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OPINION

Lake Name or Name Lake? The etymology of lake nomenclature in the United States

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SUMMARY

1. The rationale for the naming of lakes has often puzzled limnologists. This problem is especially apparent in North America because the nomenclature of lakes across the continent appears to be variable, with 'Name Lake' occurring frequently, such as in Trout Lake, but also 'Lake Name', as in Lake Sunapee.
2. We examined the potential drivers of lake naming patterns using the U.S. EPA National Lakes Assessment database of *c.* 1000 lakes chosen in a randomised, stratified design. Potential drivers included major limnological characteristics and geographical position relative to European settlement patterns.
3. Of a list of 814 lakes with this binary nomenclature, almost 20% had a Lake Name, with the other 80% being a Name Lake. Across the U.S.A., lakes with larger surface areas were more likely to have a Lake Name, but there was no significant relationship between nomenclature and maximum depth.
4. Examining naming patterns by EPA ecoregion and by state revealed that Lake Names were more common in the southern states and along the eastern seaboard, regardless of their surface area.
5. Analysis of available databases of lake nomenclature in Europe and Canada suggests that these geographical shifts in lake names may be due to the main European colonist source countries that settled these regions, with Lake Name predominating in countries where Gaelic and Romance linguistic influences were strongest.

Keywords: ecoregions, European colonisation, national lakes assessment, North America, settlement history

Introduction

Many a discussion among limnologists or with a member of the general public has at some point turned to the subject of why the names of some lakes in North America start with Lake, followed by their name (i.e., Lake Name), such as Lake Sunapee, while many others are reversed (i.e., Name Lake), such as Trout Lake. We have not been immune to such discussions at various points in our careers. Given the increasing amount of lake information available in national databases (e.g., the U.S. Environmental Protection Agency's National Lakes Assessment), the last time we embarked on this discussion with each other, it seemed a propitious moment to confront this question of lake nomenclature directly with data.

We developed a series of hypotheses that could be narrowed down to one overarching one: nomenclature of U.S. lakes reflects an interaction of settlement history and origin and lake size. The relationship with lake size was based on a basic and perhaps misguided intuition about human psychology. Lakes with a larger surface area are more imposing and impressive to a human standing on their beaches, and perhaps more likely to be named Lake Name than Name Lake. The classic case in North America is the Laurentian Great Lakes, which all exhibit Lake Names. While limnologists tend to also

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think of lake maximum depth as an important variable, and while this in many cases is correlated with lake surface area to some degree, we did not expect depth to affect lake nomenclature because most people standing on the edge of a lake are not able to ascertain its depth when they first observe a waterbody.

The hypothesised relationship between lake nomenclature and U.S. settlement and colonisation history is more complicated, requiring a simultaneous understanding of settlement patterns by European colonists, as well as the hereditary relationships of the dominant immigrant languages. For example, we expected that lakes in regions that were originally settled by English immigrants (e.g., New England) should thus reflect the predominant naming patterns in England. The patterns in English lake names remained to be verified, but as we listed the English lakes we knew, they mostly seemed to use Name Lake (including Windermere, for which 'mere' means inland sea, derived from the French 'mer'). Moving westward and southward in the U.S.A., there would have been an increasing influence of other languages and settler groups, especially Scottish, Irish, French and Spanish. For example, when we thought of lakes we knew of in francophone North America (i.e., Louisiana, Québec), it seemed that Lake Name was more common in those regions. Further investigation revealed that in the French and Spanish languages, the only limnological nomenclature possible is Lake Name (*Lac Nom* or *Lago Nombre*, respectively). Thus, we hypothesised that the varied lake nomenclature across North America may also result from the languages of the different major colonising groups from Europe. While we are not historians, we thought that general knowledge of settlement patterns by language or country of origin could be generally related, such as the southward and westward trends of non-English immigration.

Integrating these hypotheses, the following prediction emerged: there should be an interaction of settler origin and lake size with westward and southward lakes in the U.S.A. being more likely to show a Lake Name nomenclature, especially with increasing size (surface area, but not depth). Meanwhile, in eastern and more northern lakes, Name Lake should dominate.

Methods

Lake databases

We investigated the nomenclature of lakes using the U.S. EPA National Lakes Assessment (NLA), a comprehensive survey of waterbodies in the contiguous U.S.A. in 2007. The waterbodies sampled were chosen in a randomised, stratified design to include coverage of waterbodies in five lake area categories (4–10 ha, >10–20 ha, >20–50 ha, >50–100 ha and >100 ha), 48 states and aggregated Omernik level III ecoregions (Peck *et al.*, 2013). All waterbodies included in the NLA were permanent freshwater lakes, reservoirs or ponds with a surface area >4 ha and a maximum depth ≥1 m (Peck *et al.*, 2013). The Laurentian Great Lakes and the Great Salt Lake were excluded from the NLA sampling programme, as were waterbodies not classified as lakes (e.g., swamps) in the U.S. National Hydrography Dataset (NHD; Dewald, 2006).

To assess the nomenclature of U.S. lakes, we started with the full NLA dataset for 1157 lakes. We had to exclude 61 of these lakes because no names were listed, or only a proper name was listed without specifying the order of 'lake' and the name of waterbody. All missing waterbody names in the NLA were checked in the NHD and on Google Earth to help ascertain their nomenclature. Of the remaining 1096 lakes with defined names, 814 were identified as lakes, 183 as reservoirs, 87 as ponds and 12 as other (Basin, Creek, Dam, Flowage, Hole, Marsh, River or Slough). Note that the naming convention of 'lake' did not necessarily indicate that a waterbody was naturally formed, as some of the 'lakes' were defined in the NLA as having been of man-made origin. Before excluding them, we noted that 100% of all ponds and reservoirs in the NLA had the naming convention of Name Pond or Name Reservoir. Our final dataset consisted of 814 waterbodies named lakes.

We obtained data on lake nomenclature in Great Britain and Northern Ireland using data obtained on 31 March 2016 from the U.K. Lakes Portal (https://eip.ceh.ac.uk/apps/lakes/), as described in Hughes *et al.* (2004). Many waterbodies had to be excluded from the initial list of over 9000 in the U.K., as these represented dams, dykes, rivers, harbours and gravel pits. The final list consisted of 3468 lakes. Because there were only two Irish lakes matching our criteria in the U.K. Lake Portal dataset, we used the List of loughs of Ireland (https://en.wikipedia.org/wiki/List_of_loughs_of_Ireland; accessed 12 April 2016) for Northern Ireland and the Republic of Ireland. This database contains the names of 152 lakes (most >50 ha in surface area) sampled by the Irish Environmental Protection Agency (Free *et al.*, 2007) as part of the creation of a reference-based typology and ecological assessment system. For all the U.K. lakes, we used the same criteria as for the U.S. lakes: i.e., waterbodies had to be >4 ha in size, with ponds and reservoirs excluded.

To test our hypothesis on settlement origin in North America, we also examined a list of 1722 Canadian lakes obtained from Wikipedia (https://en.wikipedia.org/wiki/List_of_lakes_of_Canada) using click-throughs to provincial sites (accessed 13 September 2015). The Laurentian Great Lakes were excluded, and there were no consistently available accompanying data in any of these lists on lake morphometry or geographical coordinates. The dominance of different Canadian provinces by either English or French settlement provided an excellent opportunity for comparing lake nomenclature patterns in another country in North America. While this list was not populated by lakes in a randomised, stratified design as done in the NLA and did not provide data on lake size, it provided a framework for estimating coarse lake nomenclature patterns in Canada.

Statistical analyses

We explored potential drivers of lake nomenclature in the U.S.A. using data obtained from the NLA, focusing on variables that likely influenced a lake's naming convention. Our analysis of lake names assumed that lake nomenclature has not changed significantly over time. Our primary driver variables were lake surface area, maximum depth, latitude, and longitude; lake surface area and maximum depth were ln-transformed to meet assumptions of normality and equal variance. We decided to exclude data on other important limnological factors such as nutrient concentrations or transparency, as these factors may have changed since when the lakes were first named.

Logistic regression was used to assess the relationship between lake nomenclature (with 0 coded as Lake Name and 1 coded as Name Lake) and our driver variables at the continental scale. In addition to the continental analyses, we compared the prevalence of Lake Names versus Name Lakes among Level III EPA ecoregions and states (Fig. 1) to assess whether there were regional differences in lake nomenclature. All single variable (lake area, latitude, state, longitude and ecoregion) logistic regression models predicting lake nomenclature were compared using the corrected Akaike information criterion (AICc). Second, we conducted both backward and forward stepwise regression to assess all possible predictor combinations using stopping rules of minimum AICc or BIC (Bayesian information criterion), and the best model was again selected based on the lowest AICc. All analyses were conducted in JMP v.11.0.0 (SAS Institute, Cary, NC, U.S.A.).

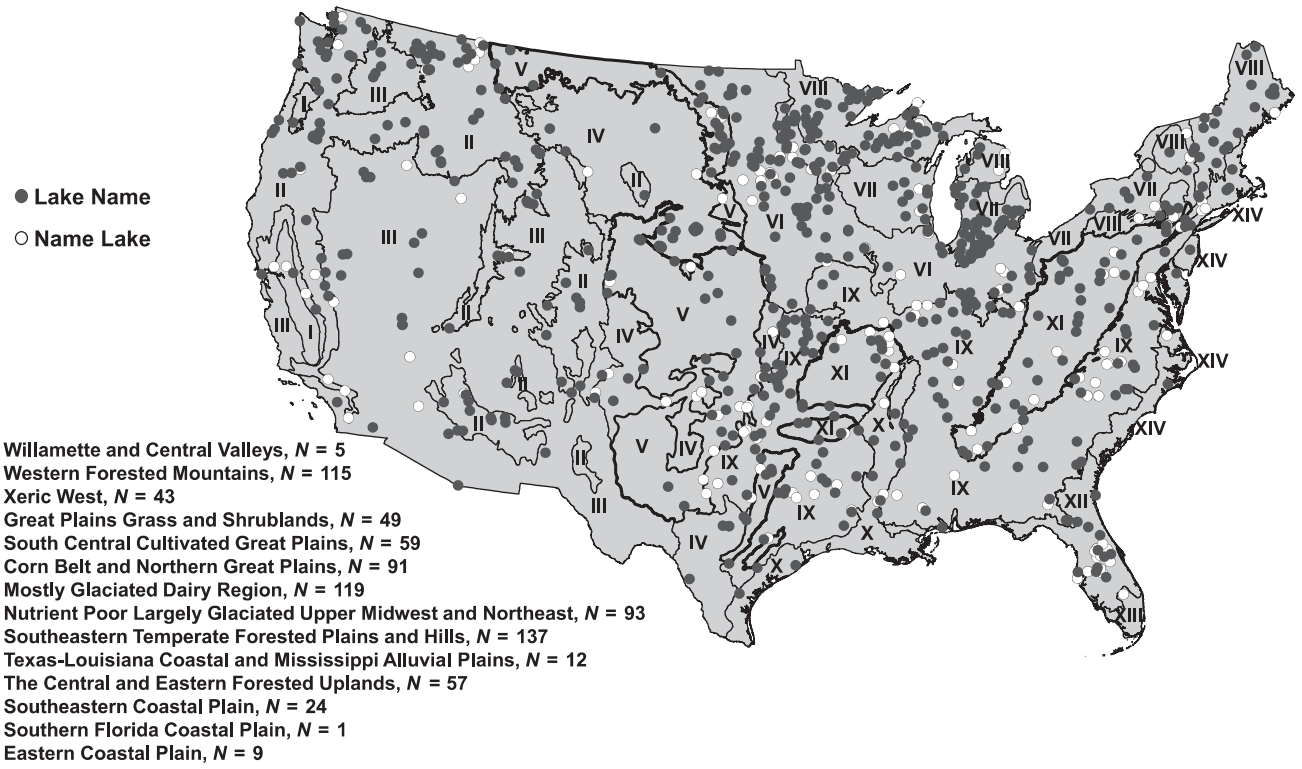

Fig. 1 Map of the 14 EPA level III Ecoregions (*N* = total number of lakes in each ecoregion included in the Analysis).

Results

U.S. lake nomenclature

Of our final dataset of 814 NLA 'lakes', 158 (19%) had a Lake Name and the remaining 656 (81%) had a Name Lake (Fig. 1). Lake area was a significant predictor of a lake's name: as lakes increased in size, the likelihood of being called Lake Name significantly increased (predicted logit = $-1.55(\pm0.10) + 0.29(\pm0.05) \times \ln$ (lake area); $X^2 = 43.06$, $P < 0.0001$; Fig. 2a). By solving the logistic regression equation with the predicted odds ratio of the logit = 0.5, we determined that the lake surface area at which there was an equal probability that a lake would either be called Lake Name or Name Lake occurred at 1100 km^2 (lakes larger than this size represent 0.00004% of lakes globally in the Downing *et al.* (2006) meta-analysis). There was no effect of maximum depth on lake nomenclature ($P = 0.23$; Fig. 2d).

Of the 814 U.S. 'lakes', 379 (47%) were defined in the NLA as having a man-made origin, and 435 were naturally formed. Regardless of lake origin, we observed the same significant relationship between lake area and lake nomenclature. Interestingly, the relationship between lake area and lake name was stronger for the naturally formed lakes ($\chi^2 = 34.21$, $P < 0.0001$) than for man-made lakes ($\chi^2 = 10.34$, $P = 0.001$), indicating that historical factors may play a role in lake nomenclature since natural lakes would have been named earlier than the more recently formed reservoirs. Man-made lakes (but not named Reservoirs, as these were excluded from the analyses) had to be very large (7700 km^2) to have an equal probability of being called a Lake Name versus Name Lake, in comparison to naturally formed lakes, where the breakpoint occurred at a surface area of 351 km^2.

We observed significant effects of latitude and longitude on the likelihood of lake nomenclature. The probability of a waterbody having a Lake Name in the contiguous U.S.A. increased moving southward, as expected ($\chi^2 = 31.76$, $P < 0.0001$; Fig. 2c), and eastward ($\chi^2 = 5.66$, $P = 0.02$; Fig. 2b), contrary to our expectations, although Name Lakes were more common overall. These latitudinal and longitudinal relationships remained significant even after the effects of lake surface area were controlled for in multiple logistic regression models that included both predictors.

The continental lake nomenclature relationships exhibited significant differences among ecoregions (Fig. 3), mirroring the longitudinal and latitudinal results described above (likelihood ratio test, $\chi^2 = 29.93$, $P = 0.005$). Across the ecoregions, Name Lakes represented >75% of all waterbodies in the Western Forested Mountains (II), Mostly Glaciated Dairy Region (VII), Glaciated Upper Midwest and Northeast (VIII), Xeric West

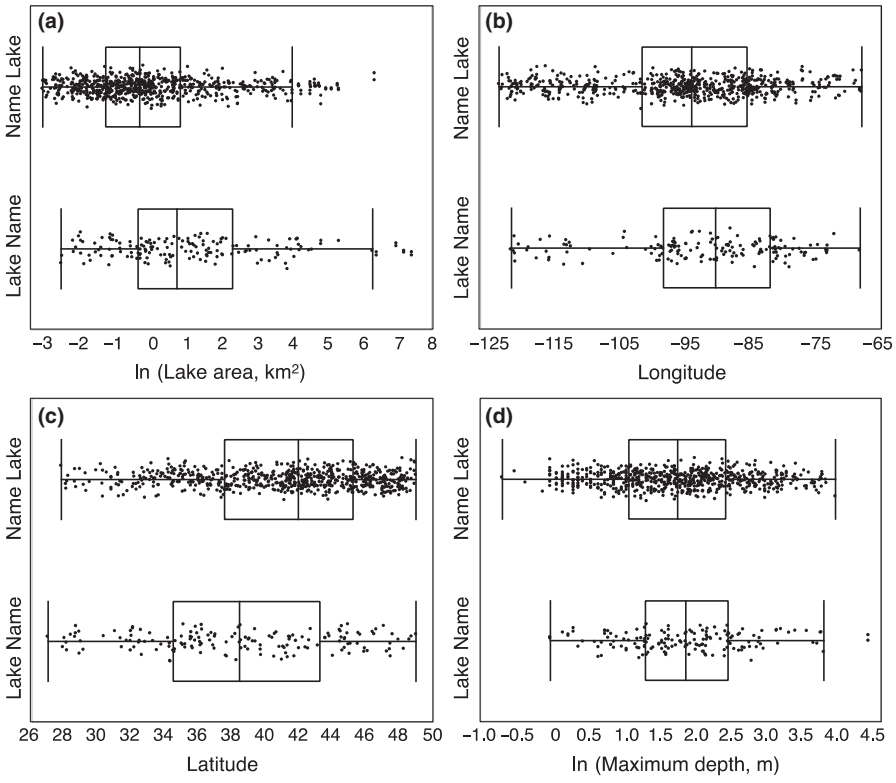

Fig. 2 Boxplots summarising the results of the logistic regressions for the relationships between lake nomenclature and lake (a) surface area, (b) longitude, (c) latitude and (d) maximum depth. Surface area and maximum depth were ln-transformed to meet assumptions of normality and equal variance.

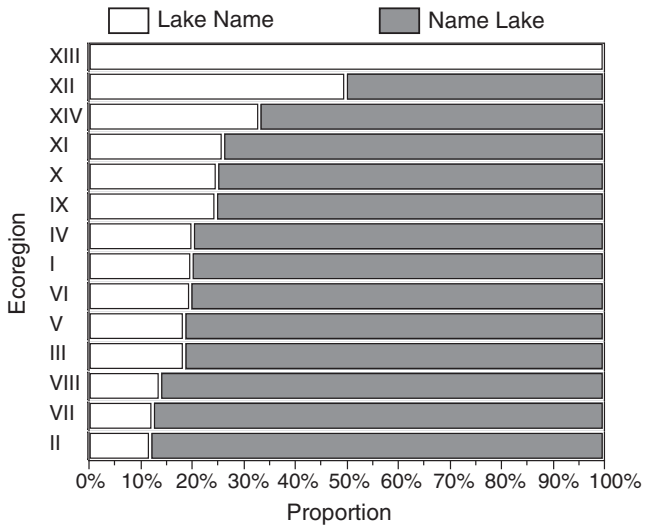

Fig. 3 Proportion of lakes in an ecoregion with Lake Name (white) or Name Lake (grey). The total number of lakes, full ecoregion names and their locations are shown in Fig. 1. Abbreviated ecoregion names moving from the top to the bottom of the figure are as follows: Southern Florida Coastal Plain (XIII), Southeastern Coastal Plain (XII), Eastern Coastal Plain (XIV), Central and Eastern Forested Uplands (XI), Texas-Louisiana Coastal and Mississippi Alluvial Plains (X), Southeastern Temperate Forested Plains and Hills (IX), Great Plains Grass and Shrublands (IV), Central Valley (I), Northern Great Plains (VI), South Central Great Plains (V), Xeric West (III), Largely Glaciated Upper Midwest and Northeast (VIII), Mostly Glaciated Dairy Region (VII) and the Western Forested Mountains (II).

(III), South Central Cultivated Great Plains (V), Corn Belt and Northern Great Plains (VI), Willamette and Central Valleys (I), and Great Plains Grass and Shrublands (IV). Ecoregions where Lake Name was more common were: Southern Florida Coastal Plain (XIII), Southern Coast Plain (XII) and Eastern Coastal Plains (XIV). In particular, 100% of the lakes in the Southern Florida Coastal Plain were called Lake Names (Fig. 3).

Among U.S. states, we observed highly variable patterns (Fig. 4), with highly significant differences in lake nomenclature (likelihood ratio test, $\chi^2 = 117.75$, $P < 0.0001$). Differences in state sizes and number of lakes per state likely account for some this variation. States where more than 50% of all waterbodies had a Lake Name were Maryland, Virginia and Florida, with California and Connecticut exhibiting an even divide in their Lake Name versus Name Lake waterbodies. States using exclusively Name Lake were Delaware, Massachusetts, New Hampshire and West Virginia (Fig. 4).

When all potential logistic regression models were compared, the best model explaining lake nomenclature at the continental scale incorporated both ln-transformed lake surface area and state predictor variables (Table 1). This model had a lower AICc than all single variable models (i.e., lake area, latitude, state, longitude and ecoregion), regardless of whether minimum AICc or BIC stopping rules were implemented in the stepwise regressions.

Observations on lake nomenclature in Europe

We observed substantial variation in lake naming patterns among major European source countries for U.S. settlement. Unlike France and Spain, where Lake Name (*Lac Nom* or *Lago Nombre*, respectively), is always used due to linguistic convention, there was much more variability in lake nomenclature in Great Britain and Ireland. In England, 98% of the lakes are referred to by Name Lake (Table 2), with only 10 incidences of Lake Name out of 481 lakes total. In contrast, Lake Name dominates 80% of lakes in Wales, where the Celtic form of 'Llyn' as lake is most commonly used. In Ireland, lakes were almost exclusively referred to as Lough (with three exceptions) and 62.5% are of the type Lake Name. Aggregated together, Scotland, Ireland and Wales had up to an order of magnitude more Lake Names than Name Lakes (Table 2).

Similar to the U.S.A., we observed that larger lakes by surface area were significantly more likely to be Lake Name than Name Lake across Great Britain and Ireland ($\chi^2 = 14.19$, $P = 0.0002$). This relationship was primarily driven by lakes in Scotland, the only country that individually exhibited a significant relationship between lake nomenclature and lake size ($\chi^2 = 25.62$, $P < 0.0001$; all other countries had $P \geq 0.09$). Across Great Britain and Ireland, all lakes >1435 ha were Lake Name, regardless of which country the lakes were located.

Lake nomenclature in Great Britain and Ireland appears to be related to the etymology of the predominant languages spoken, despite the linguistic dilution that likely occurred through trade and invasions by other linguistic groups, including the Vikings, Romans, Saxons and Normans. Generally, the early Celts consisted of two dominant language groups: Britton and Gaelic (McBain, 1911). English descends most directly from the Britton Celts, and this group appears to use Name Lake nomenclature almost exclusively. Gaelic speakers (in Ireland, Scotland and Wales) predominantly use Lake Name nomenclatures. Furthermore, Gaelic is closely related to dialects in Gaul (France) and Spain (McBain, 1911), Romance languages that always also place 'Lac' or 'Lago' before their lake names. Finally, in the other dominant Germanic 'West Teutonic' language (German), the word for lake 'See' almost always comes second (e.g., Müggelsee), as in English-speaking Great Britain, where Name Lake also dominates.

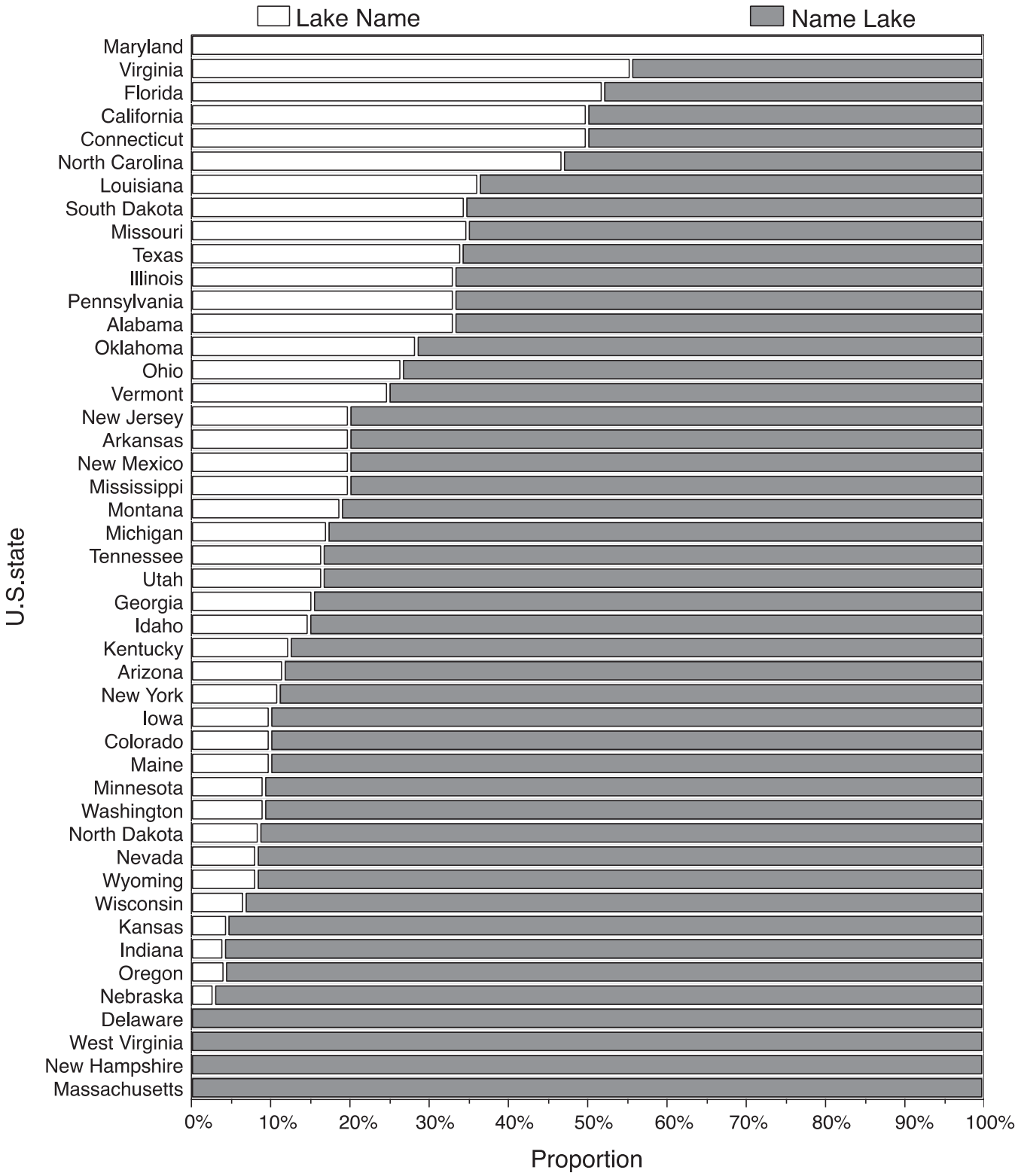

Fig. 4 Proportion of lakes in each U.S. state with Lake Name (white) or Name Lake (grey).

An interesting peripheral result of our examination of waterbodies in Great Britain and Ireland is that a wide variety of English and Celtic terms exist for lakes that may relate to their nomenclature order. When Lake Name is used for a waterbody, the most common terms for lake are Llyn, Lynau and Loch. In contrast, when

Table 1 The best-fitting logistic regression models predicting lake nomenclature at the continental scale, ranked in descending order of best-fitting model by corrected Akaike information criterion (AICc). Lake surface area was ln-transformed to improve normality.

Model	Chi-square	*P*-value	AICc
Ln (lake area) + State	152.51	<0.0001	748.54
Ln (lake area)	43.06	<0.0001	762.13
Latitude	31.76	<0.0001	773.43
State	117.76	<0.0001	781.06
Longitude	5.66	0.017	799.52
Ecoregion	29.93	0.0048	799.76

Table 2 Summary of the lake naming patterns and mean lake sizes in Great Britain and Ireland.

Country	*n*	% Lake Name	% Name Lake	Lake Name size (mean ± SE)	Name Lake size (mean ± SE)
Ireland	152	62.5	37.5	1600 ± 500 ha	160 ± 570 ha
Scotland	2836	83.4	16.6	55.4 ± 6.1 ha	19.3 ± 2.5 ha
England	481	2.0	98.0	13.4 ± 4.4 ha	39.1 ± 6.0 ha
Wales	151	80.3	19.7	34.4 ± 7.9 ha	14.7 ± 4.6 ha

Name Lake is used, terms for Lake include Broad, Flash, Mere, Mor, Pool, Tarn and Water. Such terms do not appear to have not carried over to the naming of U.S. lakes, at least as can be inferred from the NLA waterbodies.

Observations on lake nomenclature in Canada

Finally, our expectation of lake name convention based on the origin of European settlement was largely substantiated by a comparison of lakes across Canada for which only name information by province was readily available. Of the 1722 lakes on the Canadian list, 410 (24%) had a Lake Name and the remaining 1312 (76%) had a Name Lake, similar to the ratio observed in the NLA dataset. There were significant differences in naming convention among provinces (likelihood ratio test, $\chi^2 = 439.84$, $P < 0.0001$), which was largely driven by French-speaking Québec, where 89% of the lakes had a Lake Name. By contrast, British Columbia, a province heavily dominated by English settlers, exhibited only 4% of its lakes as having a Lake Name, and no other province exhibited over 25% of lakes with Lake Name.

Discussion

Our examination of lake nomenclature across the continental U.S.A. generally supported our hypotheses. Lake surface area is indeed a major factor, promoting the use of Lake Name. As such, the Laurentian Great Lakes (Lakes Erie, Huron, Michigan, Ontario and Superior) serve as classic examples, although they were not included in our analyses. Also, as we suspected, lake depth did not play a role in lake naming. Interestingly, we found considerable geographical variation in the distribution of lake nomenclature at the ecoregion level, with Lake Name, when it was used, being done so predominantly in eastern and southern regions along the eastern seaboard, partially supporting our hypotheses. A state-by-state analysis showed similar patterns, but may be influenced by small sample sizes in certain states. Our analysis suggests that colonisation influence based on the historical immigration patterns of different linguistic groups likely played a role in lake naming patterns, which is a similar finding to what was observed in a study of the nomenclature of Midwestern U.S. streams (Raup, 1957). We note, however, that some lakes may have changed their nomenclature over time, as different waves of colonizers occupied the same regions, making definitive conclusions regarding the historical influences sometimes murky.

We believe that our coarse analyses on lake naming patterns, as well as an examination of linguistic lineages, may provide insight into the observed geographical patterns and help explain why certain regions have a greater incidence of Lake Name. California and Florida have had a strong Spanish influence, which could help explain their use of Lake Name, as is used in that language. Louisiana, which was settled as a colony of France in the late 1600s before being ceded to Spain in 1763, is unsurprisingly also one of the heaviest users of Lake Name. Similarly, Missouri was originally called Haute-Louisiane (Upper Louisiana) and is also well represented in use of Lake Name.

Why several parts of the Eastern seaboard – in particular, Maryland, Virginia, North Carolina and Connecticut, as well as scattered states in the central U.S.A. – use Lake Name is less immediately clear. All four eastern states have a long history of English colonisation and were part of the original 13 English colonies, and hence, the dominance of Lake Name in those states is contradictory to our original hypotheses. None of those states had many large lakes, as would be expected if their Lake Names were driven solely by size, so it is possible that subsequent migrations of settlers from countries where Romance languages or Gaelic were spoken (e.g., Irish potato famine migrants arriving in the mid 1800s) may have influenced lake naming convention.

A closer examination of some state-by-state history may help explain the higher than expected use of the non-English Lake Name format in certain states.

Maryland, the heaviest user of Lake Names, was originally mapped by the 16th century Spanish Ajacán Mission, also serving as a refuge for some French-speaking Acadians exiled from Canada in the 1750s (Griffiths, 1992), and for some religious refugees of the French Revolution. Virginia was originally colonised by the Spanish (Weber, 1992; Adams, 2001) and later received French Huguenot settlers from Europe in the late 1600s and early 1700s (Hendricks, 2006). France was the first European nation to claim South Dakota and to send in explorers (Schell & Miller, 2004), later granting the territory to Spain in the Treaty of Fontainebleau, the same treaty that ceded Louisiana (Francis, 2006). Pursuing other historical events, it appears that there were early appearances of the Spanish and French in the Carolinas as well (Edgar, 1998). After early forays by the Spanish, Jean Ribault created the French colony of Charlesfort in 1562 in a region he called Carolana, both named for King Charles IX of France. The colony's name later stuck when the conveniently named King Charles I of England took over in 1629. There is also documented French Huguenot and Acadian immigration into the Carolinas, with South Carolina having the largest French population of the 13 original colonies (Edgar, 1998).

The fact that Connecticut and Vermont had a relatively high proportion (50 and 25%, respectively) use of Lake Name also seemed to counter our prediction for New England. Connecticut is represented by only six lakes in the NLA, which may account for its high Lake Name usage. However, the case of Vermont does help further support our colonisation hypothesis: there was considerable immigration of francophones from Québec, Canada, through the (Lake) Champlain Valley that occurred in Vermont's early years, resulting in the state name of 'Vert mont' or Green Mountain. Québec's high proportion of Lake Names in comparison to the other provinces dominated by English settlers further supports our colonisation hypothesis in another region of North America. Generally, with the exception of Connecticut and Vermont, the other New England states (Maine, Massachusetts and New Hampshire) behaved as expected, with their waterbodies dominated by Name Lakes, as in England. These states were largely settled by English colonists, and the lake naming convention likely followed the standards observed in their country of origin. Rhode Island was not represented in the 814 lake NLA dataset.

We note that there are several issues with this analysis that may influence our results. For example, the NLA dataset includes only a small subset of the U.S.'s six million lakes (Winslow *et al.*, 2014), and we can think of lakes that could alter the patterns we observed to some degree: for example, two of New Hampshire's largest lakes, Lake Winnipesaukee and Lake Sunapee, which were not in the NLA dataset, do not follow the state's 100% Name Lakes pattern, owing potentially to their multi-syllabic native name origins, which sound better to the ear when preceded by lake. Inclusion of these lakes would, thus, have reduced the apparent strict nomenclature concluded for New Hampshire based on colonisation, and instead follow the lake size pattern we also observed. However, our hope was that the NLA's randomised, stratified design across lake size classes, ecoregions, and states would provide a fair representation of major patterns. Similarly, the differences in lake density among states may have influenced the interpretation of their nomenclature (e.g., Connecticut), but likely still provide insight to general lake naming patterns across the U.S.A. We focused here on generalised patterns across the continental U.S.A. because each lake has a unique history and naming story, which likely influenced its nomenclature.

We conclude that there is evidence for lakes to have a Lake Name syntax in English when they have a larger surface area, or when they occur in a region where the Gaelic forms of English, as well as the Romance Languages, have had a significant influence. North American lakes in the U.S.A. (and Canada) do not have the naming consistency of lakes in England, Spain, France or Germany because of the mixed influence of these various countries with different conventions. Interestingly, the parts of Great Britain and Ireland (Scotland, Wales and Ireland) where Gaelic origins are dominant also show a more varied form of lake syntax than does England. This appears to be partially related to lake size in these regions, as in the U.S.A., but also to the use of Lake Name in Gaelic and their related European languages. These results support the contention relating much of lake nomenclature to linguistic history, but that where linguistic flexibility occurs (Ireland, Scotland and Wales), lake size is also an important feature of naming patterns. As a melting pot of cultures, the U.S.A. is a classic case of linguistic mélange, evident in the way its people have come to refer to its waterbodies.

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