751
18. Ontario	4.34	0.391	25.22	1.445	33.66	1.206
19. Ontario	5.34	0.383	26.36	1.058	31.47	1.042
20. Ontario	4.99	0.375	25.71	0.953	34.65	0.758
21. Ontario	4.28	0.745	25.34	0.890	33.48	0.481
22. Ontario	4.95	0.491	24.14	0.748	34.75	0.583
23. Ontario	4.93	0.369	25.38	0.536	33.45	0.912
24. Ontario	5.25	0.300	26.33	1.373	32.90	0.912
25. Ontario	4.59	0.460	25.06	1.460	33.12	1.218
26. Ontario	5.37	0.344	23.88	1.319	33.95	0.956
27. Ontario	5.21	0.467	24.06	1.852	32.89	0.832
28. Ontario	5.49	0.360	26.68	1.279	34.08	0.880
29. Ontario	4.75	0.448	22.65	0.639	33.46	0.950
30. Ontario	4.98	0.512	25.09	1.087	31.62	0.910
31. Ontario	4.76	-----	22.80	-----	32.30	-----
32. Ontario	5.23	0.317	25.02	0.667	33.90	1.762
33. Ontario	5.23	0.358	24.90	0.326	33.88	0.686
34. Ontario	5.33	0.314	24.14	1.107	32.96	1.132
35. Ontario	5.11	0.360	23.12	1.020	33.95	0.868
36. Ontario	5.65	0.373	25.36	0.809	35.35	0.759
37. Ontario	5.47	0.345	24.56	1.383	34.40	0.714

38. Ontario	5.25	0.265	24.92	1.006	33.93	1.068
39. Ontario	5.22	0.298	25.46	0.570	34.55	1.304
40. Ontario	5.67	0.240	25.52	1.727	34.58	0.773
41. Ontario	5.55	0.378	26.22	1.145	35.84	0.936
42. Ontario	5.25	0.445	24.62	1.155	34.66	1.088
43. Ontario	5.46	0.503	26.38	2.339	35.70	0.633
44. Ontario	5.59	0.300	23.04	0.687	34.05	0.472
45. Ontario	5.63	0.404	23.51	0.979	33.80	1.784
46. Ontario	5.64	0.348	27.01	0.640	35.94	1.050
47. Ontario	5.49	0.300	25.34	1.311	33.48	1.032
48. Ontario	5.26	0.537	24.32	1.377	33.94	1.284
1. Manitoba	5.89	0.404	25.18	0.861	35.14	1.080
2. Manitoba	5.91	0.297	25.39	0.899	34.29	0.495
3. Manitoba	5.76	0.221	27.56	1.137	33.83	0.416
4. Manitoba	5.95	0.252	27.30	0.825	34.64	0.702
5. Manitoba	4.67	0.490	26.13	1.705	34.49	0.955
6. Manitoba	5.15	0.176	27.83	0.776	35.23	0.901
7. Manitoba	4.79	0.650	24.05	2.192	36.80	0.141
8. Manitoba	4.76	0.380	25.45	1.128	34.33	0.462
9. Manitoba	5.04	0.180	23.52	2.560	33.60	0.751
10. Manitoba	5.76	0.365	24.96	0.057	34.90	1.153
11. Manitoba	5.20	0.413	26.22	1.082	34.18	1.019
12. Manitoba	5.86	0.228	24.84	0.828	33.79	1.267
13. Manitoba	5.43	0.288	25.38	1.268	34.80	0.575
14. Manitoba	5.91	0.585	27.89	1.339	34.44	0.916
15. Manitoba	5.57	0.384	27.61	0.796	35.82	0.973
16. Manitoba	5.64	0.285	22.46	1.050	34.20	1.180
17. Manitoba	5.88	0.270	25.81	1.518	36.16	1.342
1. Saskatchewan	3.97	0.625	25.13	0.838	34.76	0.230
2. Saskatchewan	4.28	0.768	24.90	1.777	36.83	0.901
3. Saskatchewan	4.81	0.465	26.07	1.102	36.15	0.946
4. Saskatchewan	5.49	0.846	28.47	1.602	35.85	1.047
5. Saskatchewan	5.14	0.451	25.41	1.136	35.07	0.804
6. Saskatchewan	5.86	0.147	25.57	0.518	33.15	1.066
7. Saskatchewan	5.42	-----	26.00	-----	35.50	-----
8. Saskatchewan	5.65	-----	26.80	-----	35.90	-----
9. Saskatchewan	5.10	-----	26.40	-----	36.70	-----

Appendix 6J: Number of scales in the lateral line for examined samples of *Etheostoma nigrum* and *E. olmstedii*. Location number and names correspond to those of Appendix 2.

<u>Location</u>	<u>MODE</u>	<u>UPPER</u>	<u>LOWER</u>	<u>MEAN</u>	<u>SD</u>
1. Colorado	45.0	53.0	42.0	46.636	2.356
1. Connecticut	46.0	54.0	44.0	47.143	3.288
1. Illinois	48.0	51.0	48.0	49.333	1.528
2. Illinois	47.0	53.0	47.0	49.800	2.387
3. Illinois	43.0	48.0	43.0	45.500	3.536
4. Illinois	46.0	51.0	46.0	48.500	3.536
5. Illinois	47.0	54.0	45.0	48.579	2.063
1. Indiana	48.0	54.0	43.0	47.271	2.546
2. Indiana	44.0	50.0	43.0	45.455	2.018
3. Indiana	49.0	49.0	42.0	45.833	2.994
4. Indiana	48.0	52.0	48.0	49.667	2.082
5. Indiana	46.0	48.0	46.0	47.000	1.414
6. Indiana	46.0	53.0	44.0	47.000	2.944
7. Indiana	46.0	49.0	45.0	47.100	1.370
8. Indiana	46.0	53.0	46.0	49.000	3.082
9. Indiana	48.0	52.0	48.0	50.000	2.828
1. Iowa	46.0	47.0	45.0	46.200	0.837
2. Iowa	50.0	51.0	42.0	47.909	2.700
3. Iowa	46.0	50.0	42.0	45.500	2.369
4. Iowa	38.0	47.0	38.0	42.200	3.701
5. Iowa	50.0	51.0	45.0	48.500	2.070
1. Kansas	43.0	50.0	43.0	45.833	2.714
2. Kansas	41.0	49.0	41.0	44.333	4.163
1. Kentucky	43.0	52.0	43.0	46.222	2.991
2. Kentucky	49.0	53.0	44.0	47.700	2.908
1. Maryland	42.0	49.0	42.0	44.444	2.186
2. Maryland	42.0	44.0	39.0	42.250	1.372
1. Massachusetts	45.0	48.0	45.0	46.000	1.265
1. Michigan	48.0	48.0	44.0	46.400	1.817
2. Michigan	45.0	51.0	45.0	47.636	2.203
3. Michigan	48.0	52.0	43.0	46.529	2.348
4. Michigan	46.0	51.0	43.0	47.091	2.300
5. Michigan	50.0	52.0	50.0	51.000	1.414
6. Michigan	49.0	52.0	48.0	50.143	1.574
7. Michigan	44.0	48.0	44.0	45.667	2.082

8. Michigan	49.0	54.0	49.0	51.600	2.074
9. Michigan	48.0	48.0	42.0	45.000	2.530
10. Michigan	46.0	50.0	46.0	48.000	1.673
11. Michigan	44.0	49.0	42.0	45.200	2.251
12. Michigan	54.0	61.0	51.0	55.000	3.521
13. Michigan	48.0	53.0	45.0	49.200	2.300
14. Michigan	45.0	51.0	45.0	47.417	2.065
15. Michigan	47.0	48.0	46.0	47.000	0.816
16. Michigan	46.0	53.0	44.0	48.077	2.691
17. Michigan	46.0	53.0	46.0	48.375	2.387
18. Michigan	50.0	51.0	46.0	49.714	1.704
19. Michigan	43.0	48.0	41.0	44.875	2.475
20. Michigan	46.0	53.0	46.0	48.364	2.420
21. Michigan	43.0	48.0	43.0	45.500	3.536
22. Michigan	44.0	49.0	44.0	46.000	2.160
23. Michigan	45.0	52.0	45.0	48.400	2.503
24. Michigan	44.0	51.0	44.0	46.800	2.775
25. Michigan	42.0	49.0	42.0	45.000	2.739
26. Michigan	55.0	57.0	51.0	53.800	1.814
27. Michigan	45.0	51.0	42.0	45.714	2.984
28. Michigan	44.0	45.0	44.0	44.333	0.577
29. Michigan	43.0	49.0	40.0	44.263	2.423
30. Michigan	40.0	50.0	40.0	45.600	3.847
31. Michigan	47.0	51.0	43.0	46.824	2.675
32. Michigan	49.0	55.0	47.0	49.500	2.505
33. Michigan	47.0	55.0	47.0	50.000	2.345
34. Michigan	49.0	59.0	44.0	50.706	4.427
35. Michigan	49.0	56.0	46.0	50.067	2.604
36. Michigan	51.0	57.0	48.0	51.900	2.315
37. Michigan	48.0	53.0	45.0	49.263	2.077
1. Minnesota	47.0	51.0	44.0	47.300	2.263
2. Minnesota	57.0	57.0	50.0	54.200	2.950
3. Minnesota	49.0	54.0	49.0	50.909	1.814
4. Minnesota	45.0	47.0	41.0	45.077	1.754
5. Minnesota	44.0	49.0	43.0	45.857	2.214
6. Minnesota	47.0	51.0	44.0	47.417	2.466
7. Minnesota	47.0	49.0	42.0	46.091	2.468
8. Minnesota	47.0	50.0	42.0	47.000	2.256
9. Minnesota	45.0	51.0	40.0	45.667	2.741
10. Minnesota	48.0	49.0	48.0	48.500	0.577
11. Minnesota	47.0	49.0	44.0	46.300	1.418
12. Minnesota	45.0	53.0	43.0	47.455	2.911
13. Minnesota	48.0	48.0	41.0	45.500	2.236
14. Minnesota	48.0	53.0	42.0	47.667	3.284
15. Minnesota	46.0	49.0	46.0	47.500	2.121
16. Minnesota	48.0	48.0	48.0	48.000	-----
17. Minnesota	51.0	51.0	51.0	51.000	-----
18. Minnesota	45.0	45.0	45.0	45.000	-----
19. Minnesota	49.0	51.0	47.0	49.000	2.000
20. Minnesota	47.0	47.0	47.0	47.000	0.000

21. Minnesota	46.0	48.0	45.0	46.400	1.140
22. Minnesota	48.0	52.0	48.0	50.000	2.828
23. Minnesota	48.0	53.0	47.0	49.692	1.750
24. Minnesota	43.0	49.0	43.0	45.666	2.160
25. Minnesota	48.0	53.0	44.0	49.454	2.464
26. Minnesota	48.0	53.0	45.0	48.882	2.204
27. Minnesota	47.0	51.0	42.0	46.687	2.522
1. Missouri	44.0	51.0	44.0	47.200	2.588
2. Missouri	46.0	48.0	46.0	47.000	1.000
3. Missouri	50.0	56.0	46.0	50.300	2.983
4. Missouri	48.0	53.0	48.0	50.500	3.536
5. Missouri	51.0	51.0	51.0	51.000	-----
6. Missouri	48.0	51.0	44.0	47.143	2.340
7. Missouri	48.0	48.0	48.0	48.000	-----
8. Missouri	50.0	54.0	50.0	51.167	1.602
9. Missouri	48.0	51.0	44.0	48.000	2.160
1. Nebraska	48.0	50.0	48.0	49.000	1.414
2. Nebraska	47.0	47.0	46.0	46.750	0.500
1. New Jersey	43.0	49.0	43.0	44.818	2.272
1. New Hampshire	46.0	50.0	46.0	47.833	1.602
2. New Hampshire	47.0	51.0	43.0	47.500	2.121
1. New York	51.0	56.0	47.0	51.636	3.107
2. New York	51.0	56.0	46.0	50.731	2.491
3. New York	47.0	51.0	43.0	48.200	2.530
4. New York	50.0	55.0	48.0	51.375	2.615
1. North Dakota	48.0	51.0	48.0	49.667	1.528
2. North Dakota	40.0	47.0	40.0	43.250	2.986
3. North Dakota	43.0	50.0	43.0	45.625	2.722
4. North Dakota	45.0	49.0	41.0	45.083	2.314
5. North Dakota	48.0	50.0	46.0	47.909	1.300
6. North Dakota	45.0	47.0	43.0	45.000	1.333
1. Ohio	49.0	51.0	42.0	47.300	3.302
2. Ohio	44.0	47.0	41.0	44.000	1.871
3. Ohio	45.0	51.0	42.0	45.727	3.228
4. Ohio	44.0	44.0	44.0	44.000	0.000
5. Ohio	38.0	43.0	38.0	40.667	2.517
6. Ohio	42.0	46.0	41.0	42.778	1.641
7. Ohio	41.0	41.0	39.0	40.250	0.957
8. Ohio	45.0	47.0	40.0	44.200	2.588
9. Ohio	42.0	49.0	42.0	45.400	2.881
10. Ohio	42.0	44.0	42.0	43.000	1.414
11. Ohio	49.0	51.0	44.0	48.222	2.224
12. Ohio	44.0	52.0	44.0	48.250	3.304
13. Ohio	47.0	47.0	43.0	45.500	1.852

14. Ohio	45.0	48.0	42.0	45.636	1.690
1. Pennsylvania	42.0	47.0	41.0	43.400	2.119
2. Pennsylvania	44.0	47.0	44.0	45.000	1.414
3. Pennsylvania	46.0	52.0	46.0	49.000	2.582
4. Pennsylvania	44.0	47.0	42.0	43.923	1.382
1. South Dakota	48.0	52.0	45.0	48.500	2.204
2. South Dakota	51.0	51.0	50.0	50.667	0.577
3. South Dakota	49.0	53.0	45.0	48.304	2.162
4. South Dakota	48.0	50.0	43.0	47.333	2.503
1. Tennessee	48.0	53.0	45.0	48.200	2.348
1. Vermont	49.0	56.0	45.0	49.133	2.696
1. Virginia	41.0	48.0	39.0	43.368	2.543
1. Wisconsin	50.0	51.0	45.0	48.909	1.814
2. Wisconsin	46.0	53.0	43.0	48.400	3.026
3. Wisconsin	53.0	58.0	47.0	52.900	3.213
4. Wisconsin	47.0	53.0	44.0	47.929	2.526
5. Wisconsin	51.0	51.0	45.0	48.500	2.588
6. Wisconsin	50.0	51.0	46.0	48.700	1.947
7. Wisconsin	44.0	52.0	41.0	44.143	3.716
8. Wisconsin	42.0	50.0	40.0	44.364	3.139
9. Wisconsin	44.0	50.0	44.0	46.000	2.828
10. Wisconsin	44.0	54.0	41.0	46.571	3.345
11. Wisconsin	51.0	55.0	51.0	53.000	2.000
12. Wisconsin	42.0	45.0	42.0	43.333	1.528
13. Wisconsin	48.0	48.0	46.0	47.400	0.894
14. Wisconsin	43.0	52.0	42.0	45.455	3.012
15. Wisconsin	52.0	56.0	47.0	51.357	2.341
16. Wisconsin	46.0	50.0	42.0	45.500	2.029
17. Wisconsin	47.0	53.0	44.0	47.200	2.808
18. Wisconsin	47.0	57.0	44.0	48.600	3.000
19. Wisconsin	48.0	54.0	43.0	48.250	2.558
20. Wisconsin	50.0	58.0	47.0	51.889	3.060
21. Wisconsin	52.0	54.0	48.0	51.000	2.449
22. Wisconsin	46.0	51.0	45.0	47.300	1.767
23. Wisconsin	46.0	52.0	44.0	48.615	2.567
24. Wisconsin	48.0	52.0	48.0	50.000	2.000
25. Wisconsin	51.0	53.0	46.0	49.893	1.988
26. Wisconsin	48.0	50.0	46.0	48.000	1.633
27. Wisconsin	47.0	51.0	45.0	47.909	1.758
28. Wisconsin	46.0	51.0	42.0	46.000	2.569
29. Wisconsin	43.0	48.0	42.0	45.222	1.927
30. Wisconsin	45.0	48.0	45.0	46.364	1.120
31. Wisconsin	50.0	54.0	45.0	50.870	2.052
32. Wisconsin	48.0	50.0	44.0	46.833	2.229
33. Wisconsin	44.0	48.0	44.0	46.250	1.708

34. Wisconsin	44.0	50.0	42.0	45.292	2.404
35. Wisconsin	50.0	52.0	47.0	49.556	1.509
36. Wisconsin	48.0	48.0	45.0	46.571	1.397
1. West Virginia	45.0	49.0	43.0	45.500	2.517
1. Wyoming	49.0	50.0	43.0	47.714	2.430
1. Quebec	44.0	54.0	43.0	46.462	3.072
2. Quebec	48.0	56.0	46.0	50.639	2.631
3. Quebec	45.0	51.0	42.0	45.412	2.373
4. Quebec	48.0	52.0	45.0	48.077	1.891
5. Quebec	42.0	45.0	40.0	42.333	1.414
1. Ontario	48.0	56.0	44.0	48.273	3.319
2. Ontario	48.0	49.0	48.0	48.500	0.707
3. Ontario	50.0	53.0	49.0	50.500	1.195
4. Ontario	45.0	50.0	43.0	47.000	2.216
5. Ontario	43.0	51.0	42.0	45.455	2.659
6. Ontario	48.0	51.0	46.0	48.200	1.619
7. Ontario	47.0	55.0	47.0	49.833	3.189
8. Ontario	43.0	52.0	42.0	46.154	3.262
9. Ontario	43.0	45.0	40.0	42.727	1.489
10. Ontario	45.0	50.0	45.0	47.750	2.217
11. Ontario	44.0	50.0	44.0	46.000	2.550
12. Ontario	49.0	50.0	49.0	49.500	0.707
13. Ontario	46.0	49.0	46.0	47.333	1.366
14. Ontario	48.0	48.0	48.0	48.000	-----
15. Ontario	41.0	47.0	40.0	42.700	2.214
16. Ontario	52.0	53.0	47.0	50.900	1.792
17. Ontario	54.0	58.0	50.0	53.000	2.261
18. Ontario	45.0	49.0	40.0	44.700	2.496
19. Ontario	48.0	53.0	41.0	46.643	3.225
20. Ontario	44.0	49.0	42.0	44.556	2.186
21. Ontario	48.0	48.0	44.0	46.600	1.673
22. Ontario	51.0	58.0	51.0	53.500	2.415
23. Ontario	44.0	49.0	43.0	45.286	1.976
24. Ontario	46.0	48.0	41.0	44.900	2.378
25. Ontario	42.0	47.0	42.0	44.800	1.814
26. Ontario	47.0	55.0	47.0	50.900	2.558
27. Ontario	45.0	49.0	40.0	44.571	2.623
28. Ontario	42.0	48.0	41.0	43.727	2.240
29. Ontario	48.0	56.0	46.0	50.600	3.204
30. Ontario	51.0	55.0	50.0	52.400	1.647
31. Ontario	50.0	50.0	50.0	50.000	-----
32. Ontario	46.0	52.0	46.0	49.143	2.478
33. Ontario	45.0	48.0	44.0	45.857	1.345
34. Ontario	47.0	51.0	42.0	46.300	2.452
35. Ontario	41.0	49.0	41.0	44.600	2.875
36. Ontario	47.0	54.0	42.0	46.438	3.162
37. Ontario	50.0	54.0	45.0	50.000	3.162
38. Ontario	48.0	53.0	48.0	50.250	1.912

39. Ontario	50.0	54.0	48.0	49.750	1.908
40. Ontario	50.0	56.0	45.0	50.500	2.677
41. Ontario	46.0	50.0	43.0	46.785	2.516
42. Ontario	50.0	52.0	47.0	49.625	1.407
43. Ontario	48.0	57.0	48.0	51.875	3.313
44. Ontario	50.0	47.0	48.0	51.100	2.884
45. Ontario	49.0	56.0	48.0	50.875	2.531
46. Ontario	47.0	49.0	47.0	47.600	0.894
47. Ontario	46.0	52.0	42.0	47.500	3.439
48. Ontario	47.0	51.0	40.0	46.916	3.396
1. Manitoba	48.0	51.0	45.0	48.600	2.510
2. Manitoba	47.0	50.0	44.0	46.700	2.003
3. Manitoba	48.0	48.0	47.0	47.667	0.577
4. Manitoba	47.0	51.0	45.0	47.583	1.832
5. Manitoba	48.0	54.0	47.0	49.700	2.003
6. Manitoba	44.0	50.0	44.0	47.000	3.000
7. Manitoba	50.0	56.0	50.0	53.000	4.243
8. Manitoba	47.0	50.0	44.0	46.800	1.989
9. Manitoba	48.0	52.0	48.0	50.000	1.871
10. Manitoba	51.0	55.0	51.0	53.000	2.000
11. Manitoba	50.0	52.0	43.0	47.909	3.081
12. Manitoba	49.0	55.0	49.0	51.500	2.023
13. Manitoba	49.0	53.0	47.0	50.636	1.859
14. Manitoba	46.0	49.0	42.0	45.917	1.676
15. Manitoba	45.0	48.0	42.0	44.667	1.614
16. Manitoba	55.0	58.0	49.0	53.929	2.973
17. Manitoba	48.0	52.0	43.0	48.000	2.667
1. Saskatchewan	49.0	53.0	49.0	50.333	2.309
2. Saskatchewan	50.0	51.0	50.0	50.333	0.577
3. Saskatchewan	47.0	49.0	46.0	47.250	1.258
4. Saskatchewan	43.0	48.0	43.0	46.000	2.160
5. Saskatchewan	47.0	55.0	45.0	48.300	2.946
6. Saskatchewan	48.0	51.0	48.0	49.500	1.291
7. Saskatchewan	47.0	47.0	47.0	47.000	-----
8. Saskatchewan	50.0	50.0	50.0	50.000	-----
9. Saskatchewan	46.0	46.0	46.0	46.000	-----

Appendix 6K: Number of scales below the lateral line for examined samples of *Etheostoma nigrum* and *E. olmstedii*. Location number and names correspond to those of Appendix 2.

<u>Location</u>	<u>MODE</u>	<u>UPPER</u>	<u>LOWER</u>	<u>MEAN</u>	<u>SD</u>
1. Colorado	7.0	8.0	5.0	6.758	0.614
1. Connecticut	9.0	9.0	8.0	8.714	0.488
1. Illinois	6.0	9.0	6.0	7.000	1.732
2. Illinois	8.0	8.0	7.0	7.800	0.447
3. Illinois	7.0	9.0	7.0	8.000	1.414
4. Illinois	8.0	9.0	8.0	8.500	0.707
5. Illinois	8.0	9.0	7.0	7.632	0.597
1. Indiana	7.0	9.0	6.0	7.542	0.771
2. Indiana	8.0	9.0	6.0	8.000	0.894
3. Indiana	7.0	8.0	7.0	7.333	0.516
4. Indiana	8.0	8.0	8.0	8.000	0.000
5. Indiana	7.0	7.0	7.0	7.000	0.000
6. Indiana	8.0	8.0	6.0	7.429	0.787
7. Indiana	8.0	8.0	6.0	7.500	0.707
8. Indiana	7.0	8.0	7.0	7.400	0.548
9. Indiana	8.0	8.0	8.0	8.000	0.000
1. Iowa	7.0	8.0	6.0	7.200	0.837
2. Iowa	8.0	9.0	7.0	7.818	0.603
3. Iowa	7.0	8.0	6.0	6.800	0.632
4. Iowa	6.0	8.0	6.0	6.800	0.837
5. Iowa	7.0	8.0	6.0	6.750	0.707
1. Kansas	8.0	9.0	7.0	7.833	0.753
2. Kansas	7.0	7.0	7.0	7.000	0.000
1. Kentucky	7.0	8.0	7.0	7.222	0.441
2. Kentucky	8.0	8.0	7.0	7.800	0.422
1. Maryland	6.0	8.0	6.0	6.778	0.833
2. Maryland	8.0	10.0	7.0	8.100	0.718
1. Massachusetts	9.0	9.0	7.0	8.333	0.816
1. Michigan	8.0	8.0	7.0	7.600	0.548
2. Michigan	7.0	8.0	6.0	7.000	0.632
3. Michigan	7.0	8.0	6.0	6.882	0.600
4. Michigan	8.0	8.0	7.0	7.727	0.467
5. Michigan	7.0	8.0	7.0	7.500	0.707
6. Michigan	8.0	8.0	6.0	7.429	0.787
7. Michigan	8.0	8.0	6.0	7.333	1.155

8. Michigan	7.0	7.0	6.0	6.800	0.447
9. Michigan	7.0	9.0	6.0	7.333	1.033
10. Michigan	7.0	9.0	7.0	8.000	0.894
11. Michigan	7.0	7.0	6.0	6.800	0.422
12. Michigan	8.0	9.0	7.0	7.833	0.753
13. Michigan	6.0	7.0	6.0	6.300	0.483
14. Michigan	8.0	9.0	7.0	7.667	0.651
15. Michigan	6.0	7.0	6.0	6.500	0.577
16. Michigan	6.0	9.0	6.0	7.154	0.987
17. Michigan	8.0	9.0	7.0	8.000	0.756
18. Michigan	7.0	8.0	6.0	6.857	0.690
19. Michigan	7.0	8.0	6.0	7.000	0.756
20. Michigan	8.0	9.0	6.0	7.636	0.809
21. Michigan	7.0	8.0	7.0	7.500	0.707
22. Michigan	7.0	7.0	7.0	7.000	0.000
23. Michigan	7.0	8.0	6.0	7.100	0.568
24. Michigan	6.0	8.0	6.0	6.800	0.837
25. Michigan	6.0	8.0	6.0	7.000	1.000
26. Michigan	7.0	8.0	6.0	7.000	0.667
27. Michigan	8.0	8.0	7.0	7.571	0.535
28. Michigan	7.0	9.0	7.0	8.000	1.000
29. Michigan	7.0	9.0	6.0	7.421	0.838
30. Michigan	7.0	9.0	6.0	7.400	1.140
31. Michigan	7.0	9.0	6.0	7.176	0.883
32. Michigan	7.0	8.0	6.0	6.833	0.577
33. Michigan	6.0	8.0	6.0	6.476	0.602
34. Michigan	7.0	8.0	7.0	7.471	0.514
35. Michigan	7.0	8.0	6.0	7.133	0.516
36. Michigan	7.0	8.0	6.0	7.050	0.605
37. Michigan	7.0	8.0	6.0	7.105	0.658
1. Minnesota	6.0	7.0	5.0	6.200	0.632
2. Minnesota	6.0	7.0	6.0	6.400	0.548
3. Minnesota	7.0	9.0	6.0	6.909	0.831
4. Minnesota	7.0	9.0	6.0	7.231	0.832
5. Minnesota	8.0	8.0	6.0	7.429	0.646
6. Minnesota	7.0	8.0	7.0	7.417	0.515
7. Minnesota	7.0	9.0	6.0	7.364	0.809
8. Minnesota	7.0	8.0	6.0	7.000	0.739
9. Minnesota	7.0	8.0	6.0	7.000	0.603
10. Minnesota	6.0	7.0	6.0	6.250	0.500
11. Minnesota	8.0	8.0	6.0	7.500	0.707
12. Minnesota	7.0	8.0	5.0	6.545	0.820
13. Minnesota	7.0	8.0	7.0	7.083	0.289
14. Minnesota	7.0	8.0	7.0	7.417	0.515
15. Minnesota	7.0	7.0	7.0	7.000	0.000
16. Minnesota	6.0	6.0	6.0	6.000	----
17. Minnesota	7.0	7.0	7.0	7.000	----
18. Minnesota	8.0	8.0	8.0	8.000	----
19. Minnesota	6.0	8.0	6.0	7.000	1.000
20. Minnesota	7.0	7.0	7.0	7.000	0.000

