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A methodology to classify and visualize stylistic evolution in topographic maps

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ABSTRACT

Building upon recent research to analyse stylistic diversity in 1:50 000 European state topographical mapping, this paper presents a development of the methodology to explore the development of national cartographic styles. It examines the supranational style adopted by the national mapping organizations of Great Britain and Ireland, which has been identified as the strongest among the sample of 20 countries, by using a similar classification technique to analyse and compare the symbologies of a selection of earlier topographic maps at similar scales. Star plots are used to visualize the development in cartographic vocabulary employed for the expression of national landscape, which also reveal changing imperatives in state mapping. It is suggested that the methodology could be used to explore the evolution of other national mapping initiatives and the effects of societal influences on cartographic style, particularly the impact of political independence.

INTRODUCTION

“Standardization over time means that the legend of a 1990s 1:50 000 topographic map would have been understandable and usable (apart from the detailed road and railway classification) by a 1790s cavalry officer”.¹

If topographic maps are indeed this slow to develop, they offer little more than hazy mirrors of society. Furthermore, within the realm of state imperatives of map-making, such as taxation and military advantage, the scope for diversity in the expression of national landscape seems particularly limited. Building upon an earlier study to classify stylistic diversity in current European topographical mapping² where the maps of Great Britain and Ireland were identified as having similar proportional relationships of types of features using hierarchical cluster analysis, this paper adopts a similar method of classification. In particular, it concentrates on how the stylistic similarity between the maps of Great Britain and Ireland may be visualized, offering a technique for demonstrating the evolution of national style in state topographic maps.

DEFINING STYLE IN TOPOGRAPHIC MAPS

Maps are selective views, involving choices over the inclusion and presentation of phenomena. The subject of maps undergoes symbolization: the deliberate and specific ordering of form to present the character of a feature in a particular way. It refers to the creation of a graphic figure, which, by its nature, communicates the existence and quality of a feature within the context of the map. Style is therefore defined here as the particular manner in which a feature is symbolized, or,

more specifically, the particular preservation of a feature's character through successive cartographic products and processes. The most fundamental element of cartographic style concerns the choice over what to show and how to show it, especially the amount of detail in which features should be shown, e.g. roads, and classes of roads; buildings and types of buildings; vegetation and types of vegetation. Style becomes a custom that dictates its own conventions; a homogenous style is one of the defining features of a national series of topographic maps, where the national landscape is symbolized in a particularly consistent (and often easily identifiable) way through the employment of a standardized range of cartographic symbols.

As cartographic generalization involves the process of selective omission of detail, it provides a means for discriminating between styles. In topographic maps, the process relates to the classification of landscape, i.e., which features are selected from the land and the amount of detail in which they are classified. If changing the classification of the landscape subsequently affects map content by altering the relative proportions of the types of features selected, this should also indicate the changing state imperatives. In order to discover any longer term trends and facilitate more detailed comparisons, an approach is needed which generates quantitative data while providing an acceptable assessment of style.

This paper presents a classification of official topographic maps of Great Britain and Ireland from 1894 to 2004 and a means for which to visualize the evolution of state cartographic language. The aim is not to offer any detailed interpretation of the similarities and differences, but rather to determine whether a particular technique – designed initially to identify supranational styles – is helpful for understanding the development of national styles in state cartography over time.

METHODOLOGY

The method involves the construction of a typology of cartographic style based on the classification of legend symbolologies of the state topographic maps under investigation. Originally devised for comparing the national symbolologies employed by 20 countries across Europe,³ it is essentially a development of an earlier study that sought to highlight national differences in state topographic cartography.⁴ This investigation aims to explore the development in symbology over time, so the comparison will in this case be historical rather than geographical. Being ‘vertical’ rather than ‘horizontal’, the sample comprises a selection of maps published at different points in the history of the national mapping organizations represented here, namely Ordnance Survey (Great Britain) and Ordnance Survey Ireland (Suibhéireacht Ordánáis), as summarized in Table 1 below.

