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Harnessing the biodiversity value of Central and Eastern European farmland

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Abstract

A large proportion of European biodiversity today depends on habitat provided by low-intensity farming practices, yet this resource is declining as European agriculture intensifies. Within the European Union, particularly the central and eastern new member states have retained relatively large areas of species-rich farmland, but despite increased investment in nature conservation here in recent years, farmland biodiversity trends appear to be worsening. Although the high biodiversity value of Central and Eastern European farmland has long been reported, the amount of research in the international literature focused on farmland biodiversity in this region remains comparatively tiny, and measures within the EU Common Agricultural Policy are relatively poorly adapted to support it. In this opinion paper we argue that, 10 years after the accession of the first eastern EU new member states, the continued underrepresentation of the low-intensity farmland in Central and Eastern Europe in the international literature and EU policy is impeding the development of sound, evidence-based conservation interventions. The biodiversity benefits for Europe of existing low-intensity farmland, particularly in the central and eastern states, should be harnessed before they are lost. Instead of waiting for species-rich farmland to further decline, targeted research and monitoring to create locally appropriate conservation strategies for these habitats is needed now.

Keywords: agricultural intensification, agri-environment schemes, Common Agricultural Policy, European Union, High Nature Value Farmland

Introduction

The long history of low-intensity agricultural land use in Europe has created many unique and species-rich assemblages, and a large proportion of these species are now dependent over much of their ranges on this form of human disturbance (Bignal, 1998). However, the industrialization of agriculture has, directly and indirectly, caused a dramatic impoverishment of the fauna and flora compared to the situation a century ago (Gregory et al., 2005; Tscharntke et al., 2005; Storkey et al., 2012). This has contributed not only to the current biodiversity crisis in Europe as a whole, but also to the decline in ecosystem services such as crop pollination and biological pest control (Tscharntke et al., 2005). As a result, the protection of farmland biodiversity has become a key issue in EU and national agricultural and environmental policies, and large amounts of research and funding are devoted to biodiversity conservation approaches such as agri-environment schemes (Farmer et al., 2008).

Whilst many conservation schemes play an important role in mitigating the impacts of intensive farming, the support of low-intensity practices on existing High Nature Value (HNV) farmland is, in the short and medium term, the most (cost-)effective way to stop the decline of many specialist species and species-rich communities (Bignal & McCracken, 1996; Kleijn et al., 2009). HNV farmland is present throughout Europe, although it is often restricted to upland or other areas difficult to farm, particularly in Northern and Western Europe (EEA, 2004). Eastern and Southern Europe, in contrast, generally have lower average levels of land-use intensity, and healthy populations of many species declining or endangered in the north-west persist here (EEA, 2004b; Liira et al., 2008; Stoate et al., 2009; Báldi & Batáry, 2011; Tryjanowski et al., 2011; Overmars et al., 2014). Whilst several decades of EU membership have already contributed to the large-scale loss of semi-natural farmland habitats in lowland Northern, Western, and to a lesser extent Southern Europe (e.g. Donald et al., 2001; Henle et al., 2008; Stoate et al., 2009), the central and eastern new member states (NMS) have only relatively recently started implementing EU biodiversity-related and agricultural policies. In this opinion paper, we highlight the contrast between the importance of the central and eastern NMS for farmland biodiversity in Europe on the one hand, and their poor fit with EU agricultural policy and lack of published ecological data in the international literature on the other. Addressing these problems now could help prevent a further decline in European biodiversity and ecosystem quality.