21. Minnesota	6.0	7.0	6.0	6.400	0.547
22. Minnesota	7.0	7.0	7.0	7.000	0.000
23. Minnesota	7.0	8.0	6.0	7.384	0.650
24. Minnesota	6.0	7.0	5.0	6.166	0.752
25. Minnesota	6.0	8.0	6.0	6.545	0.687
26. Minnesota	7.0	8.0	6.0	6.882	0.485
27. Minnesota	7.0	8.0	5.0	6.562	0.727
1. Missouri	8.0	9.0	7.0	8.000	0.707
2. Missouri	8.0	8.0	8.0	8.000	0.000
3. Missouri	9.0	9.0	8.0	8.800	0.422
4. Missouri	8.0	9.0	8.0	8.500	0.707
5. Missouri	8.0	8.0	8.0	8.000	-----
6. Missouri	8.0	9.0	6.0	7.857	1.069
7. Missouri	9.0	9.0	9.0	9.000	-----
8. Missouri	8.0	10.0	7.0	8.333	1.033
9. Missouri	8.0	10.0	7.0	8.143	1.069
1. Nebraska	8.0	8.0	8.0	8.000	0.000
2. Nebraska	7.0	8.0	7.0	7.500	0.577
1. New Jersey	8.0	10.0	7.0	8.273	0.786
1. New Hampshire	8.0	9.0	7.0	8.167	0.753
2. New Hampshire	8.0	9.0	7.0	8.300	0.675
1. New York	7.0	9.0	7.0	7.636	0.674
2. New York	8.0	9.0	7.0	8.000	0.693
3. New York	8.0	8.0	5.0	7.000	1.054
4. New York	8.0	9.0	7.0	8.125	0.641
1. North Dakota	8.0	8.0	7.0	7.667	0.577
2. North Dakota	7.0	7.0	7.0	7.000	0.000
3. North Dakota	8.0	8.0	6.0	7.500	0.756
4. North Dakota	7.0	7.0	6.0	6.750	0.452
5. North Dakota	7.0	8.0	6.0	7.000	0.632
6. North Dakota	7.0	8.0	6.0	7.300	0.675
1. Ohio	7.0	8.0	6.0	6.900	0.738
2. Ohio	7.0	8.0	6.0	7.111	0.601
3. Ohio	7.0	7.0	6.0	6.636	0.505
4. Ohio	7.0	8.0	7.0	7.500	0.707
5. Ohio	7.0	8.0	7.0	7.333	0.577
6. Ohio	7.0	7.0	6.0	6.667	0.500
7. Ohio	7.0	8.0	7.0	7.250	0.500
8. Ohio	7.0	8.0	7.0	7.200	0.447
9. Ohio	7.0	9.0	6.0	7.200	1.095
10. Ohio	7.0	8.0	7.0	7.500	0.707
11. Ohio	7.0	8.0	7.0	7.333	0.500
12. Ohio	7.0	7.0	7.0	7.000	0.000
13. Ohio	7.0	9.0	7.0	7.625	0.744

14. Ohio	8.0	9.0	7.0	7.818	0.751
1. Pennsylvannia	7.0	8.0	6.0	7.100	0.568
2. Pennsylvannia	7.0	8.0	5.0	6.750	1.258
3. Pennsylvannia	7.0	7.0	7.0	7.000	0.000
4. Pennsylvannia	7.0	8.0	6.0	7.000	0.577
1. South Dakota	8.0	8.0	6.0	7.375	0.744
2. South Dakota	6.0	8.0	6.0	7.000	1.000
3. South Dakota	7.0	8.0	6.0	7.087	0.515
4. South Dakota	7.0	9.0	6.0	7.167	0.983
1. Tennessee	8.0	8.0	7.0	7.600	0.516
1. Vermont	9.0	10.0	8.0	8.667	0.617
1. Virginia	8.0	9.0	6.0	7.579	0.769
1. Wisconsin	8.0	8.0	7.0	7.727	0.467
2. Wisconsin	8.0	8.0	6.0	7.500	0.707
3. Wisconsin	8.0	8.0	7.0	7.600	0.516
4. Wisconsin	7.0	7.0	6.0	6.571	0.514
5. Wisconsin	7.0	8.0	6.0	7.167	0.753
6. Wisconsin	7.0	8.0	6.0	7.300	0.675
7. Wisconsin	8.0	8.0	7.0	7.571	0.535
8. Wisconsin	7.0	8.0	6.0	7.182	0.603
9. Wisconsin	7.0	7.0	7.0	7.000	0.000
10. Wisconsin	7.0	8.0	6.0	7.071	0.616
11. Wisconsin	7.0	8.0	7.0	7.333	0.577
12. Wisconsin	8.0	8.0	7.0	7.667	0.577
13. Wisconsin	7.0	8.0	7.0	7.200	0.447
14. Wisconsin	8.0	8.0	6.0	7.455	0.688
15. Wisconsin	8.0	8.0	7.0	7.643	0.497
16. Wisconsin	7.0	9.0	7.0	7.429	0.646
17. Wisconsin	7.0	8.0	6.0	6.800	0.676
18. Wisconsin	7.0	9.0	6.0	7.520	0.823
19. Wisconsin	7.0	9.0	6.0	7.542	0.721
20. Wisconsin	7.0	10.0	7.0	7.889	1.054
21. Wisconsin	7.0	9.0	7.0	7.600	0.894
22. Wisconsin	7.0	7.0	6.0	6.900	0.316
23. Wisconsin	6.0	7.0	5.0	6.231	0.599
24. Wisconsin	7.0	7.0	6.0	6.667	0.577
25. Wisconsin	7.0	8.0	6.0	6.929	0.604
26. Wisconsin	7.0	8.0	7.0	7.250	0.500
27. Wisconsin	7.0	9.0	6.0	7.636	0.924
28. Wisconsin	7.0	9.0	7.0	7.636	0.809
29. Wisconsin	7.0	9.0	6.0	7.111	0.900
30. Wisconsin	8.0	9.0	7.0	7.818	0.603
31. Wisconsin	7.0	9.0	6.0	7.435	0.728
32. Wisconsin	7.0	9.0	7.0	7.667	0.816
33. Wisconsin	6.0	8.0	6.0	6.750	0.957

34. Wisconsin	7.0	8.0	6.0	7.333	0.565
35. Wisconsin	7.0	9.0	7.0	7.444	0.726
36. Wisconsin	7.0	9.0	6.0	7.000	1.000
1. West Virginia	7.0	7.0	6.0	6.750	0.500
1. Wyoming	7.0	9.0	7.0	7.857	0.900
1. Quebec	8.0	8.0	6.0	7.385	0.768
2. Quebec	8.0	10.0	7.0	8.000	0.676
3. Quebec	7.0	8.0	6.0	7.412	0.618
4. Quebec	6.0	7.0	6.0	6.308	0.480
5. Quebec	7.0	10.0	7.0	8.000	1.118
1. Ontario	7.0	8.0	6.0	7.091	0.831
2. Ontario	6.0	6.0	6.0	6.000	0.000
3. Ontario	6.0	7.0	6.0	6.375	0.518
4. Ontario	7.0	9.0	5.0	7.083	0.996
5. Ontario	7.0	8.0	6.0	6.818	0.751
6. Ontario	6.0	7.0	5.0	6.100	0.568
7. Ontario	7.0	7.0	6.0	6.667	0.516
8. Ontario	7.0	8.0	5.0	6.615	0.870
9. Ontario	7.0	8.0	6.0	6.727	0.647
10. Ontario	7.0	8.0	7.0	7.250	0.500
11. Ontario	6.0	7.0	6.0	6.200	0.447
12. Ontario	5.0	6.0	5.0	5.500	0.707
13. Ontario	7.0	8.0	6.0	6.833	0.753
14. Ontario	7.0	7.0	7.0	7.000	-----
15. Ontario	7.0	8.0	7.0	7.400	0.516
16. Ontario	7.0	8.0	6.0	6.800	0.632
17. Ontario	7.0	7.0	6.0	6.700	0.483
18. Ontario	7.0	8.0	6.0	7.100	0.568
19. Ontario	8.0	10.0	7.0	8.214	0.975
20. Ontario	7.0	8.0	6.0	7.000	0.500
21. Ontario	7.0	8.0	7.0	7.200	0.447
22. Ontario	6.0	8.0	6.0	6.400	0.699
23. Ontario	7.0	8.0	7.0	7.286	0.488
24. Ontario	7.0	9.0	6.0	7.100	0.876
25. Ontario	7.0	8.0	6.0	6.800	0.632
26. Ontario	7.0	8.0	6.0	7.000	0.471
27. Ontario	7.0	8.0	7.0	7.357	0.497
28. Ontario	7.0	8.0	6.0	6.818	0.751
29. Ontario	8.0	8.0	6.0	7.100	0.876
30. Ontario	8.0	8.0	6.0	7.400	0.699
31. Ontario	7.0	7.0	7.0	7.000	-----
32. Ontario	7.0	7.0	6.0	6.571	0.535
33. Ontario	8.0	10.0	7.0	8.571	1.134
34. Ontario	9.0	9.0	7.0	8.400	0.843
35. Ontario	7.0	8.0	7.0	7.400	0.516
36. Ontario	6.0	8.0	5.0	6.375	0.806
37. Ontario	8.0	9.0	7.0	7.900	0.567
38. Ontario	7.0	8.0	6.0	7.083	0.668

39. Ontario	7.0	7.0	6.0	6.625	0.517
40. Ontario	7.0	8.0	6.0	7.100	0.567
41. Ontario	7.0	8.0	6.0	7.214	0.578
42. Ontario	7.0	9.0	6.0	7.250	1.035
43. Ontario	6.0	7.0	6.0	6.375	0.517
44. Ontario	7.0	9.0	6.0	6.800	0.918
45. Ontario	7.0	8.0	7.0	7.375	0.517
46. Ontario	7.0	7.0	7.0	7.000	0.000
47. Ontario	8.0	9.0	6.0	7.600	0.843
48. Ontario	8.0	8.0	6.0	7.416	0.668
1. Manitoba	7.0	7.0	6.0	6.800	0.447
2. Manitoba	7.0	9.0	7.0	7.500	0.707
3. Manitoba	6.0	7.0	6.0	6.333	0.577
4. Manitoba	7.0	8.0	6.0	6.917	0.669
5. Manitoba	6.0	7.0	5.0	6.000	0.667
6. Manitoba	6.0	6.0	6.0	6.000	0.000
7. Manitoba	6.0	7.0	6.0	6.500	0.707
8. Manitoba	7.0	8.0	7.0	7.500	0.527
9. Manitoba	6.0	7.0	6.0	6.400	0.548
10. Manitoba	6.0	8.0	6.0	7.000	1.000
11. Manitoba	7.0	9.0	6.0	7.091	0.831
12. Manitoba	7.0	7.0	6.0	6.833	0.389
13. Manitoba	6.0	7.0	6.0	6.273	0.467
14. Manitoba	6.0	7.0	5.0	6.333	0.651
15. Manitoba	7.0	8.0	6.0	6.667	0.651
16. Manitoba	7.0	8.0	6.0	7.000	0.555
17. Manitoba	7.0	8.0	6.0	6.900	0.568
1. Saskatchewan	6.0	7.0	6.0	6.333	0.577
2. Saskatchewan	7.0	7.0	7.0	7.000	0.000
3. Saskatchewan	7.0	7.0	6.0	6.750	0.500
4. Saskatchewan	6.0	9.0	6.0	7.500	1.291
5. Saskatchewan	7.0	8.0	6.0	7.100	0.568
6. Saskatchewan	8.0	8.0	8.0	8.000	0.000
7. Saskatchewan	8.0	8.0	8.0	8.000	----
8. Saskatchewan	7.0	7.0	7.0	7.000	----
9. Saskatchewan	6.0	6.0	6.0	6.000	----

Appendix 6L: Number of scales above the lateral line (LL1) for examined samples of *Etheostoma nigrum* and *E. olmstedii*. Location number and names correspond to those of Appendix 2.

<u>Location</u>	<u>MODE</u>	<u>UPPER</u>	<u>LOWER</u>	<u>MEAN</u>	<u>SD</u>
1. Colorado	3.0	4.0	2.0	2.939	0.704
1. Connecticut	5.0	5.0	4.0	4.714	0.488
1. Illinois	4.0	4.0	4.0	4.000	0.000
2. Illinois	4.0	5.0	3.0	4.000	0.707
3. Illinois	4.0	4.0	4.0	4.000	0.000
4. Illinois	4.0	4.0	4.0	4.000	0.000
5. Illinois	4.0	4.0	3.0	3.842	0.375
1. Indiana	4.0	5.0	3.0	4.000	0.357
2. Indiana	4.0	4.0	3.0	3.727	0.467
3. Indiana	4.0	4.0	4.0	4.000	0.000
4. Indiana	4.0	5.0	4.0	4.333	0.577
5. Indiana	4.0	5.0	4.0	4.500	0.707
6. Indiana	4.0	4.0	4.0	4.000	0.000
7. Indiana	4.0	5.0	4.0	4.100	0.316
8. Indiana	4.0	5.0	4.0	4.200	0.447
9. Indiana	4.0	5.0	4.0	4.500	0.707
1. Iowa	4.0	4.0	4.0	4.000	0.000
2. Iowa	4.0	4.0	4.0	4.000	0.000
3. Iowa	4.0	4.0	3.0	3.900	0.316
4. Iowa	4.0	4.0	3.0	3.800	0.447
5. Iowa	4.0	5.0	4.0	4.125	0.354
1. Kansas	4.0	5.0	4.0	4.167	0.408
2. Kansas	4.0	4.0	4.0	4.000	0.000
1. Kentucky	4.0	4.0	3.0	3.889	0.333
2. Kentucky	3.0	4.0	3.0	3.500	0.527
1. Maryland	4.0	5.0	3.0	4.111	0.601
2. Maryland	4.0	5.0	4.0	4.050	0.224
1. Massachusetts	5.0	5.0	4.0	4.833	0.408
1. Michigan	4.0	5.0	4.0	4.400	0.548
2. Michigan	4.0	4.0	3.0	3.727	0.467
3. Michigan	4.0	4.0	3.0	3.824	0.393
4. Michigan	4.0	4.0	3.0	3.818	0.405
5. Michigan	4.0	4.0	4.0	4.000	0.000
6. Michigan	4.0	4.0	3.0	3.857	0.378
7. Michigan	4.0	5.0	4.0	4.333	0.577

8. Michigan	4.0	4.0	3.0	3.800	0.447
9. Michigan	4.0	4.0	4.0	4.000	0.000
10. Michigan	4.0	5.0	4.0	4.500	0.548
11. Michigan	3.0	4.0	3.0	3.500	0.527
12. Michigan	3.0	3.0	3.0	3.000	0.000
13. Michigan	4.0	4.0	3.0	3.900	0.316
14. Michigan	4.0	4.0	3.0	3.833	0.389
15. Michigan	2.0	3.0	2.0	2.500	0.577
16. Michigan	4.0	4.0	3.0	3.846	0.376
17. Michigan	4.0	5.0	4.0	4.375	0.518
18. Michigan	4.0	4.0	3.0	3.857	0.378
19. Michigan	4.0	4.0	3.0	3.875	0.354
20. Michigan	4.0	4.0	3.0	3.909	0.302
21. Michigan	4.0	4.0	4.0	4.000	0.000
22. Michigan	4.0	4.0	4.0	4.000	0.000
23. Michigan	4.0	4.0	3.0	3.900	0.316
24. Michigan	4.0	4.0	4.0	4.000	0.000
25. Michigan	4.0	4.0	4.0	4.000	0.000
26. Michigan	4.0	4.0	4.0	4.000	0.000
27. Michigan	4.0	5.0	3.0	4.000	0.577
28. Michigan	3.0	4.0	3.0	3.333	0.577
29. Michigan	4.0	6.0	3.0	4.263	0.653
30. Michigan	4.0	5.0	3.0	4.000	0.707
31. Michigan	4.0	5.0	4.0	4.059	0.243
32. Michigan	3.0	4.0	2.0	3.000	0.603
33. Michigan	3.0	4.0	2.0	3.000	0.548
34. Michigan	3.0	4.0	3.0	3.353	0.493
35. Michigan	4.0	4.0	4.0	4.000	0.000
36. Michigan	3.0	3.0	2.0	2.700	0.470
37. Michigan	4.0	4.0	3.0	3.789	0.419

1. Minnesota	4.0	4.0	3.0	3.800	0.422
2. Minnesota	4.0	4.0	4.0	4.000	0.000
3. Minnesota	4.0	4.0	4.0	4.000	0.000
4. Minnesota	4.0	4.0	3.0	3.769	0.439
5. Minnesota	4.0	5.0	4.0	4.286	0.469
6. Minnesota	4.0	5.0	3.0	3.917	0.515
7. Minnesota	4.0	4.0	3.0	3.727	0.467
8. Minnesota	4.0	4.0	3.0	3.583	0.515
9. Minnesota	4.0	4.0	3.0	3.833	0.389
10. Minnesota	4.0	4.0	4.0	4.000	0.000
11. Minnesota	4.0	4.0	4.0	4.000	0.000
12. Minnesota	4.0	5.0	3.0	3.909	0.539
13. Minnesota	3.0	4.0	3.0	3.500	0.522
14. Minnesota	4.0	5.0	4.0	4.333	0.492
15. Minnesota	4.0	4.0	4.0	4.000	0.000
16. Minnesota	4.0	4.0	4.0	4.000	----
17. Minnesota	4.0	4.0	4.0	4.000	----
18. Minnesota	4.0	4.0	4.0	4.000	----
19. Minnesota	4.0	4.0	3.0	3.666	0.577
20. Minnesota	3.0	4.0	3.0	3.500	0.707

21. Minnesota	3.0	3.0	2.0	2.600	0.547
22. Minnesota	3.0	4.0	3.0	3.500	0.707
23. Minnesota	4.0	4.0	3.0	3.923	0.277
24. Minnesota	4.0	4.0	3.0	3.833	0.408
25. Minnesota	3.0	4.0	3.0	3.454	0.522
26. Minnesota	4.0	4.0	3.0	3.764	0.437
27. Minnesota	4.0	4.0	3.0	3.750	0.447
1. Missouri	4.0	4.0	4.0	4.000	0.000
2. Missouri	4.0	4.0	4.0	4.000	0.000
3. Missouri	4.0	5.0	4.0	4.400	0.516
4. Missouri	4.0	5.0	4.0	4.500	0.707
5. Missouri	4.0	4.0	4.0	4.000	----
6. Missouri	4.0	5.0	4.0	4.143	0.378
7. Missouri	5.0	5.0	5.0	5.000	----
8. Missouri	5.0	5.0	4.0	4.667	0.516
9. Missouri	4.0	5.0	4.0	4.286	0.488
1. Nebraska	4.0	4.0	4.0	4.000	0.000
2. Nebraska	3.0	4.0	3.0	3.250	0.500
1. New Jersey	4.0	5.0	4.0	4.364	0.505
1. New Hampshire	5.0	5.0	5.0	5.000	0.000
2. New Hampshire	4.0	5.0	4.0	4.200	0.422
1. New York	4.0	5.0	4.0	4.455	0.522
2. New York	4.0	5.0	4.0	4.462	0.508
3. New York	4.0	5.0	3.0	4.100	0.568
4. New York	4.0	5.0	4.0	4.500	0.535
1. North Dakota	3.0	4.0	3.0	3.333	0.577
2. North Dakota	4.0	4.0	2.0	3.250	0.957
3. North Dakota	4.0	4.0	4.0	4.000	0.000
4. North Dakota	3.0	4.0	3.0	3.417	0.515
5. North Dakota	4.0	5.0	4.0	4.091	0.302
6. North Dakota	4.0	4.0	3.0	3.800	0.422
1. Ohio	4.0	4.0	4.0	4.000	0.000
2. Ohio	4.0	5.0	3.0	4.000	0.500
3. Ohio	4.0	4.0	3.0	3.909	0.302
4. Ohio	4.0	4.0	4.0	4.000	0.000
5. Ohio	4.0	4.0	3.0	3.667	0.577
6. Ohio	4.0	4.0	3.0	3.778	0.441
7. Ohio	4.0	4.0	4.0	4.000	0.000
8. Ohio	4.0	5.0	4.0	4.400	0.548
9. Ohio	4.0	4.0	4.0	4.000	0.000
10. Ohio	4.0	4.0	4.0	4.000	0.000
11. Ohio	4.0	5.0	3.0	3.778	0.667
12. Ohio	4.0	4.0	4.0	4.000	0.000
13. Ohio	4.0	4.0	3.0	3.875	0.354

14. Ohio	4.0	5.0	3.0	3.909	0.539
1. Pennsylvania	4.0	4.0	3.0	3.900	0.316
2. Pennsylvania	3.0	4.0	3.0	3.500	0.577
3. Pennsylvania	4.0	4.0	4.0	4.000	0.000
4. Pennsylvania	4.0	4.0	3.0	3.923	0.277
1. South Dakota	4.0	5.0	4.0	4.250	0.463
2. South Dakota	4.0	4.0	4.0	4.000	0.000
3. South Dakota	4.0	5.0	3.0	4.174	0.491
4. South Dakota	4.0	4.0	4.0	4.000	0.000
1. Tennessee	3.0	4.0	3.0	3.500	0.527
1. Vermont	5.0	5.0	4.0	4.733	0.458
1. Virginia	4.0	5.0	3.0	4.053	0.405
1. Wisconsin	4.0	5.0	4.0	4.091	0.302
2. Wisconsin	5.0	5.0	4.0	4.600	0.516
3. Wisconsin	4.0	4.0	3.0	3.900	0.316
4. Wisconsin	4.0	4.0	3.0	3.714	0.469
5. Wisconsin	4.0	4.0	4.0	4.000	0.000
6. Wisconsin	5.0	5.0	4.0	4.600	0.516
7. Wisconsin	4.0	5.0	3.0	4.286	0.756
8. Wisconsin	4.0	4.0	4.0	4.000	0.000
9. Wisconsin	4.0	4.0	4.0	4.000	0.000
10. Wisconsin	4.0	6.0	4.0	4.286	0.611
11. Wisconsin	5.0	5.0	4.0	4.667	0.577
12. Wisconsin	4.0	4.0	4.0	4.000	0.000
13. Wisconsin	4.0	4.0	3.0	3.800	0.447
14. Wisconsin	4.0	4.0	3.0	3.909	0.302
15. Wisconsin	4.0	5.0	4.0	4.357	0.497
16. Wisconsin	4.0	5.0	4.0	4.071	0.267
17. Wisconsin	4.0	5.0	3.0	4.067	0.458
18. Wisconsin	4.0	5.0	4.0	4.240	0.436
19. Wisconsin	4.0	5.0	3.0	4.292	0.550
20. Wisconsin	5.0	5.0	4.0	4.556	0.527
21. Wisconsin	5.0	5.0	4.0	4.600	0.548
22. Wisconsin	4.0	4.0	3.0	3.900	0.316
23. Wisconsin	3.0	4.0	2.0	2.769	0.599
24. Wisconsin	4.0	4.0	3.0	3.667	0.577
25. Wisconsin	4.0	5.0	3.0	4.036	0.508
26. Wisconsin	4.0	4.0	3.0	3.750	0.500
27. Wisconsin	4.0	6.0	4.0	4.364	0.674
28. Wisconsin	5.0	5.0	4.0	4.727	0.467
29. Wisconsin	4.0	5.0	3.0	3.889	0.471
30. Wisconsin	5.0	5.0	4.0	4.727	0.467
31. Wisconsin	5.0	5.0	4.0	4.522	0.511
32. Wisconsin	5.0	5.0	4.0	4.667	0.516
33. Wisconsin	3.0	4.0	2.0	3.000	0.816