Map Series	Scale	Publication Date of Sample Sheet
New Series (Temporary Advance Edition)	1:63 360	1894
Revised New Series	1:63 360	1898
Third Edition (Outline)	1:63 360	1905
Fourth Edition	1:63 360	1912
Fifth (Popular) Edition	1:63 360	1933
New Popular Edition	1:63 360	1946
Seventh Series	1:63 360	1967
1:50 000 First Series	1:50 000	1974
1:50 000 Second Series	1:50 000	2004
Second Edition	1:63 360	1901
Third Edition	1:63 360	1912
Military Map (Third Edition)	1:63 360	1942
1:50 000 Map of Ireland	1:50 000	1984
1:50 000 Discovery Series (Third Edition)	1:50 000	2003

Table 1 Sample map series included in the typology

The typology is constructed by sorting each distinct graphical symbol depicted in the legend of a sample of topographic maps into 19 mutually-exclusive categories, where each category (and the types of features therein) remains the same (Table 2). Using this system of classification, the content of the maps

Level Three Class	Examples of Features Symbolized
Road	Motorways, roads, tracks, bus stations, parking, junctions, tree-lined roads, and road tunnels/bridges
Rail	Railways, railway stations, cargo railways, and railway tunnels/bridges
Paths	Footpaths, bridleways, passes, ski-tracks, and footbridges
Canals	Canals, locks, canal beacons, trafficable dykes and aqueducts, and canal water level gauges
Cycle Tracks	Cycle tracks, cycle routes, and cycle bridges
Other Transport	Trams, ferries, ports, docks, airports, and helipads
General Built-Up Features	Residential buildings, schools, hospitals, post-offices, police stations, town halls, farms, towers, fences, walls, and choenfelds
Administrative Boundaries	International, national, district, province, canton, and county boundaries
Religious Features	Cathedrals, monasteries, churches, chapels, and shrines
Industry, Communications, and Power	Quarries, peat-cuttings and huts, factories, fish farms, oil/gas stores, radio masts, windmills, watermills, pylons, and power stations
Water Management and Utilization	Reservoirs, fountains, dams, dykes, levees, irrigation canals, weirs, water towers, groynes, sluices, and sewage treatment facilities
Navigation and Military Features	Triangulation pillars, cairns, isolated objects as reference points, beacons, lighthouses, shipwrecks, and military camps
Tourist and Sport Facilities	Hotels, campsites, golf courses, ski-lifts, cable-cars, sports centres, and football pitches
Historical Features	Castles, ruins, ancient earthworks, burial mounds, and monuments
Managed Land	National parks, nature reserves, cemeteries, gardens, and parkland
Hydrology	Bodies of water, submerged rocks, rivers, streams, springs, currents, and bathymetric depths
Terrain and Relief	Contours, spot heights, escarpments, natural escarpments, rocks, scree, sand, cliffs, caves, glaciers, and snowfields
Vegetation	Woods, forests, grassland, open land, shrubland, heathland, meadows, hedges, orchards, vineyards, and arable land
Non-Landscape Features	Graticule intersections

Table 2 Categories of symbol classification⁵

(and thus the relative proportions of symbols within each category) – as presented to the map user – may then be compared and analysed. Although other symbols may appear on the map surface and form part of a wider symbology, legend symbols are of particular importance because they serve the perceived user of the map. Only symbols which form a discrete and complete graphical unit are counted. Abbreviations are omitted because they do not undergo the same process of ‘coding’ that symbolization entails; the application of graphical variables which transforms them into the vocabulary of cartographic language.

The method is designed to offer a straightforward means for comparing topographic maps while allowing a broad scope for more complex quantitative analyses, should the intention be to interrogate the data in rigorous detail. Specifically, it offers the possibility of demonstrating the evolution of state symbologies through a particular technique of data visualization. While ‘qualitative’ elements (e.g. concerning colour, lettering, visual hierarchy, and ‘white’ space) are also major components of cartographic style and form part of Kent’s (2007) original study to analyse European topographic maps, it is the classification of landscape that has the most fundamental bearing on style and provides the focus for this paper. Naturally, no classification system is without room for improvement, but it is hoped that it will offer a helpful contribution to the analysis of topographic map symbologies. The maps used in this investigation are at similar scales (1:63 360 or ‘one-inch’ maps and 1:50 000), which is crucial because scale affects the choices cartographers make over what to show and how to show it and therefore the detail in which each landscape is classified. Different scales serve different purposes and these scales offer something of an equilibrium between abstraction and detail – and with it the intention to serve the general as opposed to the specific user. Moreover, these scales have represented and continue (where 1:50 000 is concerned) to represent the most widespread variety among national topographic map series and so offer potential for further comparative studies.

