

THE TAXONOMY OF NAIADES INHABITING A LAKE ENVIRONMENT.

By HENRY VAN DER SCHALIE.

(Read before the Society, 2nd February, 1940.)

As our knowledge concerning the ecology and distribution of certain groups of animals increases it becomes necessary in the light of this information to evaluate some of the nomenclature that has come into general use. Many attempts at classification have resulted in artificial arrangements. Revisions are then needed to correct these to a more natural system. This need is especially paramount in certain groups. With this problem in mind the following considerations are given regarding the taxonomy of lake-inhabiting Naiades.

It has been known for some time that mussels living in a lake environment often tend to become dwarfed or stunted. As early as 1834, Isaac Lea named *Symphynota benedictensis* which we now recognize as a lake form of *Anodonta grandis*. A few years later DeKay (1843) applied the name *rosaceus* to the stunted lake form of *Lampsilis siliquoidea*. Both species are common in the small inland lakes of the glaciated portions of the upper Mississippi and St. Lawrence drainages. It is not surprising, therefore, that these lake-forms were early named. On the other hand, the larger lakes such as Chautauqua Lake, New York, Lake Erie, and Lake Winnebago, Wisconsin, which harbour an unusually great number of naiad species, were not carefully investigated till comparatively recent time. Not until the twentieth century did the application of special names to lake forms become a common procedure, and as a result most species displaying lake-inhabiting characteristics were named by present-day conchologists.

Lake Erie, particularly the west end, is remarkable for its rich naiad fauna. No other lake anywhere harbours so many species of mussels. Consequently, this lake is the type locality for several lake-forms. Walker (1898, 1913) has shown that this abundance is directly the result of a post-glacial invasion into Lake Erie of Mississippi mussels when a connection existed between the waters of the St. Lawrence and Mississippi drainages by way of the Maumee River outlet. With a mussel fauna of approximately thirty species and a variety of ecological conditions the western portion of Lake Erie affords good opportunities for studies on the response of Naiades to different ecological factors.

Brown, Clark, and Gleissner (1938) made commendable use of the facilities available in western Lake Erie to investigate the causes of

dwarfing among lake-dwelling mussels. Their study shows that the degree of stunting in mussels is directly proportional to the degree of exposure to which Naiades are subjected in their normal habitat. It is not necessary to review the literature on the basis of what is now known concerning the effect of shoal exposure on mussels in lakes, it is sufficient reference be made to the taxonomic implications of the naming of ecological forms. An examination of the current taxonomy is desirable for several reasons: (1) it is better to appreciate difficulties when dealing with ecological forms; (2) it may give an evaluation of the significance of some names now in use; and (3) it matters for those who are not taxonomists but who are in proper designations in the use of many names for intergrading forms.

Some of the more common environmental forms accredited to Lake Erie and other large lakes are:

1. *Fusconaia flava parvula* Grier. This form was first named in 1918. That *parvula* was merely an ecological form long before Grier named it. Whether or not it warrants subspecific status is open to question, in the light of what is now known of the variation of *F. flava* in Lake Erie.

2. *Quadrula pustulosa prasina* (Conrad). Ortman (1922, 16) joins *schoolcraftensis* and *prasina*. They were recognized by Ortman (1919) and F. C. Baker (1919) as found in Lake Erie.

3. *Quadrula quadrula* (Raf.). No form has been named, but actually a form is recognized. Ortman (1919, 4) says that the Lake Erie form is 'little inflated and has a high dorsal edge'.

4. *Amblema costata plicata* (Say). Ortman (1919) gave specific rank to this form. F. C. Baker (1919) recognized that *plicata* is a lake form but suggests that it should be considered as a distinct species.

5. *Cyclonaias tuberculata* (Raf.). A special form has been applied to specimens from Lake Erie, although there are specimens available which show a high dorsal edge. To be consistent a special name should apply here.