34. Wisconsin	4.0	5.0	3.0	3.833	0.482
35. Wisconsin	3.0	5.0	3.0	3.556	0.726
36. Wisconsin	5.0	5.0	4.0	4.571	0.535
1. West Virginia	3.0	3.0	3.0	3.000	0.000
1. Wyoming	4.0	4.0	3.0	3.571	0.535
1. Quebec	4.0	5.0	4.0	4.154	0.376
2. Quebec	4.0	6.0	4.0	4.278	0.513
3. Quebec	4.0	5.0	3.0	4.000	0.354
4. Quebec	3.0	4.0	3.0	3.462	0.519
5. Quebec	4.0	5.0	3.0	3.889	0.601
1. Ontario	4.0	5.0	3.0	3.909	0.539
2. Ontario	3.0	3.0	3.0	3.000	0.000
3. Ontario	4.0	4.0	4.0	4.000	0.000
4. Ontario	4.0	4.0	3.0	3.667	0.492
5. Ontario	4.0	5.0	3.0	4.000	0.447
6. Ontario	3.0	4.0	2.0	3.100	0.568
7. Ontario	4.0	5.0	4.0	4.167	0.408
8. Ontario	3.0	4.0	2.0	3.154	0.689
9. Ontario	4.0	4.0	3.0	3.636	0.505
10. Ontario	4.0	4.0	2.0	3.500	1.000
11. Ontario	3.0	3.0	3.0	3.000	0.000
12. Ontario	2.0	2.0	2.0	2.000	0.000
13. Ontario	4.0	4.0	4.0	4.000	0.000
14. Ontario	3.0	3.0	3.0	3.000	-----
15. Ontario	4.0	4.0	4.0	4.000	0.000
16. Ontario	2.0	3.0	2.0	2.200	0.422
17. Ontario	3.0	3.0	2.0	2.700	0.483
18. Ontario	4.0	4.0	3.0	3.900	0.316
19. Ontario	4.0	5.0	4.0	4.143	0.363
20. Ontario	3.0	4.0	3.0	3.222	0.441
21. Ontario	4.0	5.0	4.0	4.400	0.548
22. Ontario	3.0	4.0	2.0	3.000	0.471
23. Ontario	4.0	4.0	3.0	3.714	0.488
24. Ontario	4.0	5.0	3.0	3.900	0.568
25. Ontario	2.0	3.0	2.0	2.300	0.483
26. Ontario	3.0	4.0	3.0	3.500	0.527
27. Ontario	4.0	5.0	3.0	3.714	0.611
28. Ontario	4.0	4.0	2.0	3.454	0.687
29. Ontario	3.0	4.0	3.0	3.100	0.316
30. Ontario	4.0	4.0	4.0	4.000	0.000
31. Ontario	3.0	3.0	3.0	3.000	-----
32. Ontario	4.0	4.0	3.0	3.571	0.535
33. Ontario	4.0	5.0	4.0	4.286	0.488
34. Ontario	4.0	5.0	4.0	4.200	0.422
35. Ontario	4.0	5.0	3.0	3.800	0.632
36. Ontario	2.0	4.0	2.0	2.188	0.544
37. Ontario	4.0	4.0	2.0	3.400	0.699
38. Ontario	3.0	4.0	2.0	2.916	0.668

39. Ontario	3.0	4.0	3.0	3.375	0.517
40. Ontario	3.0	4.0	3.0	3.500	0.527
41. Ontario	5.0	6.0	4.0	4.785	0.578
42. Ontario	3.0	4.0	2.0	3.000	0.755
43. Ontario	3.0	3.0	2.0	2.875	0.353
44. Ontario	3.0	4.0	3.0	3.200	0.421
45. Ontario	4.0	4.0	3.0	3.875	0.353
46. Ontario	4.0	4.0	4.0	4.000	0.000
47. Ontario	4.0	5.0	3.0	4.000	0.471
48. Ontario	4.0	5.0	4.0	4.166	0.389
1. Manitoba	2.0	4.0	2.0	2.800	0.837
2. Manitoba	4.0	4.0	3.0	3.800	0.422
3. Manitoba	4.0	4.0	3.0	3.667	0.577
4. Manitoba	4.0	4.0	3.0	3.667	0.492
5. Manitoba	3.0	4.0	2.0	3.000	0.471
6. Manitoba	4.0	4.0	3.0	3.667	0.577
7. Manitoba	2.0	4.0	2.0	3.000	1.414
8. Manitoba	4.0	4.0	3.0	3.600	0.516
9. Manitoba	3.0	3.0	3.0	3.000	0.000
10. Manitoba	4.0	4.0	4.0	4.000	0.000
11. Manitoba	4.0	4.0	3.0	3.727	0.467
12. Manitoba	4.0	4.0	3.0	3.917	0.289
13. Manitoba	3.0	3.0	3.0	3.000	0.000
14. Manitoba	3.0	4.0	3.0	3.333	0.492
15. Manitoba	3.0	4.0	3.0	3.500	0.522
16. Manitoba	4.0	4.0	3.0	3.714	0.469
17. Manitoba	3.0	4.0	3.0	3.300	0.483
1. Saskatchewan	3.0	3.0	2.0	2.667	0.577
2. Saskatchewan	4.0	4.0	3.0	3.667	0.577
3. Saskatchewan	4.0	4.0	3.0	3.750	0.500
4. Saskatchewan	4.0	4.0	4.0	4.000	0.000
5. Saskatchewan	4.0	4.0	3.0	3.700	0.483
6. Saskatchewan	4.0	4.0	4.0	4.000	0.000
7. Saskatchewan	4.0	4.0	4.0	4.000	-----
8. Saskatchewan	4.0	4.0	4.0	4.000	-----
9. Saskatchewan	3.0	3.0	3.0	3.000	-----

Appendix 6M: Lateral line type (1 = complete, 2 = incomplete (3 or fewer unpored scales), 3 = very incomplete (4 or more unpored scales) and/or interrupted) for examined samples of *Etheostoma nigrum* and *E. olmstedii*. Location number and names correspond to those of Appendix 2.

<u>Location</u>	<u>MODE</u>	<u>UPPER</u>	<u>LOWER</u>	<u>MEAN</u>	<u>SD</u>
1. Colorado	1.0	1.0	1.0	1.000	0.000
1. Connecticut	1.0	1.0	1.0	1.000	0.000
1. Illinois	1.0	1.0	1.0	1.000	0.000
2. Illinois	1.0	1.0	1.0	1.000	0.000
3. Illinois	1.0	1.0	1.0	1.000	0.000
4. Illinois	1.0	1.0	1.0	1.000	0.000
5. Illinois	1.0	1.0	1.0	1.000	0.000
1. Indiana	1.0	1.0	1.0	1.000	0.000
2. Indiana	2.0	3.0	2.0	2.364	0.505
3. Indiana	1.0	3.0	1.0	1.500	0.837
4. Indiana	2.0	2.0	2.0	2.000	0.000
5. Indiana	2.0	2.0	2.0	2.000	0.000
6. Indiana	3.0	3.0	2.0	2.714	0.488
7. Indiana	3.0	3.0	2.0	2.600	0.516
8. Indiana	3.0	3.0	2.0	2.600	0.548
9. Indiana	2.0	3.0	2.0	2.500	0.707
1. Iowa	1.0	1.0	1.0	1.000	0.000
2. Iowa	1.0	2.0	1.0	1.182	0.405
3. Iowa	2.0	3.0	2.0	2.300	0.483
4. Iowa	2.0	3.0	1.0	2.000	0.707
5. Iowa	2.0	3.0	1.0	1.875	0.641
1. Kansas	2.0	3.0	2.0	2.167	0.408
2. Kansas	1.0	1.0	1.0	1.000	0.000
1. Kentucky	3.0	3.0	1.0	2.222	0.833
2. Kentucky	2.0	3.0	2.0	2.300	0.483
1. Maryland	1.0	1.0	1.0	1.000	0.000
2. Maryland	1.0	1.0	1.0	1.000	0.000
1. Massachusetts	1.0	1.0	1.0	1.000	0.000
1. Michigan	1.0	1.0	1.0	1.000	0.000
2. Michigan	2.0	2.0	2.0	2.000	0.000
3. Michigan	1.0	2.0	1.0	1.412	0.507
4. Michigan	1.0	2.0	1.0	1.455	0.522

5. Michigan	2.0	2.0	2.0	2.000	0.000
6. Michigan	2.0	2.0	1.0	1.857	0.378
7. Michigan	1.0	1.0	1.0	1.000	0.000
8. Michigan	2.0	2.0	2.0	2.000	0.000
9. Michigan	2.0	2.0	1.0	1.833	0.408
10. Michigan	1.0	1.0	1.0	1.000	0.000
11. Michigan	1.0	2.0	1.0	1.100	0.316
12. Michigan	3.0	3.0	3.0	3.000	0.000
13. Michigan	2.0	3.0	1.0	2.200	0.789
14. Michigan	3.0	3.0	2.0	2.917	0.289
15. Michigan	3.0	3.0	3.0	3.000	0.000
16. Michigan	3.0	3.0	3.0	3.000	0.000
17. Michigan	1.0	2.0	1.0	1.375	0.518
18. Michigan	2.0	2.0	1.0	1.857	0.378
19. Michigan	2.0	2.0	1.0	1.625	0.518
20. Michigan	2.0	2.0	2.0	2.000	0.000
21. Michigan	3.0	3.0	3.0	3.000	0.000
22. Michigan	1.0	1.0	1.0	1.000	0.000
23. Michigan	2.0	2.0	2.0	2.000	0.000
24. Michigan	2.0	2.0	2.0	2.000	0.000
25. Michigan	2.0	2.0	2.0	2.000	0.000
26. Michigan	3.0	3.0	3.0	3.000	0.000
27. Michigan	1.0	2.0	1.0	1.143	0.378
28. Michigan	2.0	2.0	2.0	2.000	0.000
29. Michigan	2.0	2.0	1.0	1.789	0.419
30. Michigan	1.0	1.0	1.0	1.000	0.000
31. Michigan	1.0	1.0	1.0	1.000	0.000
32. Michigan	2.0	2.0	2.0	2.000	0.000
33. Michigan	3.0	3.0	2.0	2.524	0.512
34. Michigan	2.0	2.0	2.0	2.000	0.000
35. Michigan	1.0	2.0	1.0	1.200	0.414
36. Michigan	1.0	3.0	1.0	1.300	0.733
37. Michigan	1.0	2.0	1.0	1.211	0.419
1. Minnesota	1.0	2.0	1.0	1.400	0.516
2. Minnesota	3.0	3.0	3.0	3.000	0.000
3. Minnesota	3.0	3.0	2.0	2.636	0.505
4. Minnesota	2.0	3.0	1.0	1.846	0.689
5. Minnesota	2.0	3.0	1.0	1.714	0.611
6. Minnesota	2.0	3.0	1.0	2.250	0.622
7. Minnesota	2.0	3.0	1.0	2.091	0.539
8. Minnesota	2.0	3.0	1.0	2.083	0.793
9. Minnesota	1.0	3.0	1.0	1.583	0.669
10. Minnesota	1.0	2.0	1.0	1.500	0.577
11. Minnesota	2.0	3.0	1.0	2.000	0.667
12. Minnesota	3.0	3.0	2.0	2.545	0.522
13. Minnesota	2.0	3.0	1.0	2.000	0.426
14. Minnesota	2.0	3.0	1.0	1.833	0.718
15. Minnesota	3.0	3.0	3.0	3.000	0.000
16. Minnesota	2.0	2.0	2.0	2.000	-----
17. Minnesota	3.0	3.0	3.0	3.000	-----

18. Minnesota	3.0	3.0	3.0	3.000	-----
19. Minnesota	3.0	3.0	3.0	3.000	0.000
20. Minnesota	2.0	3.0	2.0	2.500	0.707
21. Minnesota	3.0	3.0	3.0	3.000	0.000
22. Minnesota	2.0	3.0	2.0	2.500	0.707
23. Minnesota	2.0	3.0	2.0	2.923	0.277
24. Minnesota	1.0	3.0	1.0	1.833	0.752
25. Minnesota	2.0	3.0	2.0	2.545	0.522
26. Minnesota	2.0	3.0	2.0	2.647	0.492
27. Minnesota	2.0	2.0	1.0	1.750	0.447
1. Missouri	2.0	3.0	2.0	2.200	0.447
2. Missouri	1.0	2.0	1.0	1.333	0.577
3. Missouri	3.0	3.0	2.0	2.900	0.316
4. Missouri	2.0	2.0	2.0	2.000	0.000
5. Missouri	2.0	2.0	2.0	2.000	-----
6. Missouri	1.0	2.0	1.0	1.286	0.488
7. Missouri	3.0	3.0	3.0	3.000	-----
8. Missouri	1.0	1.0	1.0	1.000	0.000
9. Missouri	2.0	2.0	1.0	1.714	0.488
1. Nebraska	1.0	2.0	1.0	1.500	0.707
2. Nebraska	1.0	1.0	1.0	1.000	0.000
1. New Jersey	1.0	1.0	1.0	1.000	0.000
1. New Hampshire	1.0	1.0	1.0	1.000	0.000
2. New Hampshire	1.0	1.0	1.0	1.000	0.000
1. New York	1.0	2.0	1.0	1.273	0.467
2. New York	1.0	2.0	1.0	1.115	0.326
3. New York	2.0	3.0	1.0	2.000	0.471
4. New York	1.0	2.0	1.0	1.125	0.354
1. North Dakota	2.0	3.0	2.0	2.333	0.577
2. North Dakota	2.0	3.0	1.0	2.000	0.816
3. North Dakota	2.0	2.0	1.0	1.625	0.518
4. North Dakota	2.0	3.0	1.0	2.083	0.793
5. North Dakota	2.0	3.0	1.0	2.091	0.539
6. North Dakota	3.0	3.0	1.0	2.300	0.949
1. Ohio	2.0	3.0	1.0	2.100	0.738
2. Ohio	2.0	3.0	1.0	2.222	0.667
3. Ohio	1.0	2.0	1.0	1.364	0.505
4. Ohio	2.0	2.0	2.0	2.000	0.000
5. Ohio	2.0	2.0	2.0	2.000	0.000
6. Ohio	2.0	2.0	2.0	2.000	0.000
7. Ohio	2.0	2.0	2.0	2.000	0.000
8. Ohio	2.0	2.0	2.0	2.000	0.000
9. Ohio	2.0	2.0	1.0	1.600	0.548
10. Ohio	1.0	2.0	1.0	1.500	0.707

11. Ohio	2.0	2.0	1.0	1.667	0.500
12. Ohio	1.0	1.0	1.0	1.000	0.000
13. Ohio	3.0	3.0	3.0	3.000	0.000
14. Ohio	2.0	2.0	2.0	2.000	0.000
1. Pennsylvannia	2.0	3.0	2.0	2.300	0.483
2. Pennsylvannia	1.0	2.0	1.0	1.250	0.500
3. Pennsylvannia	1.0	1.0	1.0	1.000	0.000
4. Pennsylvannia	1.0	2.0	1.0	1.462	0.519
1. South Dakota	1.0	2.0	1.0	1.375	0.518
2. South Dakota	1.0	1.0	1.0	1.000	0.000
3. South Dakota	1.0	1.0	1.0	1.000	0.000
4. South Dakota	1.0	1.0	1.0	1.000	0.000
1. Tennessee	1.0	3.0	1.0	1.200	0.632
1. Vermont	1.0	1.0	1.0	1.000	0.000
1. Virginia	1.0	3.0	1.0	1.211	0.535
1. Wisconsin	1.0	2.0	1.0	1.182	0.405
2. Wisconsin	3.0	3.0	3.0	3.000	0.000
3. Wisconsin	2.0	2.0	2.0	2.000	0.000
4. Wisconsin	1.0	2.0	1.0	1.429	0.514
5. Wisconsin	1.0	1.0	1.0	1.000	0.000
6. Wisconsin	1.0	2.0	1.0	1.200	0.422
7. Wisconsin	3.0	3.0	1.0	2.143	0.900
8. Wisconsin	1.0	3.0	1.0	1.727	0.786
9. Wisconsin	2.0	3.0	2.0	2.500	0.577
10. Wisconsin	1.0	3.0	1.0	1.286	0.611
11. Wisconsin	3.0	3.0	3.0	3.000	0.000
12. Wisconsin	2.0	2.0	2.0	2.000	0.000
13. Wisconsin	2.0	2.0	2.0	2.000	0.000
14. Wisconsin	2.0	2.0	2.0	2.000	0.000
15. Wisconsin	2.0	2.0	1.0	1.857	0.363
16. Wisconsin	1.0	2.0	1.0	1.357	0.497
17. Wisconsin	1.0	1.0	1.0	1.000	0.000
18. Wisconsin	1.0	1.0	1.0	1.000	0.000
19. Wisconsin	1.0	1.0	1.0	1.000	0.000
20. Wisconsin	3.0	3.0	3.0	3.000	0.000
21. Wisconsin	1.0	1.0	1.0	1.000	0.000
22. Wisconsin	1.0	2.0	1.0	1.100	0.316
23. Wisconsin	2.0	2.0	1.0	1.538	0.519
24. Wisconsin	2.0	2.0	1.0	1.667	0.577
25. Wisconsin	1.0	1.0	1.0	1.000	0.000
26. Wisconsin	1.0	1.0	1.0	1.000	0.000
27. Wisconsin	1.0	1.0	1.0	1.000	0.000
28. Wisconsin	1.0	2.0	1.0	1.273	0.467
29. Wisconsin	1.0	2.0	1.0	1.389	0.502
30. Wisconsin	1.0	2.0	1.0	1.455	0.522

31. Wisconsin	2.0	2.0	1.0	1.522	0.511
32. Wisconsin	1.0	1.0	1.0	1.000	0.000
33. Wisconsin	1.0	1.0	1.0	1.000	0.000
34. Wisconsin	1.0	2.0	1.0	1.417	0.504
35. Wisconsin	2.0	2.0	1.0	1.778	0.441
36. Wisconsin	1.0	2.0	1.0	1.143	0.378
1. West Virginia	1.0	2.0	1.0	1.500	0.577
1. Wyoming	1.0	1.0	1.0	1.000	0.000
1. Quebec	1.0	3.0	1.0	1.231	0.599
2. Quebec	1.0	3.0	1.0	1.167	0.447
3. Quebec	1.0	1.0	1.0	1.000	0.000
4. Quebec	1.0	3.0	1.0	1.462	0.877
5. Quebec	1.0	1.0	1.0	1.000	0.000
1. Ontario	1.0	3.0	1.0	1.818	0.874
2. Ontario	1.0	1.0	1.0	1.000	0.000
3. Ontario	1.0	1.0	1.0	1.000	0.000
4. Ontario	1.0	3.0	1.0	1.750	0.754
5. Ontario	2.0	3.0	1.0	2.000	0.775
6. Ontario	3.0	3.0	3.0	3.000	0.000
7. Ontario	2.0	2.0	2.0	2.000	0.000
8. Ontario	3.0	3.0	1.0	2.231	0.927
9. Ontario	2.0	3.0	1.0	2.364	0.674
10. Ontario	3.0	3.0	3.0	3.000	0.000
11. Ontario	2.0	2.0	2.0	2.000	0.000
12. Ontario	2.0	2.0	2.0	2.000	0.000
13. Ontario	1.0	1.0	1.0	1.000	0.000
14. Ontario	2.0	2.0	2.0	2.000	----
15. Ontario	2.0	3.0	2.0	2.300	0.483
16. Ontario	3.0	3.0	3.0	3.000	0.000
17. Ontario	3.0	3.0	3.0	3.000	0.000
18. Ontario	2.0	3.0	1.0	2.100	0.568
19. Ontario	1.0	1.0	1.0	1.000	0.000
20. Ontario	1.0	1.0	1.0	1.000	0.000
21. Ontario	1.0	1.0	1.0	1.000	0.000
22. Ontario	2.0	2.0	2.0	2.000	0.000
23. Ontario	1.0	1.0	1.0	1.000	0.000
24. Ontario	2.0	3.0	2.0	2.100	0.316
25. Ontario	1.0	1.0	1.0	1.000	0.000
26. Ontario	2.0	2.0	2.0	2.000	0.000
27. Ontario	3.0	3.0	1.0	2.429	0.646
28. Ontario	1.0	3.0	1.0	1.364	0.809
29. Ontario	2.0	2.0	2.0	2.000	0.000
30. Ontario	1.0	1.0	1.0	1.000	0.000
31. Ontario	3.0	3.0	3.0	3.000	----
32. Ontario	2.0	3.0	2.0	2.286	0.488
33. Ontario	3.0	3.0	2.0	2.714	0.488
34. Ontario	1.0	1.0	1.0	1.000	0.000

35. Ontario	3.0	3.0	2.0	2.900	0.316
36. Ontario	3.0	3.0	2.0	2.625	0.500
37. Ontario	3.0	3.0	3.0	3.000	0.000
38. Ontario	3.0	3.0	3.0	3.000	0.000
39. Ontario	3.0	3.0	3.0	3.000	0.000
40. Ontario	3.0	3.0	1.0	2.300	0.823
41. Ontario	3.0	3.0	2.0	2.857	0.363
42. Ontario	3.0	3.0	2.0	2.750	0.462
43. Ontario	3.0	3.0	2.0	2.750	0.462
44. Ontario	3.0	3.0	3.0	3.000	0.000
45. Ontario	3.0	3.0	2.0	2.875	0.353
46. Ontario	3.0	3.0	2.0	2.800	0.447
47. Ontario	2.0	3.0	1.0	2.100	0.737
48. Ontario	2.0	3.0	1.0	2.083	0.514
1. Manitoba	3.0	3.0	2.0	2.800	0.447
2. Manitoba	2.0	3.0	1.0	1.800	0.632
3. Manitoba	2.0	2.0	1.0	1.667	0.577
4. Manitoba	2.0	3.0	1.0	1.917	0.515
5. Manitoba	3.0	3.0	2.0	2.800	0.422
6. Manitoba	1.0	1.0	1.0	1.000	0.000
7. Manitoba	2.0	2.0	2.0	2.000	0.000
8. Manitoba	2.0	3.0	2.0	2.400	0.516
9. Manitoba	2.0	2.0	2.0	2.000	0.000
10. Manitoba	1.0	1.0	1.0	1.000	0.000
11. Manitoba	1.0	1.0	1.0	1.000	0.000
12. Manitoba	2.0	3.0	1.0	1.917	0.793
13. Manitoba	2.0	3.0	2.0	2.364	0.505
14. Manitoba	2.0	2.0	1.0	1.833	0.389
15. Manitoba	2.0	2.0	1.0	1.833	0.389
16. Manitoba	3.0	3.0	3.0	3.000	0.000
17. Manitoba	3.0	3.0	1.0	2.500	0.707
1. Saskatchewan	2.0	2.0	2.0	2.000	0.000
2. Saskatchewan	2.0	2.0	2.0	2.000	0.000
3. Saskatchewan	2.0	2.0	2.0	2.000	0.000
4. Saskatchewan	2.0	2.0	2.0	2.000	0.000
5. Saskatchewan	2.0	2.0	2.0	2.000	0.000
6. Saskatchewan	1.0	1.0	1.0	1.000	0.000
7. Saskatchewan	2.0	2.0	2.0	2.000	----
8. Saskatchewan	1.0	1.0	1.0	1.000	----
9. Saskatchewan	2.0	2.0	2.0	2.000	----

Appendix 6N: Number of left anterior infraorbital pores for examined samples of *Etheostoma nigrum* and *E. olmstedii*. Location number and names correspond to those of Appendix 2.

LOCATION:	MODE	UPPER	LOWER	MEAN	SD
1. Colorado	4.0	5.0	3.0	4.061	0.496
1. Connecticut	0.0	0.0	0.0	0.000	0.000
1. Illinois	4.0	4.0	4.0	4.000	0.000
2. Illinois	4.0	4.0	4.0	4.000	0.000
3. Illinois	4.0	4.0	4.0	4.000	0.000
4. Illinois	4.0	4.0	4.0	4.000	0.000
5. Illinois	4.0	4.0	4.0	4.000	0.000
1. Indiana	4.0	5.0	0.0	3.958	0.617
2. Indiana	4.0	5.0	4.0	4.182	0.405
3. Indiana	4.0	4.0	4.0	4.000	0.000
4. Indiana	4.0	4.0	4.0	4.000	0.000
5. Indiana	4.0	4.0	4.0	4.000	0.000
6. Indiana	4.0	4.0	4.0	4.000	0.000
7. Indiana	4.0	4.0	4.0	4.000	0.000
8. Indiana	4.0	4.0	4.0	4.000	0.000
9. Indiana	4.0	4.0	4.0	4.000	0.000
1. Iowa	4.0	4.0	4.0	4.000	0.000
2. Iowa	4.0	4.0	4.0	4.000	0.000
3. Iowa	4.0	5.0	4.0	4.100	0.316
4. Iowa	4.0	4.0	4.0	4.000	0.000
5. Iowa	4.0	5.0	3.0	3.875	0.641
1. Kansas	4.0	4.0	4.0	4.000	0.000
2. Kansas	4.0	4.0	4.0	4.000	0.000
1. Kentucky	4.0	4.0	3.0	3.778	0.441
2. Kentucky	4.0	4.0	4.0	4.000	0.000
1. Maryland	0.0	0.0	0.0	0.000	0.000
2. Maryland	0.0	4.0	0.0	0.200	0.894
1. Massachusetts	0.0	0.0	0.0	0.000	0.000
1. Michigan	4.0	4.0	4.0	4.000	0.000
2. Michigan	4.0	5.0	4.0	4.091	0.302
3. Michigan	4.0	5.0	4.0	4.059	0.243
4. Michigan	4.0	5.0	4.0	4.182	0.405
5. Michigan	4.0	5.0	4.0	4.500	0.707
6. Michigan	4.0	4.0	4.0	4.000	0.000
7. Michigan	4.0	4.0	4.0	4.000	0.000

8. Michigan	4.0	4.0	4.0	4.000	0.000
9. Michigan	4.0	4.0	4.0	4.000	0.000
10. Michigan	4.0	5.0	4.0	4.167	0.408
11. Michigan	4.0	4.0	3.0	3.900	0.316
12. Michigan	4.0	5.0	4.0	4.167	0.408
13. Michigan	4.0	5.0	3.0	4.000	0.471
14. Michigan	4.0	4.0	4.0	4.000	0.000
15. Michigan	4.0	4.0	4.0	4.000	0.000
16. Michigan	4.0	5.0	4.0	4.154	0.376
17. Michigan	4.0	4.0	4.0	4.000	0.000
18. Michigan	4.0	4.0	4.0	4.000	0.000
19. Michigan	4.0	5.0	4.0	4.125	0.354
20. Michigan	4.0	5.0	4.0	4.273	0.467
21. Michigan	4.0	4.0	4.0	4.000	0.000
22. Michigan	4.0	4.0	4.0	4.000	0.000
23. Michigan	4.0	5.0	4.0	4.200	0.422
24. Michigan	4.0	5.0	4.0	4.200	0.447
25. Michigan	4.0	4.0	4.0	4.000	0.000
26. Michigan	4.0	4.0	4.0	4.000	0.000
27. Michigan	4.0	4.0	4.0	4.000	0.000
28. Michigan	4.0	4.0	4.0	4.000	0.000
29. Michigan	4.0	5.0	4.0	4.053	0.229
30. Michigan	4.0	5.0	0.0	3.400	1.949
31. Michigan	4.0	5.0	4.0	4.118	0.332
32. Michigan	4.0	5.0	4.0	4.083	0.289
33. Michigan	4.0	4.0	4.0	4.000	0.000
34. Michigan	4.0	5.0	0.0	3.882	1.054
35. Michigan	4.0	4.0	4.0	4.000	0.000
36. Michigan	4.0	4.0	4.0	4.000	0.000
37. Michigan	4.0	4.0	3.0	3.895	0.315
1. Minnesota	4.0	5.0	4.0	4.100	0.316
2. Minnesota	4.0	4.0	4.0	4.000	0.000
3. Minnesota	4.0	4.0	4.0	4.000	0.000
4. Minnesota	4.0	5.0	4.0	4.154	0.376
5. Minnesota	4.0	4.0	4.0	4.000	0.000
6. Minnesota	4.0	4.0	4.0	4.000	0.000
7. Minnesota	4.0	4.0	3.0	3.909	0.302
8. Minnesota	4.0	4.0	4.0	4.000	0.000
9. Minnesota	4.0	4.0	4.0	4.000	0.000
10. Minnesota	4.0	5.0	4.0	4.250	0.500
11. Minnesota	4.0	4.0	4.0	4.000	0.000
12. Minnesota	4.0	4.0	4.0	4.000	0.000
13. Minnesota	4.0	4.0	4.0	4.000	0.000
14. Minnesota	4.0	4.0	4.0	4.000	0.000
15. Minnesota	4.0	4.0	4.0	4.000	0.000
16. Minnesota	4.0	4.0	4.0	4.000	----
17. Minnesota	4.0	4.0	4.0	4.000	----
18. Minnesota	4.0	4.0	4.0	4.000	----
19. Minnesota	4.0	4.0	4.0	4.000	0.000
20. Minnesota	4.0	4.0	4.0	4.000	0.000