The legacy of communist agriculture in Central and Eastern Europe and its implications for farmland biodiversity

Between 2004 and 2013, 11 countries from post-communist Central and Eastern Europe joined the EU in a phased enlargement process that brought it to 28 member states, sharing common policies and goals (see Fig. 1a). Although heterogeneous in many respects, a shared characteristic of the central and eastern NMS is the legacy of communist agricultural policy during the mid and late 20th century, affecting not only on the structure and use of farmland, but also farmland biodiversity (Báldi & Faragó, 2007; Liira et al., 2008; Cousins et al., 2014). In the western EU-15, and particularly countries such as the UK, France, Germany and the Netherlands, the intensification of lowland farmland was relatively effective, carried out mainly by family farms and driven by production-linked agricultural subsidies. In contrast, although the state-imposed homogenization and intensification of farmland in Central and Eastern Europe also had severe negative impacts on biodiversity in places, this process was relatively inefficient, leaving many remaining patches of semi-natural land (Young et al., 2007). Collectivization of land in most Central and Eastern European countries also merged many private smallholdings into industrial farms of up to several thousand hectares in size. After the fall of the communist regimes around 1990, much of this land was returned to private ownership by individuals, but this had a lasting effect of creating a predominance of small semi-subsistence holdings (generally <5 ha in size), contrasted with few but very large industrial farms (Fig. 2a; Davidova et al., 2012).

Production dropped dramatically in the east and large areas of both cropland and grassland were abandoned in the 1990s and early 2000s, both of which allowed at least short-term population recoveries of many species (Donald et al., 2001; Keišs, 2003; Stoate et al., 2009; Kamp et al., 2011, but see e.g. some negative effects of farmland abandonment in Hungary documented by Verhulst et al., 2004). In the EU-15 during the same period, farming intensity was maintained but with increasing regulation of environmental impacts, most notably through successive reforms of the EU Common Agricultural Policy (CAP) (see Fig. 2b,c; Stoate et al., 2009).

Through the funding structures of the EU CAP, as well as the influence of the EU market, the central and eastern NMS have experienced both large-scale reactivation and intensification of farmland since accession, and continuing abandonment of marginal areas (Stoate et al., 2009; Tryjanowski et al., 2011; Sanderson et al., 2013). Nevertheless, fragmentation of land ownership is still a major hindrance in many NMS to the consolidation of farmland and agricultural intensification (Hartvigsen, 2014), and convergence of the agricultural sectors of old and new member states is limited (Csáki & Jámbor, 2013). Thus, compared to Northern and Western Europe, the NMS can be said to have: i) lower levels of agrochemical inputs, mechanization and productivity, with per hectare yields less than half of those of the EU-15 (Csáki & Jámbor, 2013; see also Fig. 2b,c); ii) farm structures polarized between a small number of very large industrial units and a large number of very small units (Fig. 2a); and iii) a predominance of subsistence and semi-subsistence farming, which is linked with positive effects on biodiversity via its promotion of mixed farming and mosaic structures (Tryjanowski et al., 2011; Davidova et al., 2013).

These are all major reasons why comparative studies show greater ecosystem quality for biodiversity (Reidsma et al., 2006), as well as higher levels of rare species occurrence and species richness in lowland farmland (Batáry et al., 2010) in the NMS than in Northern and Western Europe. However, this also means that nutrient limited yield gaps are currently larger in Eastern than in Western Europe (Mueller et al., 2012), so that the potential to intensify in the NMS is high. Whilst farmland biodiversity declines now appear to be slowing for some taxa in Northern and Western Europe, as they have already experienced their strongest losses in the mid to late twentieth century (Carvalheiro et al., 2013), the picture may be different in the NMS. For example, long-term monitoring trends in farmland birds suggest that their decline has been accelerating in the NMS in recent years. The farmland bird indices in Hungary (Szép et al., 2012), Latvia (Aunins & Priednieks, 2009) and Poland (Sanderson et al., 2013) all decreased following their accession to the EU in 2004, which the authors link to the changes in agricultural practices provoked by the CAP. General trends are difficult to measure due to the lack of standardised monitoring data from this region (notable exceptions being the Pan-European Common Bird Monitoring Scheme; Voříšek et al., 2010, and in some countries the European Butterfly Monitoring Scheme; van Swaay & Warren, 2012), as well as time lags in species responses (Kuussaari et al., 2009; Dullinger et al., 2013). The little evidence that is available from bird monitoring suggests that the current measures in place to protect farmland biodiversity in Central and Eastern Europe seem to be insufficient, but the lack of baseline and comparative data in these regions means that we have very little idea of what is currently being lost.