Paper is a useful medium for the purposes of this study because of the many limitations it imposes upon the cartographer. The problem of presenting many themes simultaneously necessitates a skilful coordination of the complex interplay between graphical components, essential for providing an effective representation of the national landscape. Furthermore, in regarding maps as texts, paper maps offer what is perhaps the most accessible insight into the circumstances of production that governed their creation – they preserve the selection of features and their representation, and, with them, the choices made concerning their design. Colonial mapping imperatives present in the classification of a 19th century landscape therefore remain embodied in the paper map, which facilitates a comparative analysis of map series created during different periods.

RESULTS AND DISCUSSION

The first observation arising from the data is that legend symbologies generally become more exhaustive in describing the range of symbols utilized throughout the topographic map series (Table 3 and Fig.1). Another observation regarding the total number of legend symbols is the divergence after the 1:50 000 Map of Ireland series (produced jointly by the Ordnance Survey of Northern Ireland and Ordnance Survey Ireland). It would appear that the most recent Discovery Series is a move towards the establishment of a new national style of cartography and away from the cartographic legacy of Ireland’s colonial past. In contrast, the number of symbols comprising the legends of Ordnance Survey (Great Britain) map series demonstrate a steady growth over time (Fig.1) and the dominant types of features remain roughly similar (Fig.2).

Map Series	Publication Date of Sample Sheet	Total Number of Legend Symbols
New Series (Temporary Advance Edition)	1894	15
Revised New Series	1898	28
Third Edition (Outline)	1905	30
Fourth Edition	1912	30
Fifth (Popular) Edition	1933	52
New Popular Edition	1946	77
Seventh Series	1967	87
1:50 000 First Series	1974	104
1:50 000 Second Series	2004	149
Second Edition	1901	27
Third Edition	1912	30
Military Map (Third Edition)	1942	20
1:50 000 Map of Ireland	1984	93
1:50 000 Discovery Series (Third Edition)	2003	73

Table 3 Total number of legend symbols**Figure 1** Number of legend symbols on British and Irish topographic maps, 1894–2004