21. Minnesota	4.0	4.0	4.0	4.000	0.000
22. Minnesota	4.0	4.0	4.0	4.000	0.000
23. Minnesota	4.0	5.0	4.0	4.076	0.277
24. Minnesota	4.0	4.0	4.0	4.000	0.000
25. Minnesota	4.0	4.0	3.0	3.909	0.301
26. Minnesota	4.0	5.0	4.0	4.058	0.242
27. Minnesota	4.0	4.0	4.0	4.000	0.000
1. Missouri	4.0	4.0	4.0	4.000	0.000
2. Missouri	4.0	4.0	4.0	4.000	0.000
3. Missouri	4.0	4.0	3.0	3.900	0.316
4. Missouri	4.0	4.0	4.0	4.000	0.000
5. Missouri	4.0	4.0	4.0	4.000	-----
6. Missouri	4.0	4.0	4.0	4.000	0.000
7. Missouri	4.0	4.0	4.0	4.000	-----
8. Missouri	4.0	5.0	4.0	4.167	0.408
9. Missouri	4.0	4.0	4.0	4.000	0.000
1. Nebraska	4.0	4.0	4.0	4.000	0.000
2. Nebraska	4.0	4.0	4.0	4.000	0.000
1. New Jersey	0.0	0.0	0.0	0.000	0.000
1. New Hampshire	0.0	0.0	0.0	0.000	0.000
2. New Hampshire	0.0	4.0	0.0	0.800	1.687
1. New York	4.0	5.0	3.0	4.091	0.539
2. New York	0.0	5.0	0.0	1.962	2.181
3. New York	4.0	5.0	4.0	4.100	0.316
4. New York	0.0	5.0	0.0	1.125	2.100
1. North Dakota	4.0	4.0	4.0	4.000	0.000
2. North Dakota	4.0	4.0	4.0	4.000	0.000
3. North Dakota	4.0	4.0	3.0	3.875	0.354
4. North Dakota	4.0	4.0	4.0	4.000	0.000
5. North Dakota	4.0	5.0	4.0	4.091	0.302
6. North Dakota	4.0	5.0	4.0	4.100	0.316
1. Ohio	4.0	4.0	4.0	4.000	0.000
2. Ohio	4.0	5.0	4.0	4.111	0.333
3. Ohio	4.0	5.0	4.0	4.182	0.405
4. Ohio	4.0	4.0	4.0	4.000	0.000
5. Ohio	4.0	4.0	4.0	4.000	0.000
6. Ohio	4.0	5.0	4.0	4.111	0.333
7. Ohio	4.0	4.0	4.0	4.000	0.000
8. Ohio	4.0	5.0	4.0	4.200	0.447
9. Ohio	4.0	4.0	4.0	4.000	0.000
10. Ohio	4.0	4.0	4.0	4.000	0.000
11. Ohio	4.0	4.0	4.0	4.000	0.000
12. Ohio	4.0	4.0	4.0	4.000	0.000
13. Ohio	4.0	5.0	4.0	4.125	0.354

14. Ohio	4.0	5.0	4.0	4.091	0.302
1. Pennsylvannia	4.0	4.0	4.0	4.000	0.000
2. Pennsylvannia	4.0	4.0	4.0	4.000	0.000
3. Pennsylvannia	4.0	5.0	4.0	4.250	0.500
4. Pennsylvannia	4.0	4.0	4.0	4.000	0.000
1. South Dakota	4.0	4.0	4.0	4.000	0.000
2. South Dakota	4.0	4.0	4.0	4.000	0.000
3. South Dakota	4.0	4.0	4.0	4.000	0.000
4. South Dakota	4.0	4.0	4.0	4.000	0.000
1. Tennessee	4.0	5.0	4.0	4.100	0.316
1. Vermont	0.0	5.0	0.0	0.600	1.595
1. Virginia	4.0	4.0	4.0	4.000	0.000
1. Wisconsin	4.0	4.0	4.0	4.000	0.000
2. Wisconsin	4.0	4.0	4.0	4.000	0.000
3. Wisconsin	4.0	5.0	4.0	4.100	0.316
4. Wisconsin	4.0	4.0	4.0	4.000	0.000
5. Wisconsin	4.0	4.0	4.0	4.000	0.000
6. Wisconsin	4.0	5.0	4.0	4.100	0.316
7. Wisconsin	4.0	5.0	4.0	4.143	0.378
8. Wisconsin	4.0	4.0	4.0	4.000	0.000
9. Wisconsin	4.0	4.0	4.0	4.000	0.000
10. Wisconsin	4.0	5.0	4.0	4.071	0.267
11. Wisconsin	4.0	4.0	4.0	4.000	0.000
12. Wisconsin	4.0	4.0	4.0	4.000	0.000
13. Wisconsin	4.0	4.0	3.0	3.800	0.447
14. Wisconsin	4.0	4.0	4.0	4.000	0.000
15. Wisconsin	4.0	4.0	4.0	4.000	0.000
16. Wisconsin	4.0	4.0	4.0	4.000	0.000
17. Wisconsin	4.0	4.0	3.0	3.933	0.258
18. Wisconsin	4.0	5.0	4.0	4.040	0.200
19. Wisconsin	4.0	5.0	4.0	4.083	0.282
20. Wisconsin	4.0	4.0	4.0	4.000	0.000
21. Wisconsin	4.0	4.0	4.0	4.000	0.000
22. Wisconsin	4.0	4.0	4.0	4.000	0.000
23. Wisconsin	4.0	4.0	4.0	4.000	0.000
24. Wisconsin	4.0	4.0	4.0	4.000	0.000
25. Wisconsin	4.0	4.0	4.0	4.000	0.000
26. Wisconsin	4.0	4.0	4.0	4.000	0.000
27. Wisconsin	4.0	5.0	4.0	4.091	0.302
28. Wisconsin	4.0	4.0	4.0	4.000	0.000
29. Wisconsin	4.0	4.0	4.0	4.000	0.000
30. Wisconsin	4.0	4.0	4.0	4.000	0.000
31. Wisconsin	4.0	5.0	3.0	4.130	0.458
32. Wisconsin	4.0	4.0	0.0	2.667	2.066
33. Wisconsin	4.0	4.0	4.0	4.000	0.000

34. Wisconsin	4.0	4.0	4.0	4.000	0.000
35. Wisconsin	4.0	4.0	4.0	4.000	0.000
36. Wisconsin	4.0	4.0	0.0	3.429	1.512
1. West Virginia	4.0	4.0	4.0	4.000	0.000
1. Wyoming	4.0	5.0	4.0	4.143	0.378
1. Quebec	4.0	5.0	0.0	3.538	1.613
2. Quebec	0.0	6.0	0.0	2.028	2.336
3. Quebec	0.0	4.0	0.0	0.647	1.455
4. Quebec	4.0	4.0	4.0	4.000	0.000
5. Quebec	4.0	5.0	4.0	4.111	0.333
1. Ontario	4.0	5.0	4.0	4.091	0.302
2. Ontario	4.0	4.0	4.0	4.000	0.000
3. Ontario	0.0	5.0	0.0	2.500	2.138
4. Ontario	4.0	5.0	4.0	4.083	0.289
5. Ontario	4.0	5.0	4.0	4.091	0.302
6. Ontario	4.0	4.0	4.0	4.000	0.000
7. Ontario	0.0	5.0	0.0	1.500	2.345
8. Ontario	4.0	5.0	3.0	4.000	0.408
9. Ontario	4.0	4.0	3.0	3.909	0.302
10. Ontario	4.0	4.0	4.0	4.000	0.000
11. Ontario	4.0	5.0	4.0	4.200	0.447
12. Ontario	3.0	4.0	3.0	3.500	0.707
13. Ontario	4.0	4.0	4.0	4.000	0.000
14. Ontario	4.0	4.0	4.0	4.000	-----
15. Ontario	4.0	4.0	3.0	3.800	0.422
16. Ontario	4.0	4.0	4.0	4.000	0.000
17. Ontario	4.0	4.0	4.0	4.000	0.000
18. Ontario	4.0	5.0	4.0	4.100	0.316
19. Ontario	0.0	5.0	0.0	1.786	2.155
20. Ontario	4.0	4.0	4.0	4.000	0.000
21. Ontario	4.0	5.0	4.0	4.200	0.447
22. Ontario	4.0	4.0	3.0	3.900	0.316
23. Ontario	4.0	4.0	4.0	4.000	0.000
24. Ontario	4.0	4.0	4.0	4.000	0.000
25. Ontario	4.0	4.0	4.0	4.000	0.000
26. Ontario	4.0	4.0	4.0	4.000	0.000
27. Ontario	4.0	4.0	4.0	4.000	0.000
28. Ontario	4.0	5.0	4.0	4.091	0.302
29. Ontario	4.0	4.0	4.0	4.000	0.000
30. Ontario	4.0	5.0	3.0	4.000	0.471
31. Ontario	4.0	4.0	4.0	4.000	-----
32. Ontario	4.0	5.0	4.0	4.143	0.378
33. Ontario	4.0	4.0	3.0	3.714	0.488
34. Ontario	4.0	5.0	4.0	4.200	0.422
35. Ontario	4.0	4.0	4.0	4.000	0.000
36. Ontario	4.0	4.0	3.0	3.875	0.342
37. Ontario	4.0	5.0	4.0	4.200	0.421

38. Ontario	4.0	4.0	3.0	3.750	0.452
39. Ontario	4.0	5.0	4.0	4.125	0.354
40. Ontario	4.0	4.0	4.0	4.000	0.000
41. Ontario	4.0	4.0	4.0	4.000	0.000
42. Ontario	4.0	4.0	3.0	3.875	0.353
43. Ontario	4.0	4.0	4.0	4.000	0.000
44. Ontario	4.0	4.0	4.0	4.000	0.000
45. Ontario	4.0	4.0	3.0	3.875	0.353
46. Ontario	4.0	4.0	4.0	4.000	0.000
47. Ontario	4.0	4.0	4.0	4.000	0.000
48. Ontario	4.0	5.0	4.0	4.166	0.389
1. Manitoba	4.0	5.0	4.0	4.200	0.447
2. Manitoba	4.0	5.0	4.0	4.100	0.316
3. Manitoba	4.0	4.0	4.0	4.000	0.000
4. Manitoba	4.0	4.0	3.0	3.883	0.389
5. Manitoba	4.0	4.0	4.0	4.000	0.000
6. Manitoba	4.0	4.0	4.0	4.000	0.000
7. Manitoba	4.0	4.0	4.0	4.000	0.000
8. Manitoba	4.0	5.0	4.0	4.100	0.316
9. Manitoba	4.0	5.0	4.0	4.200	0.447
10. Manitoba	4.0	4.0	4.0	4.000	0.000
11. Manitoba	4.0	4.0	3.0	3.909	0.302
12. Manitoba	4.0	4.0	4.0	4.000	0.000
13. Manitoba	4.0	5.0	4.0	4.182	0.405
14. Manitoba	4.0	5.0	4.0	4.083	0.289
15. Manitoba	4.0	4.0	3.0	3.917	0.289
16. Manitoba	4.0	4.0	4.0	4.000	0.000
17. Manitoba	4.0	4.0	4.0	4.000	0.000
1. Saskatchewan	4.0	4.0	4.0	4.000	0.000
2. Saskatchewan	4.0	4.0	4.0	4.000	0.000
3. Saskatchewan	4.0	4.0	4.0	4.000	0.000
4. Saskatchewan	4.0	4.0	4.0	4.000	0.000
5. Saskatchewan	4.0	4.0	4.0	4.000	0.000
6. Saskatchewan	4.0	4.0	4.0	4.000	0.000
7. Saskatchewan	4.0	4.0	4.0	4.000	-----
8. Saskatchewan	4.0	4.0	4.0	4.000	-----
9. Saskatchewan	4.0	4.0	4.0	4.000	-----

Appendix 6O: Number of left posterior infraorbital pores for examined samples of *Etheostoma nigrum* and *E. olmstedii*. Location number and names correspond to those of Appendix 2.

LOCATION:	MODE	UPPER	LOWER	MEAN	SD
1. Colorado	3.0	3.0	2.0	2.606	0.496
1. Connecticut	8.0	9.0	8.0	8.143	0.378
1. Illinois	2.0	3.0	2.0	2.333	0.577
2. Illinois	2.0	3.0	2.0	2.200	0.447
3. Illinois	3.0	3.0	3.0	3.000	0.000
4. Illinois	2.0	3.0	2.0	2.500	0.707
5. Illinois	2.0	3.0	2.0	2.211	0.419
1. Indiana	3.0	9.0	2.0	2.771	1.077
2. Indiana	2.0	3.0	2.0	2.182	0.405
3. Indiana	3.0	4.0	2.0	3.167	0.753
4. Indiana	2.0	3.0	2.0	2.333	0.577
5. Indiana	2.0	2.0	2.0	2.000	0.000
6. Indiana	2.0	3.0	2.0	2.286	0.488
7. Indiana	2.0	3.0	2.0	2.100	0.316
8. Indiana	2.0	3.0	2.0	2.400	0.548
9. Indiana	2.0	2.0	2.0	2.000	0.000
1. Iowa	3.0	3.0	2.0	2.800	0.447
2. Iowa	3.0	3.0	2.0	2.727	0.467
3. Iowa	2.0	2.0	2.0	2.000	0.000
4. Iowa	2.0	3.0	2.0	2.200	0.447
5. Iowa	3.0	4.0	1.0	2.625	0.916
1. Kansas	2.0	3.0	2.0	2.167	0.408
2. Kansas	2.0	2.0	2.0	2.000	0.000
1. Kentucky	2.0	2.0	0.0	1.778	0.667
2. Kentucky	2.0	2.0	1.0	1.900	0.316
1. Maryland	8.0	9.0	8.0	8.222	0.441
2. Maryland	8.0	9.0	5.0	7.950	0.826
1. Massachusetts	8.0	8.0	8.0	8.000	0.000
1. Michigan	2.0	3.0	2.0	2.200	0.447
2. Michigan	2.0	2.0	2.0	2.000	0.000
3. Michigan	2.0	3.0	2.0	2.294	0.470
4. Michigan	2.0	3.0	2.0	2.455	0.522
5. Michigan	3.0	4.0	3.0	3.500	0.707
6. Michigan	2.0	3.0	2.0	2.429	0.535
7. Michigan	4.0	4.0	2.0	3.333	1.155

8. Michigan	2.0	2.0	2.0	2.000	0.000
9. Michigan	3.0	4.0	3.0	3.333	0.516
10. Michigan	3.0	4.0	3.0	3.167	0.408
11. Michigan	2.0	2.0	2.0	2.000	0.000
12. Michigan	2.0	2.0	2.0	2.000	0.000
13. Michigan	2.0	3.0	2.0	2.300	0.483
14. Michigan	2.0	3.0	2.0	2.083	0.289
15. Michigan	2.0	2.0	2.0	2.000	0.000
16. Michigan	3.0	4.0	2.0	3.231	0.725
17. Michigan	3.0	4.0	2.0	2.750	0.707
18. Michigan	3.0	3.0	2.0	2.571	0.535
19. Michigan	2.0	3.0	2.0	2.500	0.535
20. Michigan	3.0	3.0	2.0	2.636	0.505
21. Michigan	2.0	3.0	2.0	2.500	0.707
22. Michigan	2.0	3.0	2.0	2.500	0.577
23. Michigan	2.0	3.0	2.0	2.100	0.316
24. Michigan	3.0	4.0	2.0	3.000	0.707
25. Michigan	2.0	2.0	2.0	2.000	0.000
26. Michigan	2.0	3.0	2.0	2.100	0.316
27. Michigan	2.0	3.0	2.0	2.286	0.488
28. Michigan	2.0	2.0	2.0	2.000	0.000
29. Michigan	3.0	3.0	2.0	2.684	0.478
30. Michigan	3.0	8.0	3.0	4.600	2.074
31. Michigan	3.0	4.0	2.0	2.882	0.697
32. Michigan	2.0	2.0	1.0	1.917	0.289
33. Michigan	2.0	3.0	2.0	2.048	0.218
34. Michigan	2.0	9.0	2.0	2.706	1.687
35. Michigan	2.0	4.0	2.0	2.600	0.632
36. Michigan	2.0	3.0	2.0	2.050	0.224
37. Michigan	2.0	3.0	2.0	2.158	0.375
1. Minnesota	2.0	3.0	2.0	2.100	0.316
2. Minnesota	2.0	4.0	2.0	2.600	0.894
3. Minnesota	3.0	3.0	2.0	2.636	0.505
4. Minnesota	2.0	4.0	2.0	2.615	0.650
5. Minnesota	3.0	4.0	2.0	2.643	0.633
6. Minnesota	2.0	3.0	2.0	2.500	0.522
7. Minnesota	3.0	3.0	2.0	2.545	0.522
8. Minnesota	2.0	3.0	2.0	2.083	0.289
9. Minnesota	3.0	3.0	2.0	2.667	0.492
10. Minnesota	2.0	3.0	2.0	2.500	0.577
11. Minnesota	2.0	3.0	2.0	2.400	0.516
12. Minnesota	3.0	3.0	2.0	2.636	0.505
13. Minnesota	2.0	3.0	2.0	2.417	0.515
14. Minnesota	3.0	3.0	2.0	2.583	0.515
15. Minnesota	2.0	2.0	2.0	2.000	0.000
16. Minnesota	2.0	2.0	2.0	2.000	----
17. Minnesota	2.0	2.0	2.0	2.000	----
18. Minnesota	3.0	3.0	3.0	3.000	----
19. Minnesota	2.0	2.0	2.0	2.000	0.000
20. Minnesota	2.0	2.0	2.0	2.000	0.000

21. Minnesota	3.0	4.0	2.0	3.000	0.707
22. Minnesota	2.0	2.0	2.0	2.000	0.000
23. Minnesota	2.0	3.0	1.0	2.076	0.759
24. Minnesota	3.0	3.0	2.0	2.666	0.516
25. Minnesota	3.0	2.0	1.0	2.727	0.646
26. Minnesota	3.0	4.0	2.0	2.764	0.664
27. Minnesota	2.0	3.0	2.0	2.500	0.516
1. Missouri	2.0	2.0	2.0	2.000	0.000
2. Missouri	2.0	2.0	2.0	2.000	0.000
3. Missouri	2.0	2.0	2.0	2.000	0.000
4. Missouri	2.0	2.0	2.0	2.000	0.000
5. Missouri	2.0	2.0	2.0	2.000	-----
6. Missouri	3.0	3.0	2.0	2.571	0.535
7. Missouri	2.0	2.0	2.0	2.000	-----
8. Missouri	2.0	3.0	2.0	2.167	0.408
9. Missouri	2.0	3.0	2.0	2.429	0.535
1. Nebraska	2.0	3.0	2.0	2.500	0.707
2. Nebraska	2.0	3.0	2.0	2.250	0.500
1. New Jersey	8.0	9.0	8.0	8.091	0.302
1. New Hampshire	7.0	8.0	7.0	7.333	0.516
2. New Hampshire	8.0	9.0	4.0	7.300	1.767
1. New York	2.0	3.0	2.0	2.455	0.522
2. New York	8.0	9.0	2.0	5.731	2.677
3. New York	3.0	3.0	2.0	2.600	0.516
4. New York	8.0	9.0	2.0	6.750	2.659
1. North Dakota	2.0	2.0	2.0	2.000	0.000
2. North Dakota	2.0	3.0	2.0	2.500	0.577
3. North Dakota	2.0	3.0	2.0	2.375	0.518
4. North Dakota	2.0	3.0	2.0	2.417	0.515
5. North Dakota	3.0	3.0	2.0	2.545	0.522
6. North Dakota	2.0	2.0	2.0	2.000	0.000
1. Ohio	2.0	3.0	2.0	2.200	0.422
2. Ohio	2.0	3.0	1.0	1.889	0.601
3. Ohio	2.0	3.0	2.0	2.455	0.522
4. Ohio	2.0	2.0	2.0	2.000	0.000
5. Ohio	2.0	2.0	1.0	1.667	0.577
6. Ohio	2.0	3.0	2.0	2.111	0.333
7. Ohio	2.0	2.0	1.0	1.750	0.500
8. Ohio	2.0	2.0	2.0	2.000	0.000
9. Ohio	2.0	2.0	2.0	2.000	0.000
10. Ohio	2.0	2.0	2.0	2.000	0.000
11. Ohio	2.0	3.0	2.0	2.111	0.333
12. Ohio	2.0	3.0	2.0	2.250	0.500
13. Ohio	2.0	4.0	2.0	2.625	0.744

14. Ohio	2.0	3.0	2.0	2.182	0.405
1. Pennsylvannia	2.0	3.0	2.0	2.200	0.422
2. Pennsylvannia	2.0	2.0	2.0	2.000	0.000
3. Pennsylvannia	2.0	3.0	2.0	2.250	0.500
4. Pennsylvannia	2.0	3.0	2.0	2.077	0.277
1. South Dakota	3.0	3.0	2.0	2.625	0.518
2. South Dakota	2.0	2.0	2.0	2.000	0.000
3. South Dakota	2.0	4.0	2.0	2.435	0.590
4. South Dakota	2.0	3.0	2.0	2.167	0.408
1. Tennessee	2.0	3.0	2.0	2.100	0.316
1. Vermont	8.0	9.0	0.0	7.200	2.274
1. Virginia	3.0	3.0	2.0	2.947	0.229
1. Wisconsin	2.0	3.0	2.0	2.273	0.467
2. Wisconsin	2.0	3.0	2.0	2.100	0.316
3. Wisconsin	2.0	3.0	2.0	2.100	0.316
4. Wisconsin	2.0	3.0	2.0	2.357	0.497
5. Wisconsin	2.0	3.0	2.0	2.333	0.516
6. Wisconsin	3.0	3.0	2.0	2.800	0.422
7. Wisconsin	3.0	3.0	2.0	2.714	0.488
8. Wisconsin	3.0	4.0	2.0	3.091	0.539
9. Wisconsin	2.0	2.0	2.0	2.000	0.000
10. Wisconsin	3.0	3.0	2.0	2.643	0.497
11. Wisconsin	2.0	2.0	2.0	2.000	0.000
12. Wisconsin	2.0	2.0	2.0	2.000	0.000
13. Wisconsin	2.0	3.0	2.0	2.200	0.447
14. Wisconsin	2.0	3.0	2.0	2.091	0.302
15. Wisconsin	2.0	3.0	2.0	2.071	0.267
16. Wisconsin	2.0	3.0	2.0	2.500	0.519
17. Wisconsin	2.0	3.0	2.0	2.200	0.414
18. Wisconsin	2.0	3.0	2.0	2.480	0.510
19. Wisconsin	2.0	3.0	2.0	2.458	0.509
20. Wisconsin	2.0	3.0	2.0	2.111	0.333
21. Wisconsin	3.0	3.0	2.0	2.600	0.548
22. Wisconsin	2.0	2.0	2.0	2.000	0.000
23. Wisconsin	2.0	2.0	2.0	2.000	0.000
24. Wisconsin	3.0	3.0	2.0	2.667	0.577
25. Wisconsin	2.0	3.0	2.0	2.250	0.441
26. Wisconsin	2.0	3.0	2.0	2.250	0.500
27. Wisconsin	2.0	4.0	2.0	2.545	0.688
28. Wisconsin	2.0	4.0	2.0	2.273	0.647
29. Wisconsin	2.0	3.0	2.0	2.056	0.236
30. Wisconsin	3.0	4.0	2.0	2.727	0.647
31. Wisconsin	2.0	3.0	2.0	2.217	0.422
32. Wisconsin	2.0	8.0	2.0	4.333	2.875
33. Wisconsin	2.0	2.0	2.0	2.000	0.000

34. Wisconsin	2.0	3.0	2.0	2.125	0.338
35. Wisconsin	2.0	3.0	2.0	2.111	0.333
36. Wisconsin	4.0	9.0	3.0	4.571	1.988
1. West Virginia	2.0	2.0	2.0	2.000	0.000
1. Wyoming	2.0	2.0	2.0	2.000	0.000
1. Quebec	3.0	8.0	2.0	4.000	1.871
2. Quebec	9.0	10.0	2.0	6.417	2.771
3. Quebec	8.0	9.0	3.0	7.529	1.625
4. Quebec	2.0	3.0	1.0	2.000	0.408
5. Quebec	3.0	3.0	2.0	2.556	0.527
1. Ontario	3.0	3.0	2.0	2.545	0.522
2. Ontario	2.0	2.0	2.0	2.000	0.000
3. Ontario	3.0	8.0	3.0	5.125	2.416
4. Ontario	2.0	3.0	2.0	2.167	0.389
5. Ontario	2.0	3.0	2.0	2.273	0.467
6. Ontario	2.0	2.0	2.0	2.000	0.000
7. Ontario	9.0	9.0	2.0	6.667	3.266
8. Ontario	2.0	3.0	2.0	2.231	0.439
9. Ontario	2.0	3.0	2.0	2.091	0.302
10. Ontario	2.0	2.0	2.0	2.000	0.000
11. Ontario	2.0	2.0	2.0	2.000	0.000
12. Ontario	2.0	2.0	2.0	2.000	0.000
13. Ontario	2.0	2.0	2.0	2.000	0.000
14. Ontario	2.0	2.0	2.0	2.000	----
15. Ontario	2.0	2.0	2.0	2.000	0.000
16. Ontario	2.0	2.0	2.0	2.000	0.000
17. Ontario	2.0	3.0	2.0	2.100	0.316
18. Ontario	2.0	3.0	2.0	2.200	0.422
19. Ontario	8.0	8.0	3.0	6.071	2.200
20. Ontario	2.0	3.0	2.0	2.222	0.441
21. Ontario	2.0	3.0	2.0	2.200	0.447
22. Ontario	2.0	3.0	1.0	1.900	0.568
23. Ontario	3.0	3.0	2.0	2.714	0.488
24. Ontario	2.0	3.0	2.0	2.200	0.422
25. Ontario	2.0	3.0	2.0	2.100	0.316
26. Ontario	2.0	2.0	2.0	2.000	0.000
27. Ontario	2.0	3.0	2.0	2.429	0.514
28. Ontario	3.0	3.0	2.0	2.545	0.522
29. Ontario	2.0	2.0	2.0	2.000	0.000
30. Ontario	2.0	3.0	2.0	2.200	0.422
31. Ontario	2.0	2.0	2.0	2.000	----
32. Ontario	2.0	2.0	2.0	2.000	0.000
33. Ontario	2.0	2.0	2.0	2.000	0.000
34. Ontario	2.0	3.0	2.0	2.200	0.422
35. Ontario	2.0	3.0	2.0	2.200	0.422
36. Ontario	2.0	2.0	1.0	1.938	0.250
37. Ontario	2.0	2.0	2.0	2.000	0.000
38. Ontario	2.0	2.0	1.0	1.883	0.389