Agricultural biodiversity in Central and Eastern Europe is underrepresented in the international literature

The ecological literature on European farmland biodiversity has grown steadily in the last two decades. It plays an important role not only in providing locally relevant evidence to feed into conservation management, but also for large scale international reviews and meta-analyses to synthesise current knowledge on a topic of interest (Dicks et al., 2013). Searching the online data base Web of Science for peer-reviewed publications produced to date on farmland biodiversity in EU countries yielded 1952 studies published since 1991 (see Appendix S1 in Supporting Information). However, Northern and Western Europe dominates the literature both in terms of absolute number of studies (Fig. 1a; the UK, for example, is the focus of twice as many publications as the central and eastern EU NMS together), and proportional to the agricultural area (Fig. 1b).

Whilst the number of studies from central and eastern NMS is increasing, even when adjusted for the agricultural area in the region they are still only the focus of a tenth of the number of studies focussed on the rest of Europe (Fig. 1c). This confirms the results of a recent literature review on European AES, in which only 3% focussed on the NMS (Uthes & Matzdorf, 2013), despite the fact that AES have been in place in most NMS for at least 4 years by the end of the analysed time period. There are many possible reasons for the disparity in the numbers of publications on farmland biodiversity. Greater perceived urgency of farmland biodiversity loss and amount of research funding available in the west is likely to play a role, although the acceptance rate by journals of submissions from Eastern Europe has also been criticized (e.g. Rotter & Gostincar, 2014). Whilst it can be assumed that ecological research from the NMS is also published in non-English language or regional journals, these are usually not detected by the international community, e.g. when creating large scale reviews. This limits the accuracy of conclusions drawn from the literature, both for the general understanding of agricultural ecosystems and for the local design of conservation measures, because the responses of many species to management changes are moderated by the landscape context (Tscharntke et al., 2012; Gonthier et al., 2014). For example, moderate intensification was found to positively affect corn bunting (*Emberiza calandra*) populations in a study in Poland (Szymkowiak et al., 2014), compared to strong evidence for the negative effects in the UK (Brickle et al., 2000; Brickle et al., 2002), probably due to the generally low level of intensification in the surrounding Polish landscape. For similar reasons, red-backed shrikes (*Lanius collurio*) were found to have generally low breeding site fidelity in Polish landscapes, in contrast to their high site fidelity in “islands” of habitat in Western Europe (Tryjanowski et al., 2007).

Harnessing the biodiversity value of Central and Eastern European farmland

Of the support measures available for farmland biodiversity in the EU, the CAP has by far the greatest influence. With an average payment of 237 €/ha of farmland in the last programming period (Farmer et al., 2008), the direct payments of the CAP play an important role in supporting the viability of farming in the EU. However, it is particularly the subsistence and semi-subsistence farms making up such a large proportion of holdings in the NMS that benefit the least from this subsidy and therefore are most likely to be forced towards abandonment or intensification. Whilst it was known prior to accession that many of the smallest holdings in the NMS would have to be excluded from direct payments due to the administrative costs, this system was nonetheless adopted unaltered, exacerbating the competitive disadvantage of semi-subsistence farms (Swain, 2013). Furthermore, only few of the rural development measures so far offered by the CAP are accessible by semi-subsistence farms as they are either too small or lack the financial capital required (Davidova et al., 2012). There is, however, a planned single payment in the 2014-2020 CAP for "small farms", which may improve the financial situation of these holdings (Hennessy, 2014). Nevertheless, it seems to have generally been the fate of NMS thus far to have "imported" EU policies that have been designed according to the priorities of the EU-15, without being able to "upload" those with a better fit to their own structures and institutions (Gorton et al., 2009; Davidova et al., 2012; Swain, 2013).