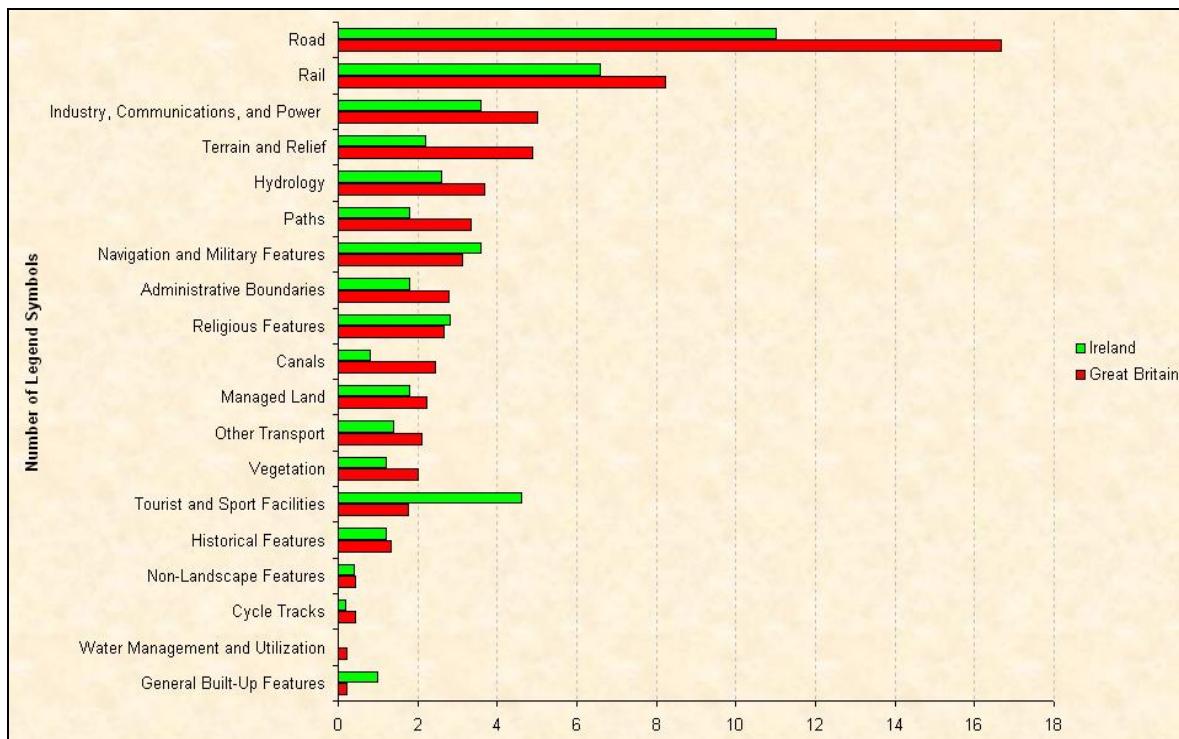


Figure 2 Mean legend symbol counts on British and Irish topographic maps, 1894–2004

The main component of the investigation in the typology concerns the number of symbols devoted to the portrayal of a particular type of feature and Table 4 below presents these data. A pie chart provides a useful summary for indicating the relative proportions of features comprising the whole symbology (Fig.3), but more effective at capturing the character of each map series, however, is the star plot (Fig.4). When used to present all the symbologies together (Fig.5), this visualization technique not only indicates the various directions that new developments in vocabulary have taken (particularly since the introduction of the metric map scales) but also a sense of the relative sizes (and growth) of the symbologies.

CONCLUSION

It is clear from these star plots that the national styles of Great Britain and Ireland follow a very similar pattern in their classification of landscape as their legend symbologies have developed. Although the Irish symbologies tend to utilize fewer symbols, their emphasis on infrastructure, and, more recently, tourist features, demonstrates their resemblance to the British style. Ordnance Survey conducted the topographical mapping of Ireland as proposed by the Spring-Rice report of 1824.⁶ After Ordnance Survey's methods of survey, landscape description, and portrayal were established in Ireland, it is likely that some of its legacy remains in the design of current Irish topographic maps. Of course, proximity has played a role in this particular historical association, whether the portrayal of landscape has been (or is) congruous with Irish culture and society or not.

If cartography may be regarded as using its own language to describe spatial relationships, it is easy to see how state topographic map symbologies provide a vocabulary for expressing the national landscape and this paper has demonstrated how these national mapping organizations have become more articulate over time as this vocabulary has evolved. It is clear that the legacy of former colonial powers is expressed in the symbolization of landscape, particularly in which features remain dominant in their proportion of symbology. The extent to which this remains true

EDITION	Road	Rail	Paths	Canals	Cycle Tracks	Other Transport	General Built-Up Features	Administrative Boundaries	Religious Features	Industry, Communications, and Power	Water Management and Utilization
New Series (Temporary Advance Edition) (1894)	7	2	1	0	0	1	0	0	2	0	0
Revised New Series (1898)	9	5	1	0	0	1	0	0	2	3	1
Third Edition (Outline) (1905)	9	5	1	0	0	1	0	0	2	3	2
Fourth Edition (1912)	9	7	1	0	0	1	0	0	2	3	2
Fifth (Popular) Edition (1933)	13	9	1	4	0	3	0	0	2	3	2
New Popular Edition (1946)	13	12	3	5	0	3	0	0	4	3	8
Seventh Series (1967)	17	13	6	4	0	2	0	0	4	3	9
1:50 000 First Series (1974)	33	12	6	4	0	3	0	0	4	3	9
1:50 000 Second Series (2004)	40	9	10	5	4	4	2	3	3	12	1
Second Edition (1901)	9	5	1	0	0	1	0	1	1	3	1
Third Edition (1912)	9	7	1	0	0	1	0	1	1	3	2
Military Map (Third Edition) 1942	5	7	1	0	0	1	0	0	0	3	2
1:50 000 Map of Ireland (1984)	17	10	4	2	0	1	2	5	3	9	0
1:50 000 Discovery Series (Third Edition) (2003)	15	4	2	2	1	3	3	2	2	4	0