39. Ontario	2.0	3.0	2.0	2.125	0.353
40. Ontario	2.0	3.0	2.0	2.100	0.316
41. Ontario	2.0	3.0	2.0	2.142	0.363
42. Ontario	2.0	2.0	2.0	2.000	0.000
43. Ontario	2.0	2.0	2.0	2.000	0.000
44. Ontario	2.0	2.0	2.0	2.000	0.000
45. Ontario	2.0	3.0	2.0	2.125	0.353
46. Ontario	2.0	2.0	2.0	2.000	0.000
47. Ontario	2.0	3.0	2.0	2.200	0.421
48. Ontario	2.0	3.0	2.0	2.583	0.514
1. Manitoba	2.0	2.0	2.0	2.000	0.000
2. Manitoba	2.0	2.0	2.0	2.000	0.000
3. Manitoba	3.0	3.0	2.0	2.667	0.577
4. Manitoba	2.0	3.0	2.0	2.333	0.492
5. Manitoba	2.0	2.0	2.0	2.000	0.000
6. Manitoba	2.0	3.0	2.0	2.333	0.577
7. Manitoba	2.0	3.0	2.0	2.500	0.707
8. Manitoba	2.0	2.0	2.0	2.000	0.000
9. Manitoba	2.0	2.0	2.0	2.000	0.000
10. Manitoba	2.0	2.0	2.0	2.000	0.000
11. Manitoba	2.0	3.0	2.0	2.273	0.467
12. Manitoba	2.0	3.0	2.0	2.417	0.515
13. Manitoba	3.0	3.0	2.0	2.545	0.522
14. Manitoba	2.0	3.0	2.0	2.333	0.492
15. Manitoba	2.0	3.0	2.0	2.250	0.452
16. Manitoba	2.0	3.0	2.0	2.071	0.267
17. Manitoba	2.0	3.0	2.0	2.200	0.422
1. Saskatchewan	2.0	2.0	2.0	2.000	0.000
2. Saskatchewan	2.0	2.0	2.0	2.000	0.000
3. Saskatchewan	2.0	3.0	2.0	2.250	0.500
4. Saskatchewan	2.0	2.0	2.0	2.000	0.000
5. Saskatchewan	2.0	2.0	2.0	2.000	0.000
6. Saskatchewan	2.0	2.0	2.0	2.000	0.000
7. Saskatchewan	2.0	2.0	2.0	2.000	-----
8. Saskatchewan	2.0	2.0	2.0	2.000	-----
9. Saskatchewan	2.0	2.0	2.0	2.000	-----

Appendix 6P: Total number of left preoperculomandibular pores for examined samples of *Etheostoma nigrum* and *E. olmstedii*. Location number and names correspond to those of Appendix 2.

LOCATION:	MODE	UPPER	LOWER	MEAN	SD
1. Colorado	8.0	10.0	6.0	8.182	0.882
1. Connecticut	10.0	10.0	9.0	9.714	0.488
1. Illinois	8.0	10.0	8.0	9.000	1.000
2. Illinois	8.0	9.0	6.0	8.000	1.225
3. Illinois	8.0	8.0	8.0	8.000	0.000
4. Illinois	10.0	10.0	10.0	10.000	0.000
5. Illinois	8.0	10.0	6.0	7.947	1.177
1. Indiana	9.0	11.0	6.0	9.042	0.944
2. Indiana	9.0	10.0	6.0	8.909	1.044
3. Indiana	9.0	10.0	9.0	9.167	0.408
4. Indiana	8.0	11.0	8.0	9.333	1.528
5. Indiana	8.0	9.0	8.0	8.500	0.707
6. Indiana	9.0	10.0	7.0	8.571	0.976
7. Indiana	10.0	10.0	8.0	9.400	0.699
8. Indiana	8.0	9.0	6.0	7.600	1.140
9. Indiana	9.0	9.0	9.0	9.000	0.000
1. Iowa	8.0	10.0	6.0	8.200	1.483
2. Iowa	6.0	10.0	6.0	7.364	1.433
3. Iowa	6.0	6.0	6.0	6.000	0.000
4. Iowa	6.0	8.0	6.0	6.400	0.894
5. Iowa	6.0	7.0	6.0	6.375	0.518
1. Kansas	6.0	10.0	6.0	7.000	1.673
2. Kansas	6.0	8.0	6.0	6.667	1.155
1. Kentucky	9.0	10.0	8.0	8.889	0.601
2. Kentucky	9.0	10.0	8.0	8.900	0.568
1. Maryland	10.0	11.0	8.0	10.000	1.000
2. Maryland	9.0	10.0	9.0	9.400	0.503
1. Massachusetts	11.0	11.0	9.0	10.333	0.816
1. Michigan	9.0	10.0	6.0	8.600	1.517
2. Michigan	6.0	10.0	6.0	7.364	1.433
3. Michigan	6.0	8.0	6.0	6.294	0.686
4. Michigan	9.0	10.0	8.0	9.091	0.701
5. Michigan	9.0	9.0	9.0	9.000	0.000
6. Michigan	6.0	9.0	6.0	6.571	1.134
7. Michigan	9.0	10.0	9.0	9.333	0.577

8. Michigan	6.0	7.0	6.0	6.200	0.447
9. Michigan	10.0	10.0	8.0	9.500	0.837
10. Michigan	9.0	10.0	9.0	9.167	0.408
11. Michigan	8.0	9.0	6.0	8.200	0.919
12. Michigan	6.0	9.0	6.0	7.167	1.329
13. Michigan	6.0	10.0	6.0	7.500	1.650
14. Michigan	6.0	10.0	6.0	7.583	1.564
15. Michigan	6.0	6.0	6.0	6.000	0.000
16. Michigan	8.0	10.0	6.0	7.615	1.121
17. Michigan	9.0	10.0	6.0	8.375	1.598
18. Michigan	6.0	8.0	6.0	6.571	0.976
19. Michigan	9.0	10.0	6.0	8.875	1.356
20. Michigan	9.0	10.0	8.0	8.909	0.701
21. Michigan	8.0	10.0	8.0	9.000	1.414
22. Michigan	6.0	10.0	6.0	7.750	2.062
23. Michigan	6.0	9.0	6.0	6.700	1.160
24. Michigan	10.0	10.0	9.0	9.800	0.447
25. Michigan	6.0	9.0	6.0	7.000	1.414
26. Michigan	6.0	6.0	5.0	5.900	0.316
27. Michigan	8.0	9.0	6.0	8.000	1.000
28. Michigan	6.0	9.0	6.0	7.000	1.732
29. Michigan	9.0	10.0	8.0	9.421	0.607
30. Michigan	9.0	11.0	9.0	9.600	0.894
31. Michigan	8.0	10.0	8.0	8.824	0.809
32. Michigan	6.0	8.0	6.0	6.667	0.888
33. Michigan	6.0	11.0	5.0	7.000	1.549
34. Michigan	6.0	10.0	6.0	7.647	1.539
35. Michigan	8.0	10.0	6.0	7.800	1.320
36. Michigan	6.0	8.0	6.0	6.700	0.865
37. Michigan	6.0	9.0	6.0	6.684	1.108
1. Minnesota	6.0	8.0	6.0	6.200	0.632
2. Minnesota	6.0	8.0	6.0	6.800	1.095
3. Minnesota	6.0	10.0	6.0	7.545	1.572
4. Minnesota	6.0	8.0	6.0	6.462	0.877
5. Minnesota	6.0	9.0	6.0	7.000	1.240
6. Minnesota	6.0	6.0	6.0	6.000	0.000
7. Minnesota	6.0	8.0	6.0	6.182	0.603
8. Minnesota	6.0	9.0	5.0	6.500	1.168
9. Minnesota	6.0	10.0	6.0	7.750	1.422
10. Minnesota	6.0	10.0	6.0	7.500	1.915
11. Minnesota	6.0	9.0	6.0	6.800	1.317
12. Minnesota	6.0	10.0	6.0	7.000	1.342
13. Minnesota	6.0	10.0	6.0	6.500	1.243
14. Minnesota	6.0	10.0	6.0	7.333	1.497
15. Minnesota	6.0	8.0	6.0	7.000	1.414
16. Minnesota	6.0	6.0	6.0	6.000	-----
17. Minnesota	6.0	6.0	6.0	6.000	-----
18. Minnesota	6.0	6.0	6.0	6.000	-----
19. Minnesota	8.0	10.0	8.0	9.000	1.000
20. Minnesota	6.0	6.0	6.0	6.000	0.000

21. Minnesota	6.0	6.0	6.0	6.000	0.000
22. Minnesota	6.0	7.0	6.0	6.500	0.707
23. Minnesota	6.0	10.0	6.0	7.153	1.281
24. Minnesota	8.0	10.0	7.0	8.666	1.211
25. Minnesota	6.0	10.0	5.0	7.090	1.640
26. Minnesota	6.0	10.0	6.0	7.470	1.462
27. Minnesota	6.0	8.0	6.0	6.437	0.813
1. Missouri	6.0	8.0	6.0	6.400	0.894
2. Missouri	6.0	7.0	6.0	6.333	0.577
3. Missouri	9.0	10.0	6.0	8.300	1.494
4. Missouri	6.0	8.0	6.0	7.000	1.414
5. Missouri	6.0	6.0	6.0	6.000	-----
6. Missouri	6.0	8.0	6.0	6.286	0.756
7. Missouri	7.0	7.0	7.0	7.000	-----
8. Missouri	8.0	9.0	6.0	7.500	1.225
9. Missouri	6.0	9.0	6.0	7.286	1.604
1. Nebraska	6.0	8.0	6.0	7.000	1.414
2. Nebraska	6.0	8.0	6.0	7.000	1.155
1. New Jersey	11.0	11.0	10.0	10.909	0.302
1. New Hampshire	9.0	11.0	9.0	9.667	0.816
2. New Hampshire	10.0	11.0	9.0	10.000	0.667
1. New York	10.0	10.0	7.0	9.182	1.168
2. New York	11.0	12.0	8.0	10.538	0.948
3. New York	11.0	11.0	10.0	10.700	0.483
4. New York	11.0	11.0	10.0	10.625	0.518
1. North Dakota	6.0	9.0	6.0	7.000	1.732
2. North Dakota	6.0	6.0	6.0	6.000	0.000
3. North Dakota	8.0	9.0	6.0	7.875	0.991
4. North Dakota	6.0	11.0	6.0	7.833	1.586
5. North Dakota	6.0	9.0	6.0	6.727	1.104
6. North Dakota	6.0	6.0	6.0	6.000	0.000
1. Ohio	8.0	10.0	6.0	8.700	1.252
2. Ohio	9.0	10.0	9.0	9.111	0.333
3. Ohio	9.0	10.0	6.0	8.273	1.272
4. Ohio	9.0	10.0	9.0	9.500	0.707
5. Ohio	6.0	10.0	6.0	8.000	2.000
6. Ohio	9.0	10.0	8.0	9.111	0.601
7. Ohio	9.0	9.0	9.0	9.000	0.000
8. Ohio	9.0	9.0	8.0	8.800	0.447
9. Ohio	9.0	11.0	9.0	9.600	0.894
10. Ohio	9.0	9.0	9.0	9.000	0.000
11. Ohio	6.0	8.0	6.0	6.889	0.928
12. Ohio	9.0	10.0	9.0	9.250	0.500
13. Ohio	9.0	10.0	9.0	9.375	0.518

14. Ohio	9.0	10.0	6.0	8.091	1.300
1. Pennsylvania	9.0	10.0	8.0	9.200	0.632
2. Pennsylvania	9.0	10.0	9.0	9.500	0.577
3. Pennsylvania	6.0	10.0	6.0	7.750	2.062
4. Pennsylvania	9.0	10.0	8.0	9.000	0.408
1. South Dakota	8.0	8.0	6.0	7.250	1.035
2. South Dakota	6.0	8.0	6.0	7.000	1.000
3. South Dakota	6.0	8.0	6.0	6.261	0.689
4. South Dakota	6.0	6.0	6.0	6.000	0.000
1. Tennessee	10.0	10.0	9.0	9.700	0.483
1. Vermont	11.0	11.0	9.0	10.800	0.561
1. Virginia	9.0	10.0	9.0	9.053	0.229
1. Wisconsin	6.0	10.0	6.0	7.909	1.640
2. Wisconsin	6.0	9.0	6.0	6.500	1.080
3. Wisconsin	6.0	6.0	6.0	6.000	0.000
4. Wisconsin	6.0	9.0	6.0	6.714	1.204
5. Wisconsin	6.0	8.0	6.0	6.333	0.816
6. Wisconsin	8.0	10.0	6.0	8.100	1.370
7. Wisconsin	9.0	10.0	6.0	8.571	1.272
8. Wisconsin	9.0	10.0	6.0	8.091	1.446
9. Wisconsin	6.0	6.0	6.0	6.000	0.000
10. Wisconsin	9.0	11.0	8.0	9.571	0.852
11. Wisconsin	6.0	7.0	6.0	6.333	0.577
12. Wisconsin	9.0	9.0	6.0	8.000	1.732
13. Wisconsin	6.0	8.0	6.0	6.400	0.894
14. Wisconsin	6.0	8.0	6.0	6.364	0.809
15. Wisconsin	6.0	9.0	5.0	6.143	0.864
16. Wisconsin	9.0	11.0	8.0	9.286	0.914
17. Wisconsin	6.0	7.0	6.0	6.133	0.352
18. Wisconsin	10.0	11.0	6.0	9.200	1.225
19. Wisconsin	10.0	11.0	6.0	9.792	1.062
20. Wisconsin	6.0	10.0	6.0	6.889	1.537
21. Wisconsin	6.0	7.0	6.0	6.400	0.548
22. Wisconsin	6.0	8.0	6.0	6.600	0.966
23. Wisconsin	6.0	7.0	6.0	6.077	0.277
24. Wisconsin	6.0	8.0	6.0	6.667	1.155
25. Wisconsin	6.0	11.0	6.0	7.821	1.827
26. Wisconsin	6.0	9.0	6.0	6.750	1.500
27. Wisconsin	8.0	10.0	6.0	8.545	1.128
28. Wisconsin	9.0	10.0	6.0	8.455	1.508
29. Wisconsin	6.0	10.0	6.0	7.333	1.455
30. Wisconsin	6.0	9.0	6.0	7.273	1.272
31. Wisconsin	6.0	10.0	6.0	7.217	1.476
32. Wisconsin	6.0	7.0	6.0	6.167	0.408
33. Wisconsin	6.0	6.0	6.0	6.000	0.000

34. Wisconsin	6.0	10.0	5.0	7.000	1.414
35. Wisconsin	6.0	9.0	6.0	6.778	1.202
36. Wisconsin	9.0	11.0	8.0	9.143	0.900
1. West Virginia	9.0	9.0	8.0	8.750	0.500
1. Wyoming	6.0	7.0	6.0	6.143	0.378
1. Quebec	11.0	13.0	8.0	10.538	1.198
2. Quebec	11.0	12.0	10.0	11.139	0.593
3. Quebec	10.0	11.0	9.0	10.353	0.606
4. Quebec	10.0	10.0	6.0	8.385	1.710
5. Quebec	9.0	10.0	7.0	8.778	0.972
1. Ontario	10.0	13.0	6.0	10.182	1.888
2. Ontario	6.0	6.0	6.0	6.000	0.000
3. Ontario	11.0	12.0	9.0	11.000	0.926
4. Ontario	10.0	10.0	8.0	9.667	0.651
5. Ontario	9.0	9.0	6.0	8.364	1.206
6. Ontario	6.0	6.0	6.0	6.000	0.000
7. Ontario	11.0	11.0	11.0	11.000	0.000
8. Ontario	10.0	10.0	5.0	8.000	1.780
9. Ontario	8.0	10.0	6.0	8.091	1.221
10. Ontario	9.0	10.0	9.0	9.250	0.500
11. Ontario	10.0	10.0	6.0	8.600	1.673
12. Ontario	6.0	6.0	6.0	6.000	0.000
13. Ontario	8.0	8.0	5.0	6.833	1.329
14. Ontario	6.0	6.0	6.0	6.000	-----
15. Ontario	9.0	10.0	5.0	8.300	1.636
16. Ontario	6.0	6.0	6.0	6.000	0.000
17. Ontario	6.0	10.0	6.0	6.800	1.398
18. Ontario	8.0	10.0	6.0	8.700	1.252
19. Ontario	11.0	11.0	7.0	9.857	1.460
20. Ontario	9.0	10.0	7.0	8.889	0.928
21. Ontario	10.0	10.0	8.0	9.600	0.894
22. Ontario	6.0	9.0	5.0	6.500	1.179
23. Ontario	9.0	10.0	9.0	9.143	0.378
24. Ontario	9.0	9.0	8.0	8.800	0.422
25. Ontario	9.0	10.0	9.0	9.400	0.516
26. Ontario	6.0	10.0	6.0	7.600	1.506
27. Ontario	9.0	10.0	7.0	8.643	0.745
28. Ontario	10.0	11.0	8.0	9.455	1.036
29. Ontario	6.0	6.0	6.0	6.000	0.000
30. Ontario	9.0	10.0	6.0	8.200	1.619
31. Ontario	6.0	6.0	6.0	6.000	-----
32. Ontario	6.0	10.0	6.0	7.571	1.618
33. Ontario	6.0	8.0	6.0	6.286	0.756
34. Ontario	10.0	11.0	6.0	9.300	1.418
35. Ontario	6.0	8.0	6.0	6.300	0.675
36. Ontario	6.0	8.0	6.0	6.313	0.602
37. Ontario	6.0	9.0	6.0	6.800	1.316
38. Ontario	6.0	6.0	5.0	5.750	0.621

39. Ontario	6.0	6.0	6.0	6.000	0.000
40. Ontario	6.0	9.0	6.0	6.300	0.948
41. Ontario	6.0	8.0	6.0	6.428	0.851
42. Ontario	6.0	7.0	6.0	6.125	0.353
43. Ontario	6.0	6.0	5.0	5.875	0.353
44. Ontario	6.0	9.0	6.0	6.500	1.080
45. Ontario	6.0	11.0	6.0	6.625	1.767
46. Ontario	9.0	9.0	6.0	8.200	1.303
47. Ontario	6.0	9.0	6.0	6.900	1.197
48. Ontario	9.0	11.0	6.0	8.750	1.815
1. Manitoba	6.0	9.0	6.0	7.200	1.304
2. Manitoba	6.0	9.0	6.0	6.700	1.160
3. Manitoba	6.0	9.0	6.0	7.000	1.732
4. Manitoba	6.0	8.0	6.0	6.500	0.905
5. Manitoba	6.0	8.0	5.0	6.300	0.949
6. Manitoba	6.0	7.0	6.0	6.333	0.577
7. Manitoba	6.0	10.0	6.0	8.000	2.828
8. Manitoba	6.0	10.0	6.0	7.200	1.476
9. Manitoba	6.0	7.0	6.0	6.200	0.447
10. Manitoba	6.0	8.0	6.0	6.667	1.155
11. Manitoba	6.0	10.0	6.0	7.091	1.446
12. Manitoba	6.0	10.0	6.0	6.583	1.240
13. Manitoba	6.0	6.0	6.0	6.000	0.000
14. Manitoba	6.0	9.0	6.0	6.583	1.084
15. Manitoba	8.0	9.0	6.0	7.250	1.138
16. Manitoba	6.0	9.0	6.0	6.500	0.941
17. Manitoba	6.0	8.0	6.0	6.500	0.850
1. Saskatchewan	7.0	7.0	6.0	6.667	0.577
2. Saskatchewan	6.0	6.0	6.0	6.000	0.000
3. Saskatchewan	6.0	6.0	5.0	5.750	0.500
4. Saskatchewan	6.0	6.0	6.0	6.000	0.000
5. Saskatchewan	6.0	7.0	5.0	6.100	0.568
6. Saskatchewan	6.0	7.0	6.0	6.250	0.500
7. Saskatchewan	6.0	6.0	6.0	6.000	-----
8. Saskatchewan	10.0	10.0	10.0	10.000	-----
9. Saskatchewan	6.0	6.0	6.0	6.000	-----

Appendix 6Q: Number of preoperculomandibular pores confined to the opercle for examined samples of *Etheostoma nigrum* and *E. olmstedii*. Location number and names correspond to those of Appendix 2.

LOCATION:	MODE	UPPER	LOWER	MEAN	SD
1. Colorado	6.0	7.0	6.0	6.030	0.174
1. Connecticut	7.0	7.0	7.0	7.000	0.000
1. Illinois	6.0	6.0	6.0	6.000	0.000
2. Illinois	6.0	6.0	6.0	6.000	0.000
3. Illinois	6.0	6.0	6.0	6.000	0.000
4. Illinois	6.0	6.0	6.0	6.000	0.000
5. Illinois	6.0	7.0	6.0	6.053	0.229
1. Indiana	6.0	7.0	6.0	6.104	0.309
2. Indiana	6.0	6.0	6.0	6.000	0.000
3. Indiana	6.0	6.0	6.0	6.000	0.000
4. Indiana	6.0	7.0	6.0	6.333	0.577
5. Indiana	6.0	6.0	6.0	6.000	0.000
6. Indiana	6.0	7.0	6.0	6.143	0.378
7. Indiana	6.0	6.0	6.0	6.000	0.000
8. Indiana	6.0	7.0	6.0	6.400	0.548
9. Indiana	6.0	6.0	6.0	6.000	0.000
1. Iowa	6.0	6.0	6.0	6.000	0.000
2. Iowa	6.0	7.0	6.0	6.091	0.302
3. Iowa	6.0	6.0	6.0	6.000	0.000
4. Iowa	6.0	6.0	6.0	6.000	0.000
5. Iowa	6.0	7.0	6.0	6.375	0.518
1. Kansas	6.0	6.0	6.0	6.000	0.000
2. Kansas	6.0	6.0	6.0	6.000	0.000
1. Kentucky	6.0	6.0	6.0	6.000	0.000
2. Kentucky	6.0	6.0	6.0	6.000	0.000
1. Maryland	6.0	7.0	6.0	6.333	0.500
2. Maryland	6.0	7.0	6.0	6.150	0.366
1. Massachusetts	7.0	7.0	7.0	7.000	0.000
1. Michigan	6.0	7.0	6.0	6.200	0.447
2. Michigan	6.0	6.0	6.0	6.000	0.000
3. Michigan	6.0	7.0	6.0	6.059	0.243
4. Michigan	6.0	6.0	6.0	6.000	0.000
5. Michigan	6.0	6.0	6.0	6.000	0.000
6. Michigan	6.0	7.0	6.0	6.286	0.488
7. Michigan	6.0	6.0	6.0	6.000	0.000

8. Michigan	6.0	7.0	6.0	6.200	0.447
9. Michigan	6.0	6.0	6.0	6.000	0.000
10. Michigan	6.0	6.0	6.0	6.000	0.000
11. Michigan	6.0	6.0	6.0	6.000	0.000
12. Michigan	6.0	6.0	6.0	6.000	0.000
13. Michigan	6.0	6.0	6.0	6.000	0.000
14. Michigan	6.0	6.0	6.0	6.000	0.000
15. Michigan	6.0	6.0	6.0	6.000	0.000
16. Michigan	6.0	6.0	6.0	6.000	0.000
17. Michigan	6.0	6.0	6.0	6.000	0.000
18. Michigan	6.0	6.0	6.0	6.000	0.000
19. Michigan	6.0	7.0	6.0	6.125	0.354
20. Michigan	6.0	6.0	6.0	6.000	0.000
21. Michigan	6.0	6.0	6.0	6.000	0.000
22. Michigan	6.0	6.0	6.0	6.000	0.000
23. Michigan	6.0	6.0	6.0	6.000	0.000
24. Michigan	6.0	6.0	6.0	6.000	0.000
25. Michigan	6.0	6.0	6.0	6.000	0.000
26. Michigan	6.0	6.0	5.0	5.900	0.316
27. Michigan	6.0	6.0	6.0	6.000	0.000
28. Michigan	6.0	6.0	6.0	6.000	0.000
29. Michigan	6.0	6.0	6.0	6.000	0.000
30. Michigan	6.0	7.0	6.0	6.200	0.447
31. Michigan	6.0	7.0	6.0	6.059	0.243
32. Michigan	6.0	7.0	6.0	6.167	0.389
33. Michigan	6.0	7.0	5.0	6.000	0.316
34. Michigan	6.0	7.0	6.0	6.059	0.243
35. Michigan	6.0	7.0	6.0	6.067	0.258
36. Michigan	6.0	8.0	6.0	6.300	0.571
37. Michigan	6.0	7.0	6.0	6.053	0.229
1. Minnesota	6.0	6.0	6.0	6.000	0.000
2. Minnesota	6.0	6.0	6.0	6.000	0.000
3. Minnesota	6.0	6.0	6.0	6.000	0.000
4. Minnesota	6.0	6.0	6.0	6.000	0.000
5. Minnesota	6.0	6.0	6.0	6.000	0.000
6. Minnesota	6.0	6.0	6.0	6.000	0.000
7. Minnesota	6.0	6.0	6.0	6.000	0.000
8. Minnesota	6.0	6.0	5.0	5.917	0.289
9. Minnesota	6.0	6.0	6.0	6.000	0.000
10. Minnesota	6.0	6.0	6.0	6.000	0.000
11. Minnesota	6.0	6.0	6.0	6.000	0.000
12. Minnesota	6.0	7.0	6.0	6.091	0.302
13. Minnesota	6.0	6.0	6.0	6.000	0.000
14. Minnesota	6.0	6.0	6.0	6.000	0.000
15. Minnesota	6.0	6.0	6.0	6.000	0.000
16. Minnesota	6.0	6.0	6.0	6.000	-----
17. Minnesota	6.0	6.0	6.0	6.000	-----
18. Minnesota	6.0	6.0	6.0	6.000	-----
19. Minnesota	6.0	7.0	6.0	6.333	0.577
20. Minnesota	6.0	6.0	6.0	6.000	0.000