This situation is also found in other rural development measures, such as agri-environment schemes (AES). AES are the only instrument in the CAP directly targeting farmland biodiversity conservation, and in 2009, 20.9 % of farmland in the EU was enrolled in AES (Eurostat, 2012), which received approximately €33.2 billion in AES support over the period 2007-2013 (ENRD, 2014). Although member states have a high degree of flexibility in the design and implementation of AES (EC, 2005), several schemes in the NMS are based on well-supported data from Northern and Western Europe that may not fit to the local or regional circumstances. For example, postponing mowing from spring to summer is a popular agri-environment measure found in a review of several Western European studies to be generally beneficial for plant and invertebrate diversity (Humbert et al., 2012; Buri et al., 2013, 2014). However, when applied to already extensively managed patches of meadow such as exist in many regions of Romania, any postponement of mowing mainly results in a synchronization of management and a loss of the mosaic of sward heights (Dahlström et al., 2013; see also Konvička et al., 2007 and Cizek et al., 2011). Even within Northern and Western Europe, the effects of AES are largely dependent on the type of landscape in which they are applied (Batáry et al., 2010; Scheper et al., 2013), suggesting that schemes are likely to be ineffective unless they are adapted to the local context.

In contrast to much of lowland EU, the main challenge – and opportunity – for farmland biodiversity conservation in the NMS is that a large number of species of conservation concern often still co-exist (e.g. in Polish field margins: Wuczyński et al., 2014). These target species may have different requirements, creating conflicts when prescribing management measures. Simple but rigid measures applied over large areas can therefore be worse than existing management (e.g. Nikolov et al., 2011; Elts & Lõhmus, 2012). Another side effect of rigid prescriptions is the disruption and eventual loss of local traditional ecological knowledge related to adaptive management (Babai & Molnár, 2014).

Many areas of HNV farmland in Central and Eastern Europe are also not eligible for AES support. As with the direct payments, a large proportion of holdings fall below the size threshold, or the vegetation does not fall into one of the categories of agricultural land defined by the EU (Kazakova & Stefanova, 2011). Actively harnessing the biodiversity value of this farmland will therefore require adapting measures to regional circumstances, and allowing for variable or even idiosyncratic small-scale management using a more flexible definition of agricultural land. For this to happen, interdisciplinary research is needed on the impact of different policy options on ecology and economy of the regions. Whilst the recent reform of the CAP has failed to meet expectations regarding provisions for biodiversity conservation, the increased devolution of responsibility to member states may provide the greater flexibility needed to develop local strategies to promote farmland biodiversity (Pe'er et al., 2014).

Conclusion

The maintenance of HNV farmland is a policy priority for the EU, not only for the ecological, cultural and economic benefits it provides, but also for the conservation of many "wild" species that over millennia of human disturbance have come to rely on these habitats. Thus, whilst there are many areas in which the promotion of low-intensity agriculture is now clearly inappropriate, the continuation of these practices should be made viable for local land managers in places where it still exists. Following Chappell & LaValle (2011), we believe that the future of food security and sustainable agriculture lies less in focussing on yield gaps, and more in increasing socio-economic access to produce, in which low-intensity and small-scale agriculture plays an important role (Tscharntke et al., 2012). Promoting sustainable development of rural regions goes hand in hand with this, most importantly by creating a direct link between the ecological state of a landscape and the well-being of its human population (see e.g. the discussion in Fischer et al., 2012). In HNV landscapes, yields are usually limited by adverse physical conditions (altitude, substrate, climate) and biodiversity promotion as well as other functions of agriculture, such as social coherence or cultural dimensions, should be the priority rather than intensification. Although approaches to valorise HNV landscapes through high-end products and tourism are starting to make an impact in some areas, the current viability of low-intensity farmland is largely supported by payments through the EU CAP.

In this paper, we have argued that the widespread low-intensity farmland and associated biodiversity in Central and Eastern European countries makes them of special conservation significance in the EU, especially given the generally poor conservation status of farmland relative to other habitat types in Europe (Halada et al., 2011). Yet these habitats are disadvantaged by the EU CAP, which is poorly adapted to their needs. This is aggravated by a lack of relevant research from the east in the international literature, leading to a bias in ecological observations in Europe towards the northwest. This not only limits the scalability and transferability of information found in the literature, but also the ability to design locally appropriate conservation measures. Whilst