Table 4 Typology data arising from the analysis of map legend symbolologies

EDITION	Navigation and Military Features	Tourist and Sport Facilities	Historical Features	Managed Land	Hydrology	Vegetation	Terrain and Relief	Non-Landscape Features
New Series (Temporary Advance Edition) (1894)	0	0	0	0	0	0	0	0
Revised New Series (1898)	3	0	0	0	2	0	1	0
Third Edition (Outline) (1905)	3	0	0	0	2	1	1	0
Fourth Edition (1912)	3	0	0	0	1	0	1	0
Fifth (Popular) Edition (1933)	3	0	0	1	4	2	5	0
New Popular Edition (1946)	4	0	1	3	6	3	8	1
Seventh Series (1967)	4	1	2	3	6	5	6	1
1:50 000 First Series (1974)	4	1	2	4	5	3	10	1
1:50 000 Second Series (2004)	4	14	7	9	7	4	10	1
Second Edition (1901)	4	0	0	0	1	0	1	0
Third Edition (1912)	4	0	0	0	1	0	1	0
Military Map (Third Edition) 1942	1	0	0	0	0	0	0	0
1:50 000 Map of Ireland (1984)	5	12	3	5	6	3	5	1
1:50 000 Discovery Series (Third Edition) (2003)	4	11	3	4	5	3	4	1

Table 4 Typology data arising from the analysis of map legend symbolologies (continued)

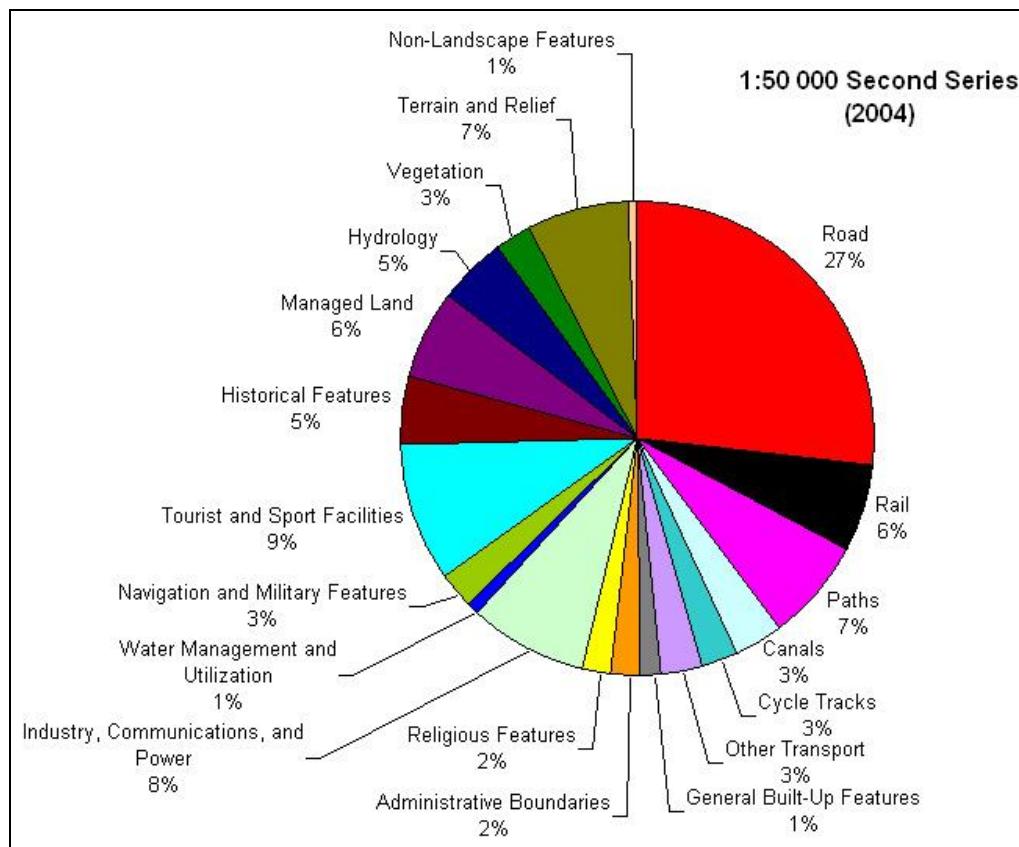


Figure 3 Pie chart showing composition of legend symbology for 1:50 000 Second Series (2004)