21. Minnesota	6.0	6.0	6.0	6.000	0.000
22. Minnesota	6.0	7.0	6.0	6.500	0.707
23. Minnesota	6.0	7.0	6.0	6.076	0.277
24. Minnesota	6.0	6.0	6.0	6.000	0.000
25. Minnesota	6.0	7.0	5.0	6.090	0.539
26. Minnesota	6.0	7.0	6.0	6.117	0.332
27. Minnesota	6.0	7.0	6.0	6.062	0.250
1. Missouri	6.0	6.0	6.0	6.000	0.000
2. Missouri	6.0	7.0	6.0	6.333	0.577
3. Missouri	6.0	7.0	6.0	6.200	0.422
4. Missouri	6.0	6.0	6.0	6.000	0.000
5. Missouri	6.0	6.0	6.0	6.000	-----
6. Missouri	6.0	6.0	6.0	6.000	0.000
7. Missouri	7.0	7.0	7.0	7.000	-----
8. Missouri	6.0	8.0	6.0	6.333	0.816
9. Missouri	6.0	7.0	6.0	6.143	0.378
1. Nebraska	6.0	6.0	6.0	6.000	0.000
2. Nebraska	6.0	6.0	6.0	6.000	0.000
1. New Jersey	7.0	8.0	6.0	7.000	0.447
1. New Hampshire	7.0	8.0	6.0	7.000	0.632
2. New Hampshire	7.0	7.0	6.0	6.800	0.422
1. New York	7.0	7.0	6.0	6.636	0.505
2. New York	7.0	8.0	6.0	6.885	0.431
3. New York	7.0	7.0	7.0	7.000	0.000
4. New York	7.0	7.0	6.0	6.875	0.354
1. North Dakota	6.0	6.0	6.0	6.000	0.000
2. North Dakota	6.0	6.0	6.0	6.000	0.000
3. North Dakota	6.0	7.0	6.0	6.125	0.354
4. North Dakota	6.0	7.0	6.0	6.083	0.289
5. North Dakota	6.0	7.0	6.0	6.091	0.302
6. North Dakota	6.0	6.0	6.0	6.000	0.000
1. Ohio	6.0	6.0	6.0	6.000	0.000
2. Ohio	6.0	7.0	6.0	6.111	0.333
3. Ohio	6.0	6.0	6.0	6.000	0.000
4. Ohio	6.0	6.0	6.0	6.000	0.000
5. Ohio	6.0	6.0	6.0	6.000	0.000
6. Ohio	6.0	7.0	6.0	6.111	0.333
7. Ohio	6.0	6.0	5.0	5.750	0.500
8. Ohio	6.0	6.0	6.0	6.000	0.000
9. Ohio	6.0	7.0	6.0	6.200	0.447
10. Ohio	6.0	6.0	6.0	6.000	0.000
11. Ohio	6.0	6.0	6.0	6.000	0.000
12. Ohio	6.0	6.0	6.0	6.000	0.000
13. Ohio	6.0	6.0	5.0	5.875	0.354

14. Ohio	6.0	6.0	6.0	6.000	0.000
1. Pennsylvannia	6.0	7.0	6.0	6.200	0.422
2. Pennsylvannia	6.0	6.0	6.0	6.000	0.000
3. Pennsylvannia	6.0	7.0	6.0	6.250	0.500
4. Pennsylvannia	6.0	6.0	6.0	6.000	0.000
1. South Dakota	6.0	6.0	6.0	6.000	0.000
2. South Dakota	6.0	7.0	6.0	6.333	0.577
3. South Dakota	6.0	6.0	6.0	6.000	0.000
4. South Dakota	6.0	6.0	6.0	6.000	0.000
1. Tennessee	6.0	6.0	6.0	6.000	0.000
1. Vermont	7.0	7.0	6.0	6.933	0.258
1. Virginia	6.0	7.0	6.0	6.053	0.229
1. Wisconsin	6.0	6.0	6.0	6.000	0.000
2. Wisconsin	6.0	6.0	6.0	6.000	0.000
3. Wisconsin	6.0	6.0	6.0	6.000	0.000
4. Wisconsin	6.0	6.0	6.0	6.000	0.000
5. Wisconsin	6.0	6.0	6.0	6.000	0.000
6. Wisconsin	6.0	6.0	6.0	6.000	0.000
7. Wisconsin	6.0	6.0	6.0	6.000	0.000
8. Wisconsin	6.0	7.0	6.0	6.091	0.302
9. Wisconsin	6.0	6.0	6.0	6.000	0.000
10. Wisconsin	6.0	7.0	6.0	6.214	0.426
11. Wisconsin	6.0	7.0	6.0	6.333	0.577
12. Wisconsin	6.0	6.0	6.0	6.000	0.000
13. Wisconsin	6.0	6.0	6.0	6.000	0.000
14. Wisconsin	6.0	6.0	6.0	6.000	0.000
15. Wisconsin	6.0	6.0	5.0	5.929	0.267
16. Wisconsin	6.0	7.0	6.0	6.071	0.267
17. Wisconsin	6.0	7.0	6.0	6.133	0.352
18. Wisconsin	6.0	7.0	6.0	6.040	0.200
19. Wisconsin	6.0	7.0	6.0	6.083	0.282
20. Wisconsin	6.0	7.0	6.0	6.222	0.441
21. Wisconsin	6.0	7.0	6.0	6.200	0.447
22. Wisconsin	6.0	6.0	6.0	6.000	0.000
23. Wisconsin	6.0	7.0	6.0	6.077	0.277
24. Wisconsin	6.0	6.0	6.0	6.000	0.000
25. Wisconsin	6.0	7.0	6.0	6.036	0.189
26. Wisconsin	6.0	6.0	6.0	6.000	0.000
27. Wisconsin	6.0	6.0	6.0	6.000	0.000
28. Wisconsin	6.0	7.0	6.0	6.182	0.405
29. Wisconsin	6.0	6.0	6.0	6.000	0.000
30. Wisconsin	6.0	6.0	6.0	6.000	0.000
31. Wisconsin	6.0	7.0	6.0	6.217	0.422
32. Wisconsin	6.0	7.0	6.0	6.167	0.408
33. Wisconsin	6.0	6.0	6.0	6.000	0.000

34. Wisconsin	6.0	6.0	5.0	5.958	0.204
35. Wisconsin	6.0	7.0	6.0	6.111	0.333
36. Wisconsin	6.0	7.0	6.0	6.143	0.378
1. West Virginia	6.0	6.0	6.0	6.000	0.000
1. Wyoming	6.0	6.0	6.0	6.000	0.000
1. Quebec	7.0	8.0	6.0	6.846	0.555
2. Quebec	7.0	8.0	7.0	7.028	0.167
3. Quebec	7.0	7.0	6.0	6.941	0.243
4. Quebec	6.0	6.0	6.0	6.000	0.000
5. Quebec	6.0	6.0	6.0	6.000	0.000
1. Ontario	6.0	8.0	6.0	6.727	0.905
2. Ontario	6.0	6.0	6.0	6.000	0.000
3. Ontario	7.0	8.0	7.0	7.125	0.354
4. Ontario	6.0	7.0	6.0	6.083	0.289
5. Ontario	6.0	7.0	6.0	6.091	0.302
6. Ontario	6.0	6.0	6.0	6.000	0.000
7. Ontario	7.0	8.0	7.0	7.167	0.408
8. Ontario	6.0	7.0	5.0	6.308	0.630
9. Ontario	6.0	6.0	6.0	6.000	0.000
10. Ontario	6.0	6.0	6.0	6.000	0.000
11. Ontario	6.0	6.0	6.0	6.000	0.000
12. Ontario	6.0	6.0	6.0	6.000	0.000
13. Ontario	6.0	6.0	5.0	5.833	0.408
14. Ontario	6.0	6.0	6.0	6.000	----
15. Ontario	6.0	6.0	5.0	5.900	0.316
16. Ontario	6.0	6.0	6.0	6.000	0.000
17. Ontario	6.0	6.0	6.0	6.000	0.000
18. Ontario	6.0	6.0	6.0	6.000	0.000
19. Ontario	6.0	7.0	6.0	6.500	0.519
20. Ontario	6.0	6.0	6.0	6.000	0.000
21. Ontario	6.0	7.0	6.0	6.200	0.447
22. Ontario	6.0	7.0	5.0	6.000	0.471
23. Ontario	6.0	6.0	6.0	6.000	0.000
24. Ontario	6.0	6.0	6.0	6.000	0.000
25. Ontario	6.0	6.0	6.0	6.000	0.000
26. Ontario	6.0	6.0	6.0	6.000	0.000
27. Ontario	6.0	6.0	6.0	6.000	0.000
28. Ontario	6.0	7.0	6.0	6.091	0.302
29. Ontario	6.0	6.0	6.0	6.000	0.000
30. Ontario	6.0	6.0	6.0	6.000	0.000
31. Ontario	6.0	6.0	6.0	6.000	----
32. Ontario	6.0	6.0	6.0	6.000	0.000
33. Ontario	6.0	6.0	6.0	6.000	0.000
34. Ontario	6.0	7.0	6.0	6.300	0.483
35. Ontario	6.0	7.0	6.0	6.100	0.316
36. Ontario	6.0	7.0	6.0	6.188	0.403
37. Ontario	6.0	6.0	5.0	5.900	0.316

38. Ontario	6.0	6.0	5.0	5.916	0.288
39. Ontario	6.0	6.0	6.0	6.000	0.000
40. Ontario	6.0	6.0	6.0	6.000	0.000
41. Ontario	6.0	6.0	6.0	6.000	0.000
42. Ontario	6.0	7.0	6.0	6.125	0.353
43. Ontario	6.0	6.0	5.0	5.875	0.353
44. Ontario	6.0	6.0	6.0	6.000	0.000
45. Ontario	6.0	7.0	6.0	6.125	0.353
46. Ontario	6.0	6.0	6.0	6.000	0.000
47. Ontario	6.0	7.0	6.0	6.200	0.421
48. Ontario	6.0	7.0	6.0	6.416	0.514
1. Manitoba	6.0	7.0	6.0	6.200	0.447
2. Manitoba	6.0	6.0	6.0	6.000	0.000
3. Manitoba	6.0	6.0	6.0	6.000	0.000
4. Manitoba	6.0	6.0	6.0	6.000	0.000
5. Manitoba	6.0	6.0	5.0	5.900	0.316
6. Manitoba	6.0	7.0	6.0	6.333	0.577
7. Manitoba	6.0	6.0	6.0	6.000	0.000
8. Manitoba	6.0	8.0	6.0	6.400	0.699
9. Manitoba	6.0	6.0	6.0	6.000	0.000
10. Manitoba	6.0	8.0	6.0	6.667	1.155
11. Manitoba	6.0	7.0	6.0	6.091	0.302
12. Manitoba	6.0	7.0	6.0	6.167	0.389
13. Manitoba	6.0	6.0	6.0	6.000	0.000
14. Manitoba	6.0	6.0	6.0	6.000	0.000
15. Manitoba	6.0	6.0	6.0	6.000	0.000
16. Manitoba	6.0	7.0	6.0	6.214	0.426
17. Manitoba	6.0	7.0	6.0	6.100	0.316
1. Saskatchewan	7.0	7.0	6.0	6.667	0.577
2. Saskatchewan	6.0	6.0	6.0	6.000	0.000
3. Saskatchewan	6.0	6.0	5.0	5.750	0.500
4. Saskatchewan	6.0	6.0	6.0	6.000	0.000
5. Saskatchewan	6.0	7.0	5.0	6.100	0.568
6. Saskatchewan	6.0	7.0	6.0	6.250	0.500
7. Saskatchewan	6.0	6.0	6.0	6.000	----
8. Saskatchewan	7.0	7.0	7.0	7.000	----
9. Saskatchewan	6.0	6.0	6.0	6.000	----

Appendix 6R: Estimated percent of belly covered with scales for examined samples of *Etheostoma nigrum* and *E. olmstedii*. Location number and names correspond to those of Appendix 2.

LOCATION:	MODE	UPPER	LOWER	MEAN	SD
1. Colorado	50.0	100.0	50.0	66.667	16.615
1. Connecticut	60.0	75.0	30.0	52.143	16.797
1. Illinois	95.0	95.0	95.0	95.000	0.000
2. Illinois	100.0	100.0	90.0	98.000	4.472
3. Illinois	80.0	95.0	80.0	87.500	10.607
4. Illinois	100.0	100.0	100.0	100.000	0.000
5. Illinois	95.0	100.0	60.0	89.474	10.916
1. Indiana	100.0	100.0	80.0	99.167	3.151
2. Indiana	50.0	50.0	10.0	31.818	16.624
3. Indiana	90.0	100.0	60.0	86.667	15.055
4. Indiana	60.0	90.0	60.0	76.667	15.275
5. Indiana	90.0	100.0	90.0	95.000	7.071
6. Indiana	90.0	90.0	60.0	80.000	11.180
7. Indiana	80.0	90.0	60.0	78.500	11.068
8. Indiana	40.0	95.0	40.0	55.000	22.913
9. Indiana	80.0	95.0	80.0	87.500	10.607
1. Iowa	100.0	100.0	95.0	98.000	2.739
2. Iowa	90.0	100.0	75.0	88.636	7.447
3. Iowa	95.0	100.0	60.0	91.000	11.499
4. Iowa	80.0	100.0	80.0	89.000	8.944
5. Iowa	100.0	100.0	100.0	100.000	0.000
1. Kansas	100.0	100.0	95.0	98.333	2.582
2. Kansas	50.0	75.0	50.0	58.333	14.434
1. Kentucky	10.0	60.0	0.0	22.222	23.333
2. Kentucky	0.0	20.0	0.0	4.000	6.992
1. Maryland	80.0	80.0	10.0	52.222	25.386
2. Maryland	80.0	90.0	30.0	71.000	17.060
1. Massachusetts	95.0	100.0	75.0	89.167	9.704
1. Michigan	50.0	90.0	50.0	66.000	18.166
2. Michigan	80.0	90.0	30.0	78.636	17.043
3. Michigan	100.0	100.0	95.0	99.412	1.661
4. Michigan	90.0	100.0	50.0	87.727	13.484
5. Michigan	95.0	100.0	95.0	97.500	3.536
6. Michigan	80.0	95.0	80.0	87.143	6.986
7. Michigan	80.0	95.0	80.0	88.333	7.638

8. Michigan	100.0	100.0	60.0	86.000	17.819
9. Michigan	95.0	100.0	60.0	90.000	15.166
10. Michigan	100.0	100.0	95.0	99.167	2.041
11. Michigan	60.0	60.0	50.0	57.000	4.830
12. Michigan	30.0	90.0	30.0	61.667	26.394
13. Michigan	90.0	100.0	90.0	94.500	4.378
14. Michigan	10.0	90.0	10.0	40.000	34.378
15. Michigan	50.0	50.0	40.0	47.500	5.000
16. Michigan	75.0	95.0	30.0	69.615	18.760
17. Michigan	80.0	95.0	60.0	81.875	10.670
18. Michigan	100.0	100.0	50.0	90.714	18.355
19. Michigan	90.0	95.0	80.0	89.375	6.232
20. Michigan	50.0	80.0	20.0	40.909	18.684
21. Michigan	100.0	100.0	100.0	100.000	0.000
22. Michigan	100.0	100.0	90.0	96.250	4.787
23. Michigan	100.0	100.0	95.0	98.500	2.415
24. Michigan	100.0	100.0	95.0	99.000	2.236
25. Michigan	100.0	100.0	80.0	94.000	8.944
26. Michigan	80.0	95.0	60.0	83.000	11.106
27. Michigan	100.0	100.0	95.0	97.857	2.673
28. Michigan	75.0	95.0	75.0	86.667	10.408
29. Michigan	100.0	100.0	90.0	98.947	2.677
30. Michigan	100.0	100.0	50.0	85.000	21.213
31. Michigan	100.0	100.0	75.0	98.529	6.063
32. Michigan	100.0	100.0	80.0	91.250	9.077
33. Michigan	95.0	100.0	80.0	93.571	6.353
34. Michigan	75.0	100.0	50.0	82.941	14.584
35. Michigan	100.0	100.0	80.0	92.000	8.194
36. Michigan	10.0	80.0	10.0	26.500	20.590
37. Michigan	90.0	100.0	30.0	79.474	20.269
1. Minnesota	100.0	100.0	95.0	99.500	1.581
2. Minnesota	100.0	100.0	100.0	100.000	0.000
3. Minnesota	100.0	100.0	100.0	100.000	0.000
4. Minnesota	100.0	100.0	50.0	94.615	13.611
5. Minnesota	95.0	100.0	50.0	86.786	14.755
6. Minnesota	90.0	100.0	60.0	90.833	11.448
7. Minnesota	95.0	100.0	90.0	95.000	3.873
8. Minnesota	100.0	100.0	80.0	95.833	6.337
9. Minnesota	100.0	100.0	80.0	90.833	9.003
10. Minnesota	100.0	100.0	100.0	100.000	0.000
11. Minnesota	100.0	100.0	75.0	95.500	7.619
12. Minnesota	100.0	100.0	100.0	100.000	0.000
13. Minnesota	100.0	100.0	80.0	96.667	6.155
14. Minnesota	95.0	95.0	75.0	87.500	7.833
15. Minnesota	100.0	100.0	100.0	100.000	0.000
16. Minnesota	100.0	100.0	100.0	100.000	-----
17. Minnesota	80.0	80.0	80.0	80.000	-----
18. Minnesota	50.0	50.0	50.0	50.000	-----
19. Minnesota	60.0	90.0	60.0	70.000	17.320
20. Minnesota	80.0	90.0	80.0	85.000	7.071

21. Minnesota	30.0	80.0	30.0	54.000	25.099
22. Minnesota	40.0	60.0	40.0	50.000	14.142
23. Minnesota	80.0	100.0	50.0	82.692	14.946
24. Minnesota	100.0	100.0	100.0	100.000	0.000
25. Minnesota	90.0	100.0	40.0	87.272	16.486
26. Minnesota	100.0	100.0	20.0	84.705	19.322
27. Minnesota	80.0	100.0	50.0	83.125	15.585
1. Missouri	100.0	100.0	60.0	86.000	17.819
2. Missouri	100.0	100.0	100.0	100.000	0.000
3. Missouri	100.0	100.0	100.0	100.000	0.000
4. Missouri	100.0	100.0	100.0	100.000	0.000
5. Missouri	100.0	100.0	100.0	100.000	-----
6. Missouri	80.0	95.0	60.0	82.143	11.495
7. Missouri	100.0	100.0	100.0	100.000	-----
8. Missouri	100.0	100.0	100.0	100.000	0.000
9. Missouri	95.0	95.0	80.0	92.857	5.669
1. Nebraska	100.0	100.0	100.0	100.000	0.000
2. Nebraska	90.0	95.0	50.0	81.250	20.966
1. New Jersey	60.0	95.0	0.0	55.909	31.608
1. New Hampshire	30.0	75.0	10.0	34.167	21.545
2. New Hampshire	20.0	90.0	20.0	49.500	26.082
1. New York	100.0	100.0	80.0	94.545	7.891
2. New York	100.0	100.0	95.0	99.808	0.981
3. New York	100.0	100.0	100.0	100.000	0.000
4. New York	90.0	100.0	90.0	95.000	4.629
1. North Dakota	50.0	95.0	50.0	68.333	23.629
2. North Dakota	100.0	100.0	80.0	92.500	9.574
3. North Dakota	100.0	100.0	100.0	100.000	0.000
4. North Dakota	100.0	100.0	50.0	92.917	15.442
5. North Dakota	100.0	100.0	100.0	100.000	0.000
6. North Dakota	100.0	100.0	95.0	99.500	1.581
1. Ohio	80.0	100.0	80.0	90.000	9.129
2. Ohio	20.0	60.0	10.0	32.222	19.221
3. Ohio	100.0	100.0	100.0	100.000	0.000
4. Ohio	80.0	95.0	80.0	87.500	10.607
5. Ohio	20.0	90.0	20.0	53.333	35.119
6. Ohio	95.0	100.0	10.0	75.556	28.988
7. Ohio	100.0	100.0	90.0	96.250	4.787
8. Ohio	95.0	95.0	60.0	87.000	15.248
9. Ohio	90.0	95.0	50.0	84.000	19.170
10. Ohio	90.0	100.0	90.0	95.000	7.071
11. Ohio	30.0	60.0	30.0	33.333	10.000
12. Ohio	100.0	100.0	90.0	96.250	4.787
13. Ohio	80.0	100.0	80.0	90.625	9.425

14. Ohio	95.0	95.0	20.0	73.636	25.602
1. Pennsylvannia	50.0	60.0	30.0	48.000	10.328
2. Pennsylvannia	80.0	100.0	80.0	88.750	10.308
3. Pennsylvannia	100.0	100.0	100.0	100.000	0.000
4. Pennsylvannia	50.0	80.0	40.0	61.923	14.074
1. South Dakota	100.0	100.0	100.0	100.000	0.000
2. South Dakota	100.0	100.0	100.0	100.000	0.000
3. South Dakota	100.0	100.0	100.0	100.000	0.000
4. South Dakota	100.0	100.0	100.0	100.000	0.000
1. Tennessee	80.0	100.0	40.0	79.000	15.239
1. Vermont	100.0	100.0	95.0	99.667	1.291
1. Virginia	50.0	90.0	30.0	58.421	15.005
1. Wisconsin	100.0	100.0	90.0	98.636	3.233
2. Wisconsin	100.0	100.0	100.0	100.000	0.000
3. Wisconsin	80.0	95.0	80.0	86.000	6.583
4. Wisconsin	100.0	100.0	75.0	94.286	7.810
5. Wisconsin	100.0	100.0	100.0	100.000	0.000
6. Wisconsin	100.0	100.0	100.0	100.000	0.000
7. Wisconsin	100.0	100.0	90.0	97.143	3.934
8. Wisconsin	100.0	100.0	60.0	96.364	12.060
9. Wisconsin	100.0	100.0	95.0	98.750	2.500
10. Wisconsin	100.0	100.0	100.0	100.000	0.000
11. Wisconsin	100.0	100.0	100.0	100.000	0.000
12. Wisconsin	100.0	100.0	80.0	93.333	11.547
13. Wisconsin	80.0	90.0	75.0	83.000	6.708
14. Wisconsin	80.0	100.0	60.0	82.273	13.668
15. Wisconsin	100.0	100.0	100.0	100.000	0.000
16. Wisconsin	100.0	100.0	90.0	97.857	3.231
17. Wisconsin	100.0	100.0	100.0	100.000	0.000
18. Wisconsin	100.0	100.0	90.0	98.200	3.786
19. Wisconsin	100.0	100.0	95.0	99.792	1.021
20. Wisconsin	100.0	100.0	100.0	100.000	0.000
21. Wisconsin	100.0	100.0	100.0	100.000	0.000
22. Wisconsin	100.0	100.0	95.0	98.000	2.582
23. Wisconsin	20.0	80.0	20.0	40.000	23.094
24. Wisconsin	80.0	100.0	80.0	90.000	10.000
25. Wisconsin	100.0	100.0	50.0	97.500	9.477
26. Wisconsin	95.0	95.0	95.0	95.000	0.000
27. Wisconsin	100.0	100.0	100.0	100.000	0.000
28. Wisconsin	100.0	100.0	80.0	94.091	7.687
29. Wisconsin	80.0	95.0	50.0	82.778	10.463
30. Wisconsin	100.0	100.0	100.0	100.000	0.000
31. Wisconsin	100.0	100.0	90.0	99.130	2.455
32. Wisconsin	100.0	100.0	100.0	100.000	0.000
33. Wisconsin	95.0	95.0	30.0	78.750	32.500

34. Wisconsin	75.0	100.0	10.0	80.208	19.642
35. Wisconsin	95.0	100.0	80.0	94.444	6.346
36. Wisconsin	100.0	100.0	100.0	100.000	0.000
1. West Virginia	30.0	50.0	20.0	32.500	12.583
1. Wyoming	75.0	80.0	60.0	75.000	7.071
1. Quebec	100.0	100.0	45.0	87.692	19.323
2. Quebec	100.0	100.0	100.0	100.000	0.000
3. Quebec	75.0	100.0	5.0	72.647	24.819
4. Quebec	100.0	100.0	80.0	96.923	7.511
5. Quebec	20.0	20.0	10.0	15.556	5.270
1. Ontario	80.0	100.0	80.0	91.364	9.244
2. Ontario	80.0	90.0	80.0	85.000	7.071
3. Ontario	100.0	100.0	95.0	99.375	1.768
4. Ontario	80.0	90.0	60.0	74.583	9.876
5. Ontario	60.0	80.0	20.0	58.636	17.043
6. Ontario	100.0	100.0	95.0	98.500	2.415
7. Ontario	100.0	100.0	95.0	99.167	2.041
8. Ontario	30.0	80.0	30.0	58.462	21.831
9. Ontario	75.0	90.0	50.0	71.818	15.045
10. Ontario	80.0	90.0	75.0	81.250	6.292
11. Ontario	100.0	100.0	90.0	96.000	5.477
12. Ontario	50.0	50.0	50.0	50.000	0.000
13. Ontario	100.0	100.0	100.0	100.000	0.000
14. Ontario	100.0	100.0	100.0	100.000	-----
15. Ontario	80.0	100.0	75.0	85.500	9.560
16. Ontario	50.0	75.0	25.0	51.000	12.202
17. Ontario	50.0	90.0	20.0	49.500	20.609
18. Ontario	80.0	90.0	60.0	81.500	9.443
19. Ontario	100.0	100.0	80.0	98.214	5.409
20. Ontario	95.0	95.0	75.0	88.889	8.207
21. Ontario	100.0	100.0	100.0	100.000	0.000
22. Ontario	75.0	95.0	75.0	80.500	6.852
23. Ontario	90.0	100.0	90.0	92.143	3.934
24. Ontario	80.0	95.0	80.0	83.500	5.798
25. Ontario	10.0	50.0	10.0	19.000	16.633
26. Ontario	80.0	90.0	80.0	81.000	3.162
27. Ontario	80.0	90.0	60.0	81.429	7.703
28. Ontario	80.0	95.0	75.0	85.909	8.006
29. Ontario	50.0	90.0	30.0	54.000	21.705
30. Ontario	95.0	95.0	80.0	91.000	6.146
31. Ontario	60.0	60.0	60.0	60.000	-----
32. Ontario	80.0	100.0	75.0	82.143	8.092
33. Ontario	100.0	100.0	95.0	97.857	2.673
34. Ontario	95.0	100.0	50.0	87.000	17.981
35. Ontario	80.0	100.0	60.0	86.000	12.428
36. Ontario	10.0	60.0	0.0	20.313	19.362
37. Ontario	95.0	100.0	75.0	89.500	8.316

38. Ontario	50.0	100.0	20.0	57.083	29.806
39. Ontario	60.0	95.0	20.0	68.125	25.626
40. Ontario	80.0	95.0	60.0	84.000	11.254
41. Ontario	100.0	100.0	100.0	100.000	0.000
42. Ontario	60.0	95.0	10.0	61.250	31.253
43. Ontario	10.0	60.0	5.0	26.875	19.809
44. Ontario	20.0	75.0	10.0	32.000	23.828
45. Ontario	80.0	90.0	60.0	77.500	11.649
46. Ontario	90.0	100.0	90.0	94.000	4.183
47. Ontario	100.0	100.0	75.0	97.000	7.888
48. Ontario	100.0	100.0	75.0	96.666	7.177
1. Manitoba	40.0	60.0	5.0	31.000	23.022
2. Manitoba	80.0	100.0	60.0	86.500	11.797
3. Manitoba	100.0	100.0	95.0	98.333	2.887
4. Manitoba	95.0	100.0	60.0	90.000	14.302
5. Manitoba	75.0	90.0	50.0	74.000	13.904
6. Manitoba	90.0	90.0	80.0	86.667	5.774
7. Manitoba	25.0	50.0	25.0	37.500	17.678
8. Manitoba	30.0	40.0	20.0	32.000	6.325
9. Manitoba	20.0	60.0	20.0	28.000	17.889
10. Manitoba	90.0	95.0	90.0	91.667	2.887
11. Manitoba	95.0	100.0	80.0	90.000	8.062
12. Manitoba	100.0	100.0	100.0	100.000	0.000
13. Manitoba	95.0	100.0	75.0	90.000	9.220
14. Manitoba	95.0	100.0	80.0	94.167	5.573
15. Manitoba	95.0	100.0	80.0	95.000	5.641
16. Manitoba	60.0	95.0	30.0	72.500	22.079
17. Manitoba	90.0	95.0	10.0	64.500	34.837
1. Saskatchewan	50.0	75.0	50.0	58.333	14.434
2. Saskatchewan	25.0	25.0	25.0	25.000	0.000
3. Saskatchewan	25.0	90.0	25.0	65.000	27.988
4. Saskatchewan	100.0	100.0	100.0	100.000	0.000
5. Saskatchewan	100.0	100.0	90.0	98.000	3.496
6. Saskatchewan	100.0	100.0	100.0	100.000	0.000
7. Saskatchewan	100.0	100.0	100.0	100.000	-----
8. Saskatchewan	100.0	100.0	100.0	100.000	-----
9. Saskatchewan	75.0	75.0	75.0	75.000	-----

APPENDIX 7

Appendix 7: Frequency distribution table of the number of scales on the opercle, cheek, nape-parietal juncture area (NCT), nape and breast from 2111 *Etheostoma nigrum*.