6. *Pleurobema cordatum pauperculum* (Simpson). The same as variety *magnalacustris* of Simpson (1919, 84) states: "I have not seen any specimens of the parent-form, and for this reason we might prefer to regard this as a true species." However, Ortman does not wish to make the necessary change because of

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dwarfing among lake-dwelling mussels. Their studies conclusively show that the degree of stunting in mussels is directly correlated with the degree of exposure to which Naiades are subjected in their normal habitat. It is not necessary to review their work here, but on the basis of what is now known concerning the environmental effect of shoal exposure on mussels in lakes, it is advisable that some reference be made to the taxonomic implications involved in the naming of ecological forms. An examination of the validity of current taxonomy is desirable for several reasons: (1) It enables us better to appreciate difficulties when dealing with intergrading forms; (2) it may give an evaluation of the significance or insignificance of some names now in use; and (3) it may simplify matters for those who are not taxonomists but who are interested in proper designations in the use of many names now applied to intergrading forms.

Some of the more common environmental forms of Naiades accredited to Lake Erie and other large lakes are as follows:—

1. *Fusconaia flava parvula* Grier. This form was named by Grier in 1918. That *parvula* was merely an ecological form was recognized long before Grier named it. Whether or not its configuration warrants subspecific status is open to question, particularly in the light of what is now known of the variation of this species within Lake Erie.

2. *Quadrula pustulosa prasina* (Conrad). Ortmann and Walker (1922, 16) join *schoolcraftensis* and *prasina*. The *prasina* form is recognized by Ortmann (1919) and F. C. Baker (1928) as the form found in Lake Erie.

3. *Quadrula quadrula* (Raf.). No form has been named, although actually a form is recognized. Ortmann (1919, 43) wrote: "Sterki says that the Lake Erie form is 'little inflated and has few tubercles'."

4. *Amblema costata plicata* (Say). Ortmann and Walker (1922, 13) gave specific rank to this form. F. C. Baker (1928, 79-80) admits that *plicata* is a lake form but suggests that it should be written as though it were a distinct species.

5. *Cyclonaias tuberculata* (Raf.). A special form name has not been applied to specimens from Lake Erie, although actually there are specimens available which show a high degree of stunting. To be consistent a special name should apply here as well.

6. *Pleurobema cordatum pauperculum* (Simpson). This is the same as variety *magnalacustris* of Simpson (1914, 884). Ortmann (1919, 84) states: "I have not seen any specimens grading toward the parent-form, and for this reason we might perhaps be justified in regarding this as a true species." However, Ortmann clearly did not wish to make the necessary change because of a lack of sufficient

material. From what we now know concerning the variation of other species of Naiades in Lake Erie there is every reason to believe that intergrading specimens do exist.

7. *Elliptio dilatatus sterkii* Grier. Although Grier described this as a distinct variety Brown, Clark, and Gleissner (1938, 689) have shown that: "According to height, all of our specimens (those from the river as well as the lake) belong to the stream variety while according to obesity they would all become *sterkii*. We seriously doubt the validity of varieties based upon such characters."

8. *Anodonta grandis footiana* (Lea). Certain conditions in lakes give rise to the *footiana* form of *grandis*. Although Ortmann (1919, 148) was inclined to consider *footiana* as a geographical race of *grandis*, he indicated that both *footiana* and *benedictensis* were "distinctly dependent on ecological conditions", and that they were connected by intergrades. Recent studies reveal that similar conditions anywhere will produce similar forms among Naiades so that the concept of geographical races in the *grandis* group is untenable.

9. *Anodonta imbecillis fusca* F. C. Baker. This dwarfed form of *imbecillis* according to Baker represents an ecological variety, and is reported by him from the open shore of Sturgeon Bay, Wisconsin. He (1927, 222) writes: "It appears to be a dwarfed form of *imbecillis* produced, probably, by its habitat in a turbulent bay . . ." Similar forms appear under similar circumstances in western Lake Erie and elsewhere.

10. *Anodontooides ferussacianus buchanensis* (Lea). That *buchanensis* is an ecological form is clearly indicated by Ortmann (1919, 170-171) in his discussion of this form in Lake Erie. Of considerable interest in this connection is a supposed new species of *Anodontooides* named *birgei* by F. C. Baker (1923, 123). Baker (1928, 182) states that *birgei* is a form produced by a lake environment and adds: "It is possible that the *buchanensis* listed by Ortmann as living in Lake Erie may readily be a form of *birgei*." This procedure of naming ecological forms and even elevating them to the rank of good species is quite illustrative of the dangers which attend a taxonomy that fails to take into account intergrading forms.

11. *Strophitus rugosus rhombicus* (Anthony). Although the name *rhombicus* is not generally applied to the Lake Erie form, F. C. Baker (1922, 132) states that Anthony's *rhombica* "appears to fit this form and renders a new name unnecessary". The variation of this species has been discussed by van der Schalie (1938, 58) and it is suggested that the range of variation in *rugosus* is so great that it is not expedient to refer extremes of variation to subspecific categories which have been artificially erected.

12. *Alasmidonta calceolus magnalacust* of naming the lake form of this species (Schalie, 1938, 58-59). As in the case becomes impracticable to apply name even though it is of interest to observe correlated with the environment.

13. *Lasmigona costata eriganensis* Grier named as a distinct variety by Grier (subspecies is doubtful because it will to recognize this variety as it is to *ac* and *Fusconaia flava parvula*, which we

14. *Lasmigona complanata katherin* *complanata* have not been found in Lak from Lake Huron by Goodrich and However, this species has been repo (van der Schalie, 1938, 54-55) making lake form, *katherinae*, may occur in form is produced in exposed conditic might well be considered with other:

15. *Ptychobranthus fasciolaris lacustr* known that a stunted lake form of this Ortmann (1919, 210) did not think "i lake-form by a varietal name, but the race is clearly indicated in this case" (1928a, 52) suggested that a special n Brown, Clark, and Gleissner (1938, variation of *fasciolaris* in Lake Erie, that varieties named on the basis of significance in this species."

16. *Obliquaria reflexa* Rafinesque. stated: "There is a dwarf race in La possibly deserves a varietal name," special name to this form.

17. *Proptera alata* (Say). Since L this species, a form name cannot be a form. Ortmann (1919, 255) called a suggested that the form from rivers *alata megaptera*, if a nomenclatorial of this species is to be made. T Brown, Clark, and Gleissner (1938), Erie, clearly shows that it is not fe forms.

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(Lea). Certain conditions in lakes of the *grandis* group. Although Ortmann (1919, 1920) described *footiana* as a geographical race of the *grandis* group, both *footiana* and *benedictensis* were described under "ecological conditions", and that they are distinct. Recent studies reveal that similar forms produce similar forms among Naiades of the *grandis* group is

12. *Alasmidonta calceolus magnalacustris* F. C. Baker. This dwarfed form of the species represents an ecological variety, and is known from the open shore of Sturgeon Bay, Wisconsin. It appears to be a dwarfed form of the species, by its habitat in a turbulent bay . . . similar circumstances in western Lake Erie.

13. *Lasmigona costata eriganensis* Grier. This ecological form was named as a distinct variety by Grier (1918, 10). Its validity as a subspecies is doubtful because it will most likely prove as unwise to recognize this variety as it is to accept *Elliptio dilatatus sterkii* and *Fusconaia flava parvula*, which were named simultaneously.

14. *Lasmigona complanata katherinae* (Lea). Specimens of *complanata* have not been found in Lake Erie, but they are reported from Lake Huron by Goodrich and van der Schalie (1932, 9). However, this species has been reported from the Huron River (van der Schalie, 1938, 54-55) making it highly probable that the lake form, *katherinae*, may occur in Lake Erie. Obviously this form is produced in exposed conditions of lake environment and might well be considered with other forms similarly produced.

15. *Ptychobranthus fasciolaris lacustris* F. C. Baker. It is generally known that a stunted lake form of this species occurs in Lake Erie. Ortmann (1919, 210) did not think "it advisable to distinguish the lake-form by a varietal name, but the tendency to develop a local race is clearly indicated in this case". Nevertheless, F. C. Baker (1928a, 52) suggested that a special name should be applied. But Brown, Clark, and Gleissner (1938, 690), in their study of the variation of *fasciolaris* in Lake Erie, conclude: "It seems to us that varieties named on the basis of size variation alone have no significance in this species."

16. *Obliquaria reflexa* Rafinesque. Although Ortmann (1919, 215) stated: "There is a dwarf race in Lake Erie, light in colour, which possibly deserves a varietal name," no one has as yet applied a special name to this form.

17. *Proptera alata* (Say). Since Lake Erie is the type locality of this species, a form name cannot be applied to distinguish the lake-form. Ortmann (1919, 255) called attention to this condition, and suggested that the form from rivers should be known as *Proptera alata megaptera*, if a nomenclatorial distinction between the forms of this species is to be made. The variation demonstrated by Brown, Clark, and Gleissner (1938), in their study of *alata* in Lake Erie, clearly shows that it is not feasible to name these ecological forms.

18. *Leptodea fragilis lacustris* F. C. Baker. The marked variation of *fragilis* in Lake Erie is strikingly shown by Brown, Clark, and

Gleissner (1938, 693). Ortmann (1919, 249) also recognized this fact and consequently did not feel that a name should be applied to the extremes of variation within *fragilis*.

19. *Obovaria leibii* (Lea). It has long been known that *leibii* is merely the lake form of *O. subrotunda*. Ortmann (1919, 225) clearly stated this: "Another 'species' distinguished by Lea (and Simpson), *O. leibii*, is nothing but the form from Lake Erie of *O. subrotunda*."

20. *Ligumia nasuta* (Say). Ortmann (1919, 275) states: "There is not much variability in *E. nasuta*." However, Brown, Clark, and Gleissner (1938, 694) have shown that this species becomes definitely stunted much as other species of mussels do upon exposure. In the Huron River (a tributary of Lake Erie) two specimens were reported as river-mouth inhabitants by van der Schalie (1938, 64). Their size indicates that this species reacts to river conditions in a way similar to *Ligumia recta latissima*, the river form of *Ligumia recta*. The following measurements are given to indicate the comparatively large size of the two river-inhabiting *nasuta* taken from the mouth of the Huron River in Michigan:—

Number of Specimens.	Annulac.	Length		Height		Diameter	Obesity.	Locality.
		in mm.	in mm.	in mm.	in mm.			
1	13	115	44	36.5	.317	Huron River, Flat Rock.		
1	12	114	48	36.5	.320	Huron River, E. of Willow.		

None of the specimens reported by Ortmann (1919) or by Brown and others (1938) are as large as those reported here.

21. *Ligumia recta* (Lamarck). Since the stunted lake-form *recta* was originally described from Lake Erie, as pointed out by Ortmann (1919, 279), the name *recta* is retained for the lake form. *L. recta latissima* is then generally applied to the form inhabiting rivers. Brown, Clark, and Gleissner (1938, 695) state: "Grier (1920) gives the Lake Erie form the varietal name of *latissima* but fails to show as great a difference between the lake and stream form as we found within the lake itself."

22. *Micromya iris novi-eboraci* (Lea). This variety is considered to be (Ortmann, 1919, 270) the form common to Lake Erie. However, the distinction is made on the basis of colour pattern, which in specimens from the Huron River (van der Schalie, 1938, 63) was found to be an unreliable criterion in the separation of *iris* and *novi-eboraci*. As for size, *iris* becomes stunted in a lake environment but this has never been emphasized by the application of a special name.

23. *Lampsilis siliquioidea rosacea* evidence indicating a marked response is found among specimens of (1938, 68-9), complete intergradation between and normal *siliquioidea*. However, (1938, 697) in comparing size differences "It is doubtful whether these differences, since the variation within the difference between lake and stream considerable doubt on the validity and *chadwicki* described by F. C. B.

24. *Lampsilis ventricosa canadensis* to *ventricosa* is much the same as *siliquioidea*. Brown, Clark, and Gleissner (1938, 697) suggest a direct correlation between the degree of exposure within portions of the lake taken into account there is little difference as *lurida* Simpson (1914, 41), *perplexa* or *winnebagoensis* F. C. Baker (1938, 697).

25. *Truncilla truncata lacustris* *truncata* from Lake Erie are definitely stunted (1938, 228) suggests that these forms are not. The variation of *truncata* within Lake Erie is unreasonable to apply special names.

26. *Truncilla donaciformis* (Lea) from Lake Erie is usually smaller than *truncata* and is probably stunted in a lake environment. F. C. Baker named a lake form of *truncata* a special name for the lake form of (1938, 231) states: "The same relative difference also occurs in *donaciformis*." That those who would advocate special names for themselves too convinced that it is not.

27. *Dysnomia triquetra* (Raf.) from Lake Erie. There is some doubt as to whether the name *triangularis* later the use of *triangularis* was considered of *triquetra* in lakes may account for the name to the dwarfed lake form.

28. *Dysnomia perplexa rangiana* regarding the taxonomic status of *rangiana* belongs with one or the other name here. In either case *rangiana*

mann (1919, 249) also recognized this but does not feel that a name should be applied within *fragilis*.

It has long been known that *leibii* is *ubrotunda*. Ortmann (1919, 225) clearly distinguishes 'species' distinguished by Lea (and named) but the form from Lake Erie of

Ortmann (1919, 275) states: "There is no *nasuta*." However, Brown, Clark, and Ortmann show that this species becomes definitely stunted in lakes of mussels do upon exposure. In Lake Erie (and in other parts of Lake Erie) two specimens were taken by van der Schalie (1938, 64). This species reacts to river conditions in a way similar to that of *latissima*, the river form of *Ligumia*. Measurements are given to indicate the commonness of the two river-inhabiting *nasuta* taken from Lake Erie in Michigan:—

Height in mm.	Diameter in mm.	Obesity.	Locality.
44	36.5	.317	Huron River, Flat Rock.
48	36.5	.320	Huron River, E. of Willow.

reported by Ortmann (1919) or by Brown and Ortmann as those reported here.

(k). Since the stunted lake-form *recta* is found in Lake Erie, as pointed out by Ortmann and Ortmann, it is retained for the lake form. *L. recta* is applied to the form inhabiting rivers. Ortmann and Ortmann (1938, 695) state: "Grier (1920) used the varietal name of *latissima* but fails to distinguish between the lake and stream form as we

do in *recta* (Lea). This variety is considered as a lake form common to Lake Erie. However, on the basis of colour pattern, which is different in the Huron River (van der Schalie, 1938, 63) and in Lake Erie, the criterion in the separation of *iris* and *recta* is emphasized by the application of a

23. *Lampsilis siliquoidea rosacea* (DeKay). Some of the best evidence indicating a marked response of mussels to their environment is found among specimens of *siliquoidea*. Ortmann (1919, 291), van der Schalie (1938, 68-9) and others have stressed the complete intergradation between the stunted lake-form, *rosacea* and normal *siliquoidea*. However, Brown, Clark, and Gleissner (1938, 697) in comparing size differences conclusively show that: "It is doubtful whether these differences have significance taxonomically, since the variation within Lake Erie itself is greater than the difference between lake and stream forms." These results cast considerable doubt on the validity of such subspecies as *pepinensis* and *chadwicki* described by F. C. Baker (1927, 223, and 1928, 279).

24. *Lampsilis ventricosa canadensis* (Lea). The relationship of *canadensis* to *ventricosa* is much the same as that of *rosacea* to *siliquoidea*. Brown, Clark, and Gleissner (1938, 699) have shown a direct correlation between the degree of stunting and the amount of exposure within portions of western Lake Erie. When this is taken into account there is little reason for accepting such names as *lurida* Simpson (1914, 41), *perglobosa* F. C. Baker (1928, 285), or *winnebagoensis* F. C. Baker (1928, 291).

25. *Truncilla truncata lacustris* F. C. Baker. Specimens of *truncata* from Lake Erie are definitely stunted. F. C. Baker (1928, 228) suggests that these forms may also be referred to *lacustris*. The variation of *truncata* within Lake Erie is large enough to make it unreasonable to apply special names to the lake forms.

26. *Truncilla donaciformis* (Lea). Although *donaciformis* in Lake Erie is usually smaller than *truncata*, it also tends to become noticeably stunted in a lake environment. It is indeed surprising that F. C. Baker named a lake form of *truncata* but failed to suggest a special name for the lake form of *donaciformis*. Yet Baker (1928, 231) states: "The same relative variation recorded under *truncata* also occurs in *donaciformis*." This is inconsistent, or is it possible that those who would advocate naming ecological forms are not themselves too convinced that it is wise to do so?

27. *Dysnomia triquetra* (Raf.). Stunted forms of *triquetra* are found in Lake Erie. There is some indication that Walker (1913, 21) considered the name *triangularis* as applicable to this form. But later the use of *triangularis* was discontinued. The relative scarcity of *triquetra* in lakes may account for the failure to apply a special name to the dwarfed lake form.

28. *Dysnomia perplexa rangiana* (Lea). Considerable doubt exists regarding the taxonomic status of *perplexa* and *torulosa*, but whether *rangiana* belongs with one or the other is not of immediate importance here. In either case *rangiana* represents the dwarfed lake form

and it shows much the same response to exposure as has been observed in other Naiades.

A SUMMARY OF THE ENVIRONMENTAL FORMS OF NAIADES INHABITING LARGER LAKES IN U.S.A.

Name.	Type Locality.	Date.
1. <i>Fusconaia flava parvula</i> Grier . . .	Lake Erie . . .	1918
2. <i>Quadrula pustulosa prasina</i> (Conrad)	Fox River, at Green Bay	1834
3. <i>Quadrula quadrula</i> (Rafinesque) . . .	Ohio River . . .	1820
4. <i>Amblema costata plicata</i> (Say) . . .	Lake Erie . . .	1817
5. <i>Cyclonaias tuberculata</i> (Rafinesque)	Ohio River . . .	1820
6. <i>Pleurobema cordatum pauperculum</i> (Simp.) . . .	Niagara Falls . . .	1900
7. <i>Elliptio dilatatus sterkii</i> Grier . . .	Lake Erie . . .	1918
8. <i>Anodonta grandis footiana</i> (Lea) . . .	Lake Winnebago . . .	1840
9. <i>Anodonta imbecillis fusca</i> F. C. Baker	Sturgeon Bay, Wisc.	1927
10. <i>Anodontooides fer. buchmanensis</i> (Lea)	Buck Creek, Ohio . . .	1838
11. <i>Strophitus rugosus rhombicus</i> (Anthony) . . .	Michigan . . .	1865
12. <i>Alasmidonta calceolus magnalacustris</i> (F. C. Baker)	Sturgeon Bay, Wisc.	1928
13. <i>Lasmigona costata eriganensis</i> Grier . . .	Lake Erie . . .	1918
14. <i>Lasmigona complanata katherinae</i> (Lea)	Lake Superior (erroneous)	1838
15. <i>Ptychobranhus fasciolaris lacustris</i> F. C. Baker	Chautauqua Lake, N.Y.	1928
16. <i>Obliquaria reflexa</i> Rafinesque . . .	Kentucky River . . .	1820
17. <i>Proptera alata</i> (Say) . . .	Lake Erie . . .	1817
18. <i>Leptodea fragilis lacustris</i> (F. C. Baker)	Lake Butte des Morts . . .	1922
19. <i>Obovaria leibii</i> (Lea) . . .	Erie County, Michigan . . .	1862
20. <i>Ligumia nasuta</i> (Say) . . .	Delaware and Schuylkill Rivers . . .	1817
21. <i>Ligumia recta</i> (Lamarck) . . .	Lake Erie . . .	1819
22. <i>Micromya iris novi-eboraci</i> (Lea) . . .	Oak Orchard Creek, N.Y.	1838
23. <i>Lampsilis siliquioidea rosacea</i> (DeKay)	Seneca Lake, N.Y. . . .	1843
24. <i>Lampsilis ventricosa canadensis</i> (Lea)	St. Lawrence River . . .	1857
25. <i>Truncilla truncata lacustris</i> F. C. Baker . . .	Lake Winnebago . . .	1928
26. <i>Truncilla donaciformis</i> (Lea) . . .	Ohio . . .	1828
27. <i>Dysnomia triquetra</i> (Rafinesque) . . .	Falls of the Ohio . . .	1820
28. <i>Dysnomia perplexa rangiana</i> (Lea) . . .	Ohio River . . .	1839

In the preceding discussion an effort has been made to show that most mussels inhabiting a lake environment develop stunted forms to which varietal names have usually been applied. If dwarfing were restricted to Lake Erie there would perhaps be occasion to designate the stunted forms as geographic races. But the studies of Brown, Clark, and Gleissner, Ortmann, Grier, F. C. Baker, van der Schalie and others, covering many lakes and streams, reveal that similar ecological forms are produced by similar ecological conditions. It is obvious that unless some endeavour is made to indicate definitely the difference between ecological forms and subspecies an undue amount of confusion will persist in our

taxonomy. If for any reason what a form it would be more sensible *siliquioidea* form *rosacea*. A rule misleading emphasis which is placed as a subspecific or even as a species. Other experiments and studies effect of ecological factors on mussel aid the taxonomist. Such studies A few attempts have been made in were not successful. Although that dwarfing among Naiades is experimental evidence is desirable

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the response to exposure as has been

MENTAL FORMS OF NAIADES INHABITING LAKES IN U.S.A.

	Type Locality.	Date.
r.	Lake Erie	1918
Conrad)	Fox River, at Green Bay	1834
ue)	Ohio River	1820
)	Lake Erie	1817
esque)	Ohio River	1820
iculum		
	Niagara Falls	1900
	Lake Erie	1918
ea)	Lake Winnebago	1840
Baker	Sturgeon Bay, Wisc.	1927
(Lea)	Buck Creek, Ohio	1838
	Michigan	1865
lacustris		
	Sturgeon Bay, Wisc.	1928
Grier	Lake Erie	1918
therinae		
	Lake Superior (<i>erroneous</i>)	1838
lacustris		
	Chautauqua Lake, N.Y.	1928
	Kentucky River	1820
	Lake Erie	1817
Baker)	Lake Butte des Morts	1922
	Erie County, Michigan	1862
	Delaware and Schuylkill Rivers	1817
	Lake Erie	1819
ea)	Oak Orchard Creek, N.Y.	1838
DeKay)	Seneca Lake, N.Y.	1843
is (Lea)	St. Lawrence River	1857
F. C.		
	Lake Winnebago	1928
	Ohio	1828
ea)	Falls of the Ohio	1820
Lea)	Ohio River	1839

an effort has been made to show that the environment develop stunted forms usually been applied. If dwarfing there would perhaps be occasion to as geographic races. But the studies sner, Ortmann, Grier, F. C. Baker, vering many lakes and streams, reveal s are produced by similar ecological t unless some endeavour is made to nce between ecological forms and t of confusion will persist in our

taxonomy. If for any reason whatsoever one wishes to designate a form it would be more sensible to do so as follows: *Lampsilis siliquoidea* form *rosacea*. A rule of this sort would eliminate the misleading emphasis which is placed on forms when they are written as a subspecific or even as a specific name.

Other experiments and studies along the lines of testing the effect of ecological factors on mussel characteristics will undoubtedly aid the taxonomist. Such studies as these should be encouraged. A few attempts have been made in mussel transplantation, but these were not successful. Although the evidence at hand would indicate that dwarfing among Naiades is entirely phenotypic, recourse to experimental evidence is desirable to prove that it is not genotypic.

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