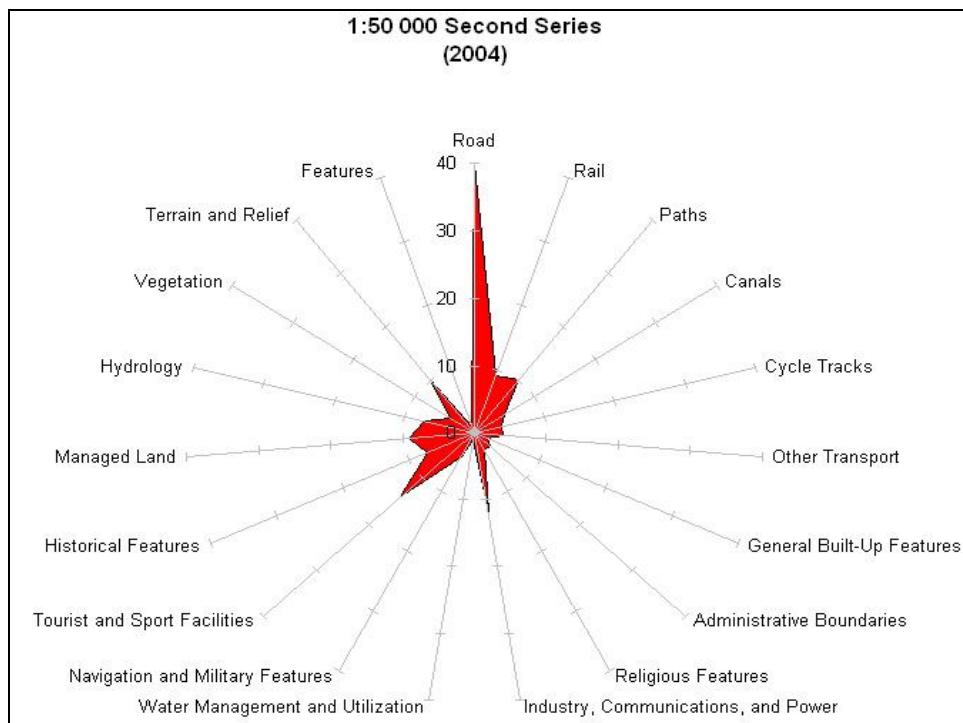


Figure 4 Star plot showing composition of legend symbology for 1:50 000 Second Series (2004), where the axes denote the number of discrete legend symbols falling within each category

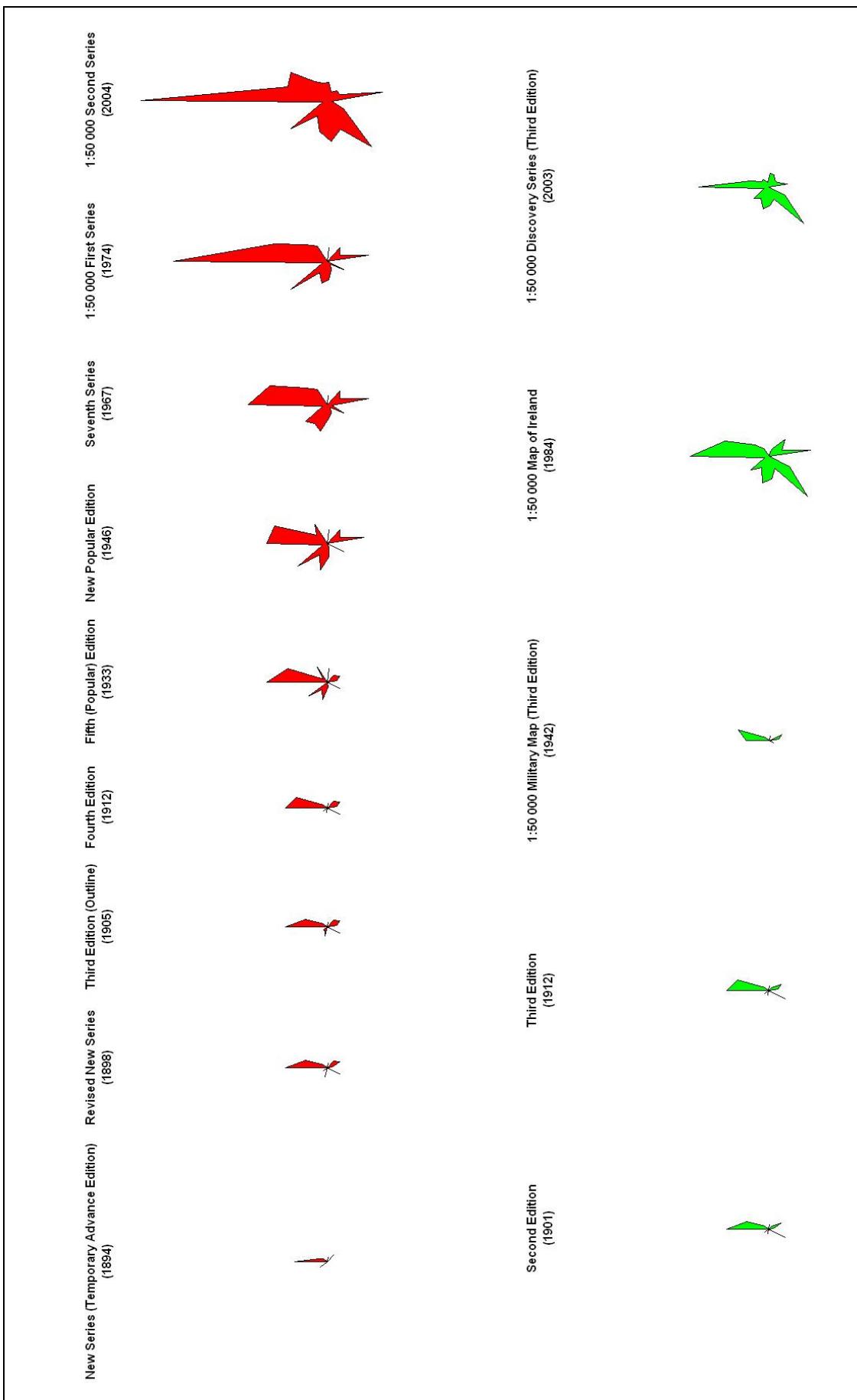


Fig.5 Star plots of all map legends (plotted on same axes as Fig.3)

for post-communist countries in their attempt to (re)construct their national landscape remains to be explored. In this respect, it is hoped that this paper offers a contribution to understanding the national characteristics of state topographic maps and the factors which influence them.

ENDNOTES

¹ Dorling, D. and Fairbairn, D. (1997) *Mapping: Ways of Representing the World* Harlow: Longman (p.92)

² Kent, A.J. (2007) "An Analysis of the Cartographic Language of European State Topographic Maps: Aesthetics, Style, and Identity" (*PhD thesis*) University of Kent at Canterbury.

³ *Ibid.*

⁴ Piket, J.J.C. (1972) "Five European Topographic Maps: A Contribution to the Classification of Topographic Maps and their Relation to Other Map Types" *Geografisch Tijdschrift* 6 (3), pp. 266–276

⁵ The classes and their example features are exactly those adopted by Kent (2007), *op. cit.*

⁶ Doherty, G.M. (2004) *The Irish Ordnance Survey: History, Culture and Memory* Dublin: Four Courts Press (p.14)

BIOGRAPHY

Dr Alex Kent. After degrees at Oxford Brookes University and Queens' College, Cambridge, Alex lectured in GIS, Remote Sensing, and Cartography while acting as an independent consultant on a variety of geospatial projects, including *An Atlas of the Social and Intellectual History of Islam* at the Oxford Centre for Islamic Studies. A fascination with topographic maps led to his PhD thesis *An Analysis of the Cartographic Language of European State Topographic Maps: Aesthetics, Style, and Identity* which won the National Geographic Society's *New Mapmaker Award* for 2007. Elected a Fellow of the British Cartographic Society in 2002 and Fellow of the Royal Geographic Society shortly after, Alex became Assistant Editor of *The Cartographic Journal* in 2006, Editor of the Bulletin of the Society of Cartographers in 2007, and in June this year, was appointed Head of Cartographic Unit, University of Southampton.