# of Scales	Body area examined				
	Opercle	Cheek	NCT	Nape	Breast
0	11	1622	1310	1355	1428
1	18	57	42	45	36
2	39	36	117	45	45
3	50	19	55	37	24
4	79	15	373	50	26
5	122	22	154	29	18
6	141	7	45	26	13
7	126	10	8	25	8
8	156	11	5	26	13
9	151	6	-	17	9
10	161	15	1	16	11
11	133	8	1	14	6
12	146	12	-	13	8
13	111	13	-	8	5
14	103	10	-	7	4
15	78	10	-	10	10
16	85	6	-	8	10
17	59	7	-	8	3
18	60	7	-	2	3
19	50	11	-	5	6
20	44	17	-	8	6
21	35	8	-	5	3
22	42	10	-	6	6
23	24	7	-	8	4
24	16	12	-	9	5
25	14	6	-	2	8
26	15	5	-	4	7
27	14	10	-	5	3
28	7	6	-	5	7
29	4	9	-	7	1
30	5	8	-	5	7
31	1	10	-	5	6
32	4	4	-	10	3
33	2	8	-	7	-
34	1	11	-	12	4
35	3	4	-	17	2
36	1	5	-	11	3
37	-	5	-	10	4
38	-	1	-	16	4

Appendix 7: Continued.

# of Scales	Body area examined				
	Opercle	Cheek	NCT	Nape	Breast
39	-	6	-	6	3
40	-	10	-	13	1
41	-	5	-	13	3
42	-	3	-	11	1
43	-	7	-	13	2
44	-	3	-	12	4
45	-	3	-	16	4
46	-	6	-	15	4
47	-	3	-	15	4
48	-	1	-	15	6
49	-	3	-	13	5
50	-	1	-	9	4
51	-	2	-	10	4
52	-	4	-	9	6
53	-	-	-	7	4
54	-	2	-	8	4
55	-	-	-	6	1
56	-	-	-	6	6
57	-	-	-	2	6
58	-	-	-	3	3
59	-	1	-	4	2
60	-	-	-	3	2
61	-	-	-	1	3
62	-	-	-	2	2
63	-	-	-	-	1
64	-	-	-	-	6
65	-	-	-	-	4
66	-	1	-	-	8
67	-	-	-	-	4
68	-	-	-	-	5
69	-	-	-	-	3
70	-	-	-	-	4
71	-	-	-	-	3
72	-	-	-	-	4
73	-	-	-	-	4
74	-	-	-	-	9
75	-	-	-	-	3
76	-	-	-	-	7
77	-	-	-	-	11
78	-	-	-	-	6
79	-	-	-	-	8
80	-	-	-	-	7
81	-	-	-	-	3
82	-	-	-	-	7

Appendix 7: Continued.

# of Scales	Body area examined				
	Opercle	Cheek	NCT	Nape	Breast
83	-	-	-	-	2
84	-	-	-	-	3
85	-	-	-	-	7
86	-	-	-	-	3
87	-	-	-	-	5
88	-	-	-	-	9
89	-	-	-	-	6
90	-	-	-	-	5
91	-	-	-	-	5
92	-	-	-	-	7
93	-	-	-	-	4
94	-	-	-	-	3
95	-	-	-	-	8
96	-	-	-	-	5
97	-	-	-	-	5
98	-	-	-	-	4
99	-	-	-	-	4
100	-	-	-	-	5
101	-	-	-	-	1
102	-	-	-	-	2
103	-	-	-	-	4
104	-	-	-	-	2
105	-	-	-	-	6
106	-	-	-	-	4
107	-	-	-	-	1
108	-	-	-	-	2
109	-	-	-	-	4
110	-	-	-	-	6
111	-	-	-	-	1
112	-	-	-	-	2
113	-	-	-	-	1
114	-	-	-	-	1
115	-	-	-	-	1
116	-	-	-	-	1
117	-	-	-	-	2
118	-	-	-	-	-
119	-	-	-	-	-
120	-	-	-	-	4
121	-	-	-	-	2
122	-	-	-	-	1
123	-	-	-	-	1
124	-	-	-	-	1
125	-	-	-	-	-
126	-	-	-	-	1

Appendix 7: Continued.

# of Scales	Body area examined				
	Opercle	Cheek	NCT	Nape	Breast
127	-	-	-	-	1
128	-	-	-	-	-
129	-	-	-	-	2
130	-	-	-	-	1
131	-	-	-	-	1
132	-	-	-	-	-
133	-	-	-	-	-
134	-	-	-	-	1
135	-	-	-	-	-
136	-	-	-	-	-
137	-	-	-	-	-
138	-	-	-	-	-
139	-	-	-	-	1
140	-	-	-	-	-
141	-	-	-	-	-
142	-	-	-	-	1
143	-	-	-	-	1
144	-	-	-	-	-
145	-	-	-	-	-
146	-	-	-	-	-
147	-	-	-	-	-
148	-	-	-	-	-
149	-	-	-	-	-
150	-	-	-	-	-
151	-	-	-	-	-
152	-	-	-	-	-
153	-	-	-	-	-
154	-	-	-	-	-
155	-	-	-	-	-
156	-	-	-	-	1

APPENDIX 8

Appendix 8: Chi-square calculations at all polymorphic loci for populations of *Etheostoma nigrum* analyzed using electrophoresis.

McVicars Creek, Ontario *PGM-1**

AA=44 AB=06 BB=01

$$p = \frac{2 \times 44 + 6}{2 \times 51} = 0.921568627$$

$$q = 1 - p = 0.078431373$$

Expected Frequencies

$$AA = 51 \times .921568627^2 = 43.31372545$$

$$AB = 2 \times 51 \times 0.921568627 \times 0.078431373 = 7.372549058$$

$$BB = 51 \times 0.078431373^2 = 0.313725494$$

Chi-square

$$AA = \frac{(44 - 43.31372545)^2}{43.31372545} = 0.010873522$$

$$AB = \frac{(6 - 7.372549058)^2}{7.372549058} = 0.255527756$$

$$BB = \frac{(1 - 0.313725494)^2}{0.31372549058} = 1.501225455$$

$$\text{Chi-square} = 1.767626733$$

$$df = 1$$

$$P > 0.10 \quad \text{NS}$$

McVicars Creek, Ontario ME-2*

$$AA=12 \ AB=28 \ BB=11$$

$$p = \frac{2 \times 12 + 28}{2 \times 51} = 0.509803922 \qquad q = 1 - p = 0.490196078$$

Expected Frequencies

$$AA = 51 \times 0.509803922^2 = 13.25490198$$

$$AB = 2 \times 51 \times 0.509803922 \times 0.490196078 = 25.49019608$$

$$BB = 51 \times 0.490196078^2 = 12.25490194$$

Chi-square

$$AA = \frac{(12 - 13.25490198)^2}{13.25490198} = 0.11880729$$

$$AB = \frac{(28 - 25.49019608)^2}{25.49019608} = 0.247119155$$

$$BB = \frac{(11 - 12.25490194)^2}{12.25490194} = 0.128501957$$

$$\text{Chi-square} = 0.494428402$$

$$df = 1$$

$$P > 0.40 \quad NS$$

McVicars Creek, Ontario PGM-2*

$$AA=42 \ AB=09 \ BB=00$$

$$p = \frac{2 \times 42 + 9}{2 \times 51} = 0.911764706 \quad q = 1 - p = 0.088235294$$

Expected Frequencies

$$AA = 51 \times 0.911764706^2 = 42.39705883$$

$$AB = 2 \times 51 \times 0.911764706 \times 0.088235294 = 8.205882343$$

$$BB = 51 \times 0.088235294^2 = 0.397058822$$

Chi-square

$$AA = \frac{(42 - 42.39705883)^2}{42.39705883} = 0.003718553$$

$$AB = \frac{(9 - 8.205882343)^2}{8.205882343} = 0.076850097$$

$$BB = \frac{(0 - 0.397058822)^2}{0.397058822} = 0.397058822$$

$$\text{Chi-square} = 0.477627472$$

$$df = 1$$

$$P > 0.40 \quad \text{NS}$$

McVicars Creek, Ontario PGDH*

$$AA=14 \ AB=24 \ BB=13$$

$$p = \frac{2 \times 14 + 24}{2 \times 51} = 0.509803922 \quad q = 1 - p = 0.490196078$$

Expected Frequencies

$$AA = 51 \times 0.509803922^2 = 13.25490198$$

$$AB = 2 \times 51 \times 0.509803922 \times 0.490196078 = 25.49019608$$

$$BB = 51 \times 0.490196078^2 = 12.25490194$$

Chi-square

$$AA = \frac{(14 - 13.25490198)^2}{13.25490198} = 0.041884207$$

$$AB = \frac{(24 - 25.49019608)^2}{25.49019608} = 0.087119156$$

$$BB = \frac{(13 - 12.25490194)^2}{12.25490194} = 0.045301963$$

$$\text{Chi-square} = 0.174305326$$

$$df = 1$$

$$P > 0.60 \quad \text{NS}$$

McVicars Creek, Ontario EST-3*

AA=28 AB=20 BB=03

$$p = \frac{2 \times 28 + 20}{2 \times 51} = 0.745098039 \quad q = 1 - p = 0.254901961$$

Expected Frequencies

$$AA = 51 \times 0.745098039^2 = 28.31372547$$

$$AB = 2 \times 51 \times 0.745098039 \times 0.254901961 = 19.37254903$$

$$BB = 51 \times 0.254901961^2 = 3.313725496$$

Chi-square

$$AA = \frac{(28 - 28.31372547)^2}{28.31372547} = 0.003476182$$

$$AB = \frac{(20 - 19.37254903)^2}{19.37254903} = 0.020322298$$

$$BB = \frac{(3 - 3.313725496)^2}{3.313725496} = 0.029701823$$

$$\text{Chi-square} = 0.053500303$$

$$df = 1$$

$$P > 0.80 \quad \text{NS}$$

McVicars Creek, Ontario *EST-1**, *IDH**-Liver, *LDH-B** and *G3PDH**

AA=50 AB=01 BB=00

$$p = \frac{2 \times 50 + 1}{2 \times 51} = 0.990196078 \quad q = 1 - p = 0.009803922$$

Expected Frequencies

$$AA = 51 \times 0.990196078^2 = 50.0049192$$

$$AB = 2 \times 51 \times 0.990196078 \times 0.009803922 = 0.990196122$$

$$BB = 51 \times 0.009803922^2 = 0.004901961$$

Chi-square

$$AA = \frac{(50 - 50.0049192)^2}{50.0049192} = 0.000000484$$

$$AB = \frac{(1 - 0.990196122)^2}{0.990196122} = 0.000097068$$

$$BB = \frac{(0 - 0.004901961)^2}{0.004901961} = 0.004901961$$

$$\text{Chi-square} = 0.004999513$$

$$df = 1$$

$$P > 0.80 \quad \text{NS}$$

Neebing-McIntyre River, Ontario *PGM-I**

AA=52 AB=04 BB=00

$$p = \frac{2 \times 52 + 4}{2 \times 56} = 0.964285714 \quad q = 1 - p = 0.035714286$$

Expected Frequencies

$$AA = 56 \times 0.964285714^2 = 52.07142854$$

$$AB = 2 \times 56 \times 0.964285714 \times 0.035714286 = 3.857142887$$

$$BB = 56 \times 0.035714286^2 = 0.071428573$$

Chi-square

$$AA = \frac{(52 - 52.07142854)^2}{52.07142854} = 0.000097981$$

$$AB = \frac{(4 - 3.857142887)^2}{3.857142887} = 0.005291003$$

$$BB = \frac{(0 - 0.071428573)^2}{0.071428573} = 0.071428573$$

Chi-square = 0.076817557

df = 1

P > 0.70 NS

Neebing-McIntyre River, Ontario PGM-2*

$$AA=20 \quad AB=25 \quad BB=11$$

$$p = \frac{2 \times 20 + 25}{2 \times 56} = 0.580357143 \quad q = 1 - p = 0.419642857$$

Expected Frequencies

$$AA = 56 \times 0.580357143^2 = 18.86160715$$

$$AB = 2 \times 56 \times 0.580357143 \times 0.419642857 = 27.27678571$$

$$BB = 56 \times 0.419642857^2 = 9.861607136$$

Chi-square

$$AA = \frac{(20 - 18.86160715)^2}{18.86160715} = 0.068707734$$

$$AB = \frac{(25 - 27.27678571)^2}{27.27678571} = 0.190042669$$

$$BB = \frac{(11 - 9.861607136)^2}{9.861607136} = 0.131412486$$

$$\text{Chi-square} = 0.390162889$$

$$df = 1$$

$$P > 0.50 \quad \text{NS}$$

Neebing-McIntyre River, Ontario ME-2*

AA=39 AB=16 BB=01

$$p = \frac{2 \times 39 + 16}{2 \times 56} = 0.839285714 \quad q = 1 - p = 0.160714286$$

Expected Frequencies

$$AA = 56 \times 0.839285714^2 = 39.44642854$$

$$AB = 2 \times 56 \times 0.839285714 \times 0.160714286 = 15.10714288$$

$$BB = 56 \times 0.160714286^2 = 1.446428577$$

Chi-square

$$AA = \frac{(39 - 39.44642854)^2}{39.44642854} = 0.005052382$$

$$AB = \frac{(16 - 15.10714288)^2}{15.10714288} = 0.052769332$$

$$BB = \frac{(1 - 1.446428577)^2}{1.446428577} = 0.137786599$$

$$\text{Chi-square} = 0.195608313$$

$$df = 1$$

$$P > 0.60 \quad \text{NS}$$

Neebing-McIntyre River, Ontario *G3PDH*

AA=53 AB=03 BB=00

$$p = \frac{2 \times 53 + 3}{2 \times 56} = 0.973214286 \quad q = 1 - p = 0.026785714$$

Expected Frequencies

$$AA = 56 \times 0.973214286^2 = 53.0401786$$

$$AB = 2 \times 56 \times 0.973214286 \times 0.026785714 = 2.919642827$$

$$BB = 56 \times 0.026785714^2 = 0.040178571$$

Chi-square

$$AA = \frac{(53 - 53.0401786)^2}{53.0401786} = 0.000030436$$

$$AB = \frac{(3 - 2.919642827)^2}{2.919642827} = 0.002211666$$

$$BB = \frac{(0 - 0.040178571)^2}{0.040178571} = 0.040178571$$

$$\text{Chi-square} = 0.042420673$$

$$df = 1$$

$$P > 0.80 \quad \text{NS}$$

Neebing-McIntyre River, Ontario PGDH*

AA=28 AB=22 BB=06

$$p = \frac{2 \times 28 + 22}{2 \times 56} = 0.696428571 \quad q = 1 - p = 0.303571429$$

Expected Frequencies

$$AA = 56 \times 0.696428571^2 = 27.16071425$$

$$AB = 2 \times 56 \times 0.696428571 \times 0.303571429 = 23.67857145$$

$$BB = 56 \times 0.303571429^2 = 5.1607143$$

Chi-square

$$AA = \frac{(28 - 27.16071425)^2}{27.16071425} = 0.025934538$$

$$AB = \frac{(22 - 23.67857145)^2}{23.67857145} = 0.118993754$$

$$BB = \frac{(6 - 5.1607143)^2}{5.1607143} = 0.136492827$$

$$\text{Chi-square} = 0.281421119$$

$$df = 1$$

$$P > 0.50 \quad NS$$

Neebing-McIntyre River, Ontario *EST-I**

AA=55 AB=01 BB=00

$$p = \frac{2 \times 55 + 1}{2 \times 56} = 0.991071429 \quad q = 1 - p = 0.008928571$$

Expected Frequencies

$$AA = 56 \times 0.991071429^2 = 55.00446433$$

$$AB = 2 \times 56 \times 0.991071429 \times 0.008928571 = 0.991071381$$

$$BB = 56 \times 0.008928571^2 = 0.004464285$$

Chi-square

$$AA = \frac{(55 - 55.00446433)^2}{55.00446433} = 0.000000362$$

$$AB = \frac{(1 - 0.991071381)^2}{0.991071381} = 0.000080438$$

$$BB = \frac{(0 - 0.004464285)^2}{0.004464285} = 0.004464285$$

$$\text{Chi-square} = 0.004545085$$

$$df = 1$$

$$P > 0.90 \quad \text{NS}$$

Neebing-McIntyre River, Ontario EST-3*

$$AA=33 \quad AB=20 \quad BB=03$$

$$p = \frac{2 \times 33 + 20}{2 \times 56} = 0.767857143 \quad q = 1 - p = 0.232142857$$

Expected Frequencies

$$AA = 56 \times 0.767857143^2 = 33.01785716$$

$$AB = 2 \times 56 \times 0.767857143 \times 0.232142857 = 19.96428571$$

$$BB = 56 \times 0.232142857^2 = 3.017857139$$

Chi-square

$$AA = \frac{(33 - 33.01785716)^2}{33.01785716} = 0.000009658$$

$$AB = \frac{(20 - 19.96428571)^2}{19.96428571} = 0.00006389$$

$$BB = \frac{(3 - 3.017857139)^2}{3.017857139} = 0.000105664$$

$$\text{Chi-square} = 0.000179212$$

$$df = 1$$

$$P > 0.90 \quad \text{NS}$$

Upper St. Croix Lake, Wisconsin PGM-2*

AA=31 AC=03 CC=00

$$p = \frac{2 \times 31 + 3}{2 \times 34} = 0.955882353 \quad q = 1 - p = 0.044117647$$

Expected Frequencies

$$AA = 34 \times 0.955882353^2 = 31.06617647$$

$$AC = 2 \times 34 \times 0.955882353 \times 0.044117647 = 2.867647055$$

$$CC = 34 \times 0.044117647^2 = 0.06617647$$

Chi-square

$$AA = \frac{(31 - 31.06617647)^2}{31.06617647} = 0.000140968$$

$$AC = \frac{(3 - 2.867647055)^2}{2.867647055} = 0.006108598$$

$$CC = \frac{(0 - 0.06617647)^2}{0.06617647} = 0.06617647$$

$$\text{Chi-square} = 0.072426036$$

$$df = 1$$

$$P > 0.70 \quad \text{NS}$$

Upper St. Croix Lake, Wisconsin LDH-A*

AA=33 AB=01 BB=00

$$p = \frac{2 \times 33 + 1}{2 \times 34} = 0.985294118 \quad q = 1 - p = 0.014705882$$

Expected Frequencies

$$AA = 34 \times 0.985294118^2 = 33.00735296$$

$$AB = 2 \times 34 \times 0.985294118 \times 0.014705882 = 0.985294094$$

$$BB = 34 \times 0.014705882^2 = 0.007352941$$

Chi-square

$$AA = \frac{(33 - 33.00735296)^2}{33.00735296} = 0.000001638$$

$$AB = \frac{(1 - 0.985294094)^2}{0.985294094} = 0.000219491$$

$$BB = \frac{(0 - 0.007352941)^2}{0.007352941} = 0.007352941$$

$$\text{Chi-square} = 0.00757407$$

$$df = 1$$

$$P > 0.90 \quad \text{NS}$$

Upper St. Croix Lake, Wisconsin AAT-3,4*

AA=09 AB=18 BB=07

$$p = \frac{2 \times 9 + 18}{2 \times 34} = 0.529411765 \quad q = 1 - p = 0.470588235$$

Expected Frequencies

$$AA = 34 \times 0.529411765^2 = 9.52941175$$

$$AB = 2 \times 34 \times 0.529411765 \times 0.470588235 = 16.94117647$$

$$BB = 34 \times 0.470588235^2 = 7.529411755$$

Chi-square

$$AA = \frac{(9 - 9.52941175)^2}{9.52941175} = 0.029411763$$

$$AB = \frac{(18 - 16.94117647)^2}{16.94117647} = 0.066176471$$

$$BB = \frac{(7 - 7.529411755)^2}{7.529411755} = 0.037224263$$

Chi-square = 0.132812497

df = 1

P > 0.70 NS

Upper St. Croix Lake, Wisconsin ME-2*

AA=07 AB=18 BB=09

$$p = \frac{2 \times 7 + 18}{2 \times 34} = 0.470588235 \quad q = 1 - p = 0.529411765$$

Expected Frequencies

$$AA = 34 \times 0.470588235^2 = 7.529411755$$

$$AB = 2 \times 34 \times 0.470588235 \times 0.529411765 = 16.94117647$$

$$BB = 34 \times 0.529411765^2 = 9.529411775$$

Chi-square

$$AA = \frac{(7 - 7.529411755)^2}{7.529411755} = 0.037224263$$

$$AB = \frac{(18 - 16.94117647)^2}{16.94117647} = 0.066176471$$

$$BB = \frac{(9 - 9.529411775)^2}{9.529411775} = 0.029411766$$

Chi-square = 0.1328125

df = 1

P > 0.70 NS

Little Dog Lake, Ontario *LDH-A**

AA=65 AB=03 BB=00

$$p = \frac{2 \times 65 + 3}{2 \times 68} = 0.977941176 \quad q = 1 - p = 0.022058824$$

Expected Frequencies

$$AA = 68 \times 0.977941176^2 = 65.03308817$$

$$AB = 2 \times 68 \times 0.977941176 \times 0.022058824 = 2.933823591$$

$$BB = 68 \times 0.022058824^2 = 0.033088237$$

Chi-square

$$AA = \frac{(65 - 65.03308817)^2}{65.03308817} = 0.000016835$$

$$AB = \frac{(3 - 2.933823591)^2}{2.933823591} = 0.0014927$$

$$BB = \frac{(0 - 0.033088237)^2}{0.033088237} = 0.033088237$$

$$\text{Chi-square} = 0.034597772$$

$$df = 1$$

$$P > 0.80 \quad \text{NS}$$

Big Arbor Vitae Lake, Wisconsin LDH-A*

AA=57 AB=02 BB=00

$$p = \frac{2 \times 57 + 2}{2 \times 59} = 0.983050857 \quad q = 1 - p = 0.016949153$$

Expected Frequencies

$$AA = 59 \times 0.983050857^2 = 57.01695026$$

$$AB = 2 \times 59 \times 0.983050857 \times 0.016949153 = 1.966101767$$

$$BB = 59 \times 0.016949153^2 = 0.016949153$$

Chi-square

$$AA = \frac{(57 - 57.01695026)^2}{57.01695026} = 0.000005039$$

$$AB = \frac{(2 - 1.966101767)^2}{1.966101767} = 0.000584451$$

$$BB = \frac{(0 - 0.016949153)^2}{0.016949153} = 0.016949153$$

$$\text{Chi-square} = 0.017538643$$

$$df = 1$$

$$P > 0.80 \quad NS$$

Big Arbor Vitae Lake, Wisconsin *IDH*^{*}-White muscle

$$AA=48 \ AB=11 \ BB=00$$

$$p = \frac{2 \times 48 + 11}{2 \times 59} = 0.906779661 \quad q = 1 - p = 0.093220339$$

Expected Frequencies

$$AA = 59 \times 0.906779661^2 = 48.51271186$$

$$AB = 2 \times 59 \times 0.906779661 \times 0.093220339 = 9.974576273$$

$$BB = 59 \times 0.093220339^2 = 0.512711865$$

Chi-square

$$AA = \frac{(48 - 48.51271186)^2}{48.51271186} = 0.005418651$$

$$AB = \frac{(11 - 9.974576273)^2}{9.974576273} = 0.105417392$$

$$BB = \frac{(0 - 0.512711865)^2}{0.512711865} = 0.512711865$$

$$\text{Chi-square} = 0.623547908$$

$$df = 1$$

$$P > 0.40 \quad \text{NS}$$

Big Arbor Vitae Lake, Wisconsin ME-2*

$$AA=15 \ AB=30 \ BB=14$$

$$p = \frac{2 \times 15 + 30}{2 \times 59} = 0.508474576 \quad q = 1 - p = 0.491525424$$

Expected Frequencies

$$AA = 59 \times 0.508474576^2 = 15.25423727$$

$$AB = 2 \times 59 \times 0.508474576 \times 0.491525424 = 29.49152542$$

$$BB = 59 \times 0.491525424^2 = 14.2542373$$

Chi-square

$$AA = \frac{(15 - 15.25423727)^2}{15.25423727} = 0.004237288$$

$$AB = \frac{(30 - 29.49152543)^2}{29.49152542} = 0.008766803$$

$$BB = \frac{(14 - 14.2542373)^2}{14.2542373} = 0.004534554$$

$$\text{Chi-square} = 0.017538645$$

$$df = 1$$

$$P > 0.80 \quad NS$$

Puckaway Lake, Wisconsin LDH-B*

AA=13 AB=02 BB=00

$$p = \frac{2 \times 13 + 2}{2 \times 15} = 0.933333333 \quad q = 1 - p = 0.066666667$$

Expected Frequencies

$$AA = 15 \times 0.933333333^2 = 13.06666666$$

$$AB = 2 \times 15 \times 0.933333333 \times 0.066666667 = 1.86666675$$

$$BB = 15 \times 0.066666667^2 = 0.066666667$$

Chi-square

$$AA = \frac{(13 - 13.06666666)^2}{13.06666666} = 0.000340136$$

$$AB = \frac{(2 - 1.86666675)^2}{1.86666675} = 0.009523808$$

$$BB = \frac{(0 - 0.066666667)^2}{0.066666667} = 0.066666667$$

$$\text{Chi-square} = 0.076530611$$

$$df = 1$$

$$P > 0.70 \quad \text{NS}$$

Puckaway Lake, Wisconsin ME-2*

AA=05 AB=07 BB=03

$$p = \frac{2 \times 5 + 7}{2 \times 15} = 0.56666667 \quad q = 1 - p = 0.43333333$$

Expected Frequencies

$$AA = 15 \times 0.56666667^2 = 4.81666672$$

$$AB = 2 \times 15 \times 0.56666667 \times 0.43333333 = 7.36666665$$

$$BB = 15 \times 0.43333333^2 = 2.81666662$$

Chi-square

$$AA = \frac{(5 - 4.81666672)^2}{4.81666672} = 0.006978085$$

$$AB = \frac{(7 - 7.36666665)^2}{7.36666665} = 0.018250377$$

$$BB = \frac{(3 - 2.81666662)^2}{2.81666662} = 0.0119329939$$

$$\text{Chi-square} = 0.037161401$$

$$df = 1$$

$$P > 0.80 \quad \text{NS}$$

Puckaway Lake, Wisconsin *IDH*^{*}-Liver

AA=14 AB=01 BB=00

$$p = \frac{2 \times 14 + 1}{2 \times 15} = 0.966666667 \quad q = 1 - p = 0.033333333$$

Expected Frequencies

$$AA = 15 \times 0.966666667^2 = 14.01666668$$

$$AB = 2 \times 15 \times 0.966666667 \times 0.033333333 = 0.966666657$$

$$BB = 15 \times 0.033333333^2 = 0.016666667$$

Chi-square

$$AA = \frac{(14 - 14.01666668)^2}{14.01666668} = 0.000019818$$

$$AB = \frac{(1 - 0.966666657)^2}{0.966666657} = 0.001149426$$

$$BB = \frac{(0 - 0.016666667)^2}{0.016666667} = 0.016666667$$

$$\text{Chi-square} = 0.017835911$$

$$df = 1$$

$$P > 0.80 \quad \text{NS}$$

Puckaway Lake, Wisconsin AAT-3,4*

AA=00 AB=04 BB=11

$$p = \frac{2 \times 0 + 4}{2 \times 15} = 0.13333333$$

$$q = 1 - p = 0.86666667$$

Expected Frequencies

$$AA = 15 \times 0.13333333^2 = 0.266666665$$

$$AB = 2 \times 15 \times 0.13333333 \times 0.86666667 = 3.466666659$$

$$BB = 15 \times 0.86666667^2 = 11.26666668$$

Chi-square

$$AA = \frac{(0 - 0.266666665)^2}{0.266666665} = 0.266666665$$

$$AB = \frac{(4 - 3.466666659)^2}{3.466666659} = 0.082051285$$

$$BB = \frac{(11 - 11.26666668)^2}{11.26666668} = 0.006311638$$

$$\text{Chi-square} = 0.355029589$$

$$df = 1$$

$$P > 0.50 \quad \text{NS}$$

Silver Falls Creek, Ontario *EST-I**

AA=08 AB=01 BB=00

$$p = \frac{2 \times 8 + 1}{2 \times 9} = 0.944444444$$

$$q = 1 - p = 0.055555556$$

Expected Frequencies

$$AA = 9 \times 0.944444444^2 = 8.02777777$$

$$AB = 2 \times 9 \times 0.944444444 \times 0.055555556 = 0.944444452$$

$$BB = 9 \times 0.055555556^2 = 0.027777778$$

Chi-square

$$AA = \frac{(8 - 8.02777777)^2}{8.02777777} = 0.000096117$$

$$AB = \frac{(1 - 0.944444452)^2}{0.944444452} = 0.003267973$$

$$BB = \frac{(0 - 0.027777778)^2}{0.027777778} = 0.027777778$$

$$\text{Chi-square} = 0.031141868$$

$$df = 1$$

$$P > 0.80 \quad \text{NS}$$

Silver Falls Creek, Ontario ME-2*

AA=03 AB=05 BB=01

$$p = \frac{2 \times 3 + 5}{2 \times 9} = 0.61111111$$

$$q = 1 - p = 0.38888889$$

Expected Frequencies

$$AA = 9 \times 0.61111111^2 = 3.36111111$$

$$AB = 2 \times 9 \times 0.61111111 \times 0.38888889 = 4.27777778$$

$$BB = 9 \times 0.38888889^2 = 1.36111111$$

Chi-square

$$AA = \frac{(3 - 3.36111111)^2}{3.36111111} = 0.038797061$$

$$AB = \frac{(5 - 4.27777778)^2}{4.27777778} = 0.121933622$$

$$BB = \frac{(1 - 1.36111111)^2}{1.36111111} = 0.095804989$$

$$\text{Chi-square} = 0.256535672$$

$$df = 1$$

$$P > 0.60 \quad \text{NS}$$

Silver Falls Creek, Ontario AAT-3,4*

AA=01 AB=08 BB=00

$$p = \frac{2 \times 1 + 8}{2 \times 9} = 0.55555556$$

$$q = 1 - p = 0.44444444$$

Expected Frequencies

$$AA = 9 \times 0.55555556^2 = 2.77777782$$

$$AB = 2 \times 9 \times 0.55555556 \times 0.44444444 = 4.44444444$$

$$BB = 9 \times 0.44444444^2 = 1.77777774$$

Chi-square

$$AA = \frac{(1 - 2.77777782)^2}{2.77777782} = 1.13777781$$

$$AB = \frac{(8 - 4.44444444)^2}{4.44444444} = 2.84444445$$

$$BB = \frac{(0 - 1.77777774)^2}{1.77777774} = 1.77777774$$

Chi-square = 5.76

df = 1

P < 0.01 Highly significant

Prelate Lake, Ontario AAT-3,4'

AA=26 AC=08 CC=01

$$p = \frac{2 \times 26 + 8}{2 \times 35} = 0.857142857 \quad q = 1 - p = 0.142857143$$

Expected Frequencies

$$AA = 35 \times 0.857142857^2 = 25.71428571$$

$$AC = 2 \times 35 \times 0.857142857 \times 0.142857143 = 8.571428579$$

$$CC = 35 \times 0.142857143^2 = 0.714285716$$

Chi-square

$$AA = \frac{(26 - 25.71428571)^2}{25.71428571} = 0.003174603$$

$$AC = \frac{(8 - 8.571428579)^2}{8.571428579} = 0.038095239$$

$$CC = \frac{(1 - 0.714285716)^2}{0.714285716} = 0.114285713$$

Chi-square = 0.155555555

df = 3

P > 0.60 NS

Nipigon River, Ontario *IDH*-Liver

AA=64 AB=02 BB=00

$$p = \frac{2 \times 64 + 2}{2 \times 66} = 0.984848485 \quad q = 1 - p = 0.015151515$$

Expected Frequencies

$$AA = 66 \times 0.984848485^2 = 64.01515153$$

$$AB = 2 \times 66 \times 0.984848485 \times 0.015151515 = 1.96969695$$

$$BB = 66 \times 0.015151515^2 = 0.015151515$$

Chi-square

$$AA = \frac{(64 - 64.01515153)^2}{64.01515153} = 0.000003586$$

$$AB = \frac{(2 - 1.96969695)^2}{1.96969695} = 0.000466201$$

$$BB = \frac{(0 - 0.015151515)^2}{0.015151515} = 0.015151515$$

Chi square = 0.015621302

df = 1

P > 0.90 NS

Sandstone Lake, Ontario *EST-I**

AA=91 AB=01 BB=00

$$p = \frac{2 \times 91 + 1}{2 \times 92} = 0.994565217 \quad q = 1 - p = 0.005434783$$

Expected Frequencies

$$AA = 92 \times 0.994565217^2 = 91.00271732$$

$$AB = 2 \times 92 \times 0.994565217 \times 0.005434783 = 0.994565289$$

$$BB = 92 \times 0.005434783^2 = 0.002717391$$

Chi-square

$$AA = \frac{(91 - 91.00271732)^2}{91.00271732} = 0.000000081$$

$$AB = \frac{(1 - 0.994565289)^2}{0.994565289} = 0.000029697$$

$$BB = \frac{(0 - 0.002717391)^2}{0.002717391} = 0.002717391$$

$$\text{Chi-square} = 0.002747169$$

$$df = 1$$

$$P > 0.90 \quad \text{NS}$$

Flambeau River, Wisconsin PGDH*

AA=04 AB=07 BB=05

$$p = \frac{2 \times 4 + 7}{2 \times 16} = 0.46875$$

$$q = 1 - p = 0.53125$$

Expected Frequencies

$$AA = 16 \times 0.46875^2 = 3.515625$$

$$AB = 2 \times 16 \times 0.46875 \times 0.53125 = 7.96875$$

$$BB = 16 \times 0.53125^2 = 4.515625$$

Chi-square

$$AA = \frac{(2 - 3.515625)^2}{3.515625} = 0.066736111$$

$$AB = \frac{(7 - 7.96875)^2}{7.96875} = 0.117769608$$

$$BB = \frac{(5 - 4.515625)^2}{4.515625} = 0.05195718$$

$$\text{Chi-square} = 0.236462899$$

$$df = 1$$

$$P > 0.60 \quad \text{NS}$$

Flambeau River, Wisconsin *GPI-A, *GPI-B****

AA=14 AB=02 BB=00

$$p = \frac{2 \times 14 + 2}{2 \times 16} = 0.9375$$

$$q = 1 - p = 0.0625$$

Expected Frequencies

$$AA = 16 \times 0.9375^2 = 14.0625$$

$$AB = 2 \times 16 \times 0.9375 \times 0.0625 = 1.875$$

$$BB = 16 \times 0.0625^2 = 0.0625$$

Chi-square

$$AA = \frac{(14 - 14.0625)^2}{14.0625} = 0.000277778$$

$$AB = \frac{(2 - 1.875)^2}{1.875} = 0.008333333$$

$$BB = \frac{(0 - 0.0625)^2}{0.0625} = 0.0625$$

$$\text{Chi-square} = 0.071111111$$

$$df = 1$$

$$P > 0.70 \quad \text{NS}$$

Flambeau River, Wisconsin AAT-1,2*

AA=15 AB=01 BB=00

$$p = \frac{2 \times 15 + 1}{2 \times 16} = 0.96875$$

$$q = 1 - p = 0.03125$$

Expected Frequencies

$$AA = 16 \times 0.96875^2 = 15.015625$$

$$AB = 2 \times 16 \times 0.96875 \times 0.03125 = 0.96875$$

$$BB = 16 \times 0.03125^2 = 0.015625$$

Chi-square

$$AA = \frac{(15 - 15.015625)^2}{15.015625} = 0.000016259$$

$$AB = \frac{(1 - 0.96875)^2}{0.96875} = 0.001008065$$

$$BB = \frac{(0 - 0.015625)^2}{0.015625} = 0.015625$$

$$\text{Chi-square} = 0.016649324$$

$$df = 1$$

$$P > 0.80 \quad \text{NS}$$

Whitefish Lake, Wisconsin PGDH*

AA=06 AB=01 BB=00

$$p = \frac{2 \times 6 + 1}{2 \times 7} = 0.928571429 \quad q = 1 - p = 0.071428571$$

Expected Frequencies

$$AA = 7 \times 0.928571429^2 = 6.035714291$$

$$AB = 2 \times 7 \times 0.928571429 \times 0.071428571 = 0.928571423$$

$$BB = 7 \times 0.071428571^2 = 0.035714285$$

Chi-square

$$AA = \frac{(6 - 6.035714291)^2}{6.035714291} = 0.000211327$$

$$AB = \frac{(1 - 0.928571423)^2}{0.928571423} = 0.005494506$$

$$BB = \frac{(0 - 0.035714285)^2}{0.035714285} = 0.035714285$$

$$\text{Chi-square} = 0.041420118$$

$$df = 1$$

$$P > 0.80 \quad \text{NS}$$

Whitefish Lake, Wisconsin ME-2*

$$AA=04 \ AB=03 \ BB=00$$

$$p = \frac{2 \times 4 + 3}{2 \times 7} = 0.785714286 \qquad q = 1 - p = 0.214285714$$

Expected Frequencies

$$AA = 7 \times 0.785714286^2 = 4.321428575$$

$$AB = 2 \times 7 \times 0.785714286 \times 0.214285714 = 2.357142855$$

$$BB = 7 \times 0.214285714^2 = 0.321428571$$

Chi-square

$$AA = \frac{(4 - 4.321428575)^2}{4.321428575} = 0.023907911$$

$$AB = \frac{(3 - 2.357142855)^2}{2.357142855} = 0.175324677$$

$$BB = \frac{(0 - 0.321428571)^2}{0.321428571} = 0.321428571$$

$$\text{Chi-square} = 0.520661159$$

$$df = 1$$

$$P > 0.40 \quad NS$$

Whitefish Lake, Wisconsin AAT-3,4*

AA=02 AB=01 BB=00 AC=02 BC=00 CC=02

$$p = \frac{2 \times 2 + 1 + 2}{2 \times 7} = 0.5$$

$$q = \frac{1}{2 \times 7} = 0.071428571$$

$$r = 1 - (p+q) = 0.428571429$$

Expected Frequencies

$$AA = 7 \times 0.5^2 = 1.75$$

$$AB = 2 \times 7 \times 0.5 \times 0.071428571 = 0.499999997$$

$$BB = 7 \times 0.071428571^2 = 0.035714285$$

$$AC = 2 \times 7 \times 0.5 \times 0.428571429 = 3.000000003$$

$$BC = 2 \times 7 \times 0.071428571 \times 0.428571429 = 0.428571426$$

$$CC = 7 \times 0.428571429^2 = 1.285714288$$

Chi-square

$$AA = \frac{(2 - 1.75)^2}{1.75} = 0.035714286$$

$$AB = \frac{(1 - 0.499999997)^2}{0.499999997} = 0.500000009$$

$$BB = \frac{(0 - 0.035714285)^2}{0.035714285} = 0.035714285$$

$$AC = \frac{(2 - 3.000000003)^2}{3.000000003} = 0.333333335$$

$$BC = \frac{(0 - 0.428571426)^2}{0.428571426} = 0.428571426$$

$$CC = \frac{(2 - 1.285714288)^2}{1.285714288} = 0.396825394$$

Chi-square = 1.730158735

df = 3

P > 0.60 NS

Flambeau River, Wisconsin AAT-3,4*

AA=03 AB=01 AC=09 BB=00 BC=00 CC=03

$$p = \frac{2 \times 3 + 1 + 9}{2 \times 16} = 0.5$$

$$q = \frac{2 \times 0 + 1}{2 \times 16} = 0.03125$$

$$r = 1 - (p+q) = 0.46875$$

Expected Frequencies

$$AA = 16 \times 0.5^2 = 4.0$$

$$AB = 2 \times 16 \times 0.5 \times 0.03125 = 0.5$$

$$BB = 16 \times 0.03125^2 = 0.015625$$

$$AC = 2 \times 16 \times 0.5 \times 0.46875 = 7.5$$

$$BC = 2 \times 16 \times 0.03125 \times 0.46875 = 0.46875$$

$$CC = 16 \times 0.46875^2 = 3.515625$$

Chi-square

$$AA = \frac{(3 - 4.0)^2}{4.0} = 0.25$$

$$AB = \frac{(1 - 0.5)^2}{0.5} = 0.5$$

$$AC = \frac{(9 - 7.5)^2}{7.5} = 0.3$$

$$BB = \frac{(0 - 0.015625)^2}{0.015625} = 0.015625$$

$$BC = \frac{(0 - 0.46875)^2}{0.46875} = 0.46875$$

$$CC = \frac{(3 - 3.515625)^2}{3.515625} = 0.075625$$

$$\text{Chi-square} = 1.61$$

$$df = 3$$

$$P > 0.60 \quad \text{NS}$$

Rock River, Wisconsin GPI-A*

AA=00 AB=01 AC=01 BB=02 BC=09 CC=02

$$p = \frac{2 \times 0 + 1 + 1}{2 \times 15} = 0.066666667 \quad q = \frac{2 \times 2 + 9 + 1}{2 \times 15} = 0.466666667$$

$$r = 1 - (p+q) = 0.466666667$$

Expected Frequencies

$$\begin{aligned} AA &= 15 \times 0.066666667^2 = 0.066666667 \\ AB &= 2 \times 15 \times 0.066666667 \times 0.466666667 = 0.933333339 \\ AC &= 2 \times 15 \times 0.066666667 \times 0.466666667 = 0.933333339 \\ BB &= 15 \times 0.466666667^2 = 3.266666671 \\ BC &= 2 \times 15 \times 0.466666667^2 = 6.533333343 \\ CC &= 15 \times 0.466666667^2 = 3.266666671 \end{aligned}$$

Chi-square

$$AA = \frac{(0 - 0.066666667)^2}{0.066666667} = 0.066666667$$

$$AB = \frac{(1 - 0.933333339)^2}{0.933333339} = 0.004761904$$

$$AC = \frac{(1 - 0.933333339)^2}{0.933333339} = 0.004761904$$

$$BB = \frac{(2 - 3.266666671)^2}{3.266666671} = 0.491156465$$

$$CC = \frac{(2 - 3.266666671)^2}{3.266666671} = 0.491156465$$

$$BC = \frac{(9 - 6.533333343)^2}{6.533333343} = 0.93129508$$

$$\text{Chi-square} = 1.989795913$$

$$df = 3$$

$$P > 0.50 \quad \text{NS}$$

Rock River, Wisconsin *LDH-B**, *ME-1**

AA=14 AB=01 BB=00

$$p = \frac{2 \times 14 + 1}{2 \times 15} = 0.966666667 \quad q = 1 - p = 0.033333333$$

Expected Frequencies

$$AA = 15 \times 0.966666667^2 = 14.01666668$$

$$AB = 2 \times 15 \times 0.966666667 \times 0.033333333 = 0.966666657$$

$$BB = 15 \times 0.033333333^2 = 0.016666666$$

Chi-square

$$AA = \frac{(14 - 14.01666668)^2}{14.01666668} = 0.000019818$$

$$AB = \frac{(1 - 0.966666657)^2}{0.966666657} = 0.001149426$$

$$BB = \frac{(0 - 0.016666666)^2}{0.016666666} = 0.016666666$$

$$\text{Chi-square} = 0.01783591$$

$$df = 1$$

$$P > 0.80 \quad \text{NS}$$

Rock River, Wisconsin *EST-I**

AA=10 AB=05 BB=00

$$p = \frac{2 \times 10 + 5}{2 \times 15} = 0.833333333$$

$$q = 1 - p = 0.166666667$$

Expected Frequencies

$$AA = 15 \times 0.833333333^2 = 10.41666666$$

$$AB = 2 \times 15 \times 0.833333333 \times 0.166666667 = 4.166666748$$

$$BB = 15 \times 0.166666667^2 = 0.416666668$$

Chi-square

$$AA = \frac{(10 - 10.41666666)^2}{10.41666666} = 0.016666666$$

$$AB = \frac{(5 - 4.166666748)^2}{4.166666748} = 0.166666631$$

$$BB = \frac{(0 - 0.416666668)^2}{0.416666668} = 0.416666668$$

$$\text{Chi-square} = 0.599999965$$

$$df = 1$$

$$P > 0.40 \quad \text{NS}$$

Neebing-McIntyre river, Ontario GPI-A*

AA=25 AB=01 AC=22 BB=00 BC=02 CC=06

$$p = \frac{2 \times 25 + 1 + 22}{2 \times 56} = 0.651785714 \quad q = \frac{2 + 1}{2 \times 56} = 0.026785714$$

$$r = 1 - (p+q) = 0.321428571$$

Expected Frequencies

$$AA = 56 \times 0.651785714^2 = 23.79017855$$

$$AB = 2 \times 56 \times 0.651785714 \times 0.026785714 = 1.955357121$$

$$AC = 2 \times 56 \times 0.651785714 \times 0.321428571 = 23.46428567$$

$$BB = 56 \times 0.026785714^2 = 0.040178571$$

$$BC = 2 \times 56 \times 0.026785714 \times 0.321428571 = 0.964285703$$

$$CC = 56 \times 0.321428571^2 = 5.78571427$$

Chi-square

$$AA = \frac{(25 - 23.79017855)^2}{23.79017855} = 0.061524042$$

$$AB = \frac{(1 - 1.955357121)^2}{1.955357121} = 0.466772652$$

$$AC = \frac{(22 - 23.46428567)^2}{23.46428567} = 0.091378555$$

$$BB = \frac{(0 - 0.040178571)^2}{0.040178571} = 0.040178571$$

$$CC = \frac{(6 - 5.78571427)^2}{5.78571427} = 0.007936509$$

$$BC = \frac{(2 - 0.964285703)^2}{0.964285703} = 1.1124339$$

$$\text{Chi-square} = 1.780224229$$

$$df = 3$$

$$P > 0.60 \quad \text{NS}$$

McVicars Creek, Ontario GPI-A*

AA=08 AB=02 AC=22 BB=00 BC=05 CC=14

$$p = \frac{2 \times 8 + 2 + 22}{2 \times 51} = 0.392156863 \quad q = \frac{2 + 5}{2 \times 51} = 0.068627451$$

$$r = 1 - (p+q) = 0.539215686$$

Expected Frequencies

$$\begin{aligned} AA &= 51 \times 0.392156863^2 = 7.843137265 \\ AB &= 2 \times 51 \times 0.392156863 \times 0.068627451 = 2.745098042 \\ AC &= 2 \times 51 \times 0.392156863 \times 0.539215686 = 21.56862745 \\ BB &= 51 \times 0.068627451^2 = 0.240196079 \\ BC &= 2 \times 51 \times 0.068627451 \times 0.539215686 = 3.774509803 \\ CC &= 51 \times 0.539215686^2 = 14.82843136 \end{aligned}$$

Chi-square

$$AA = \frac{(8 - 7.843137265)^2}{7.843137265} = 0.003137254$$

$$AB = \frac{(2 - 2.745098042)^2}{2.745098042} = 0.202240898$$

$$AC = \frac{(22 - 21.56862745)^2}{21.56862745} = 0.008627451$$

$$BB = \frac{(0 - 0.240196079)^2}{0.240196079} = 0.240196079$$

$$CC = \frac{(14 - 14.82843136)^2}{14.82843136} = 0.046282611$$

$$BC = \frac{(5 - 3.774509803)^2}{3.774509803} = 0.397886428$$

$$\text{Chi-square} = 0.898370721$$

$$df = 2$$

$$P > 0.80 \quad \text{NS}$$

McVicars Creek, Ontario *IDH*-White muscle

AA=42 AB=08 AC=01 BB=00 BC=00 CC=00

$$p = \frac{2 \times 42 + 8 + 1}{2 \times 51} = 0.911764706 \quad q = \frac{8}{2 \times 51} = 0.078431373$$

$$r = 1 - (p+q) = 0.009803922$$

Expected Frequencies

$$\begin{aligned} AA &= 51 \times 0.911764706^2 = 42.39705883 \\ AB &= 2 \times 51 \times 0.911764706 \times 0.078431373 = 7.29411769 \\ AC &= 2 \times 51 \times 0.911764706 \times 0.009803922 = 0.911764746 \\ BB &= 51 \times 0.078431373^2 = 0.313725494 \\ BC &= 2 \times 51 \times 0.078431373 \times 0.009803922 = 0.078431376 \\ CC &= 51 \times 0.009803922^2 = 0.004901961 \end{aligned}$$

Chi-square

$$AA = \frac{(42 - 44.39705883)^2}{44.39705883} = 0.003718553$$

$$AB = \frac{(8 - 7.29411769)^2}{7.29411769} = 0.068311187$$

$$AC = \frac{(1 - 0.911764746)^2}{0.911764746} = 0.008538891$$

$$BB = \frac{(0 - 0.313725494)^2}{0.313725494} = 0.313725494$$

$$CC = \frac{(0 - 0.004901961)^2}{0.004901961} = 0.004901961$$

$$BC = \frac{(0 - 0.078431376)^2}{0.078431376} = 0.078431376$$

$$\text{Chi-square} = 0.477627462$$

$$df = 3$$

$$P > 0.90 \quad \text{NS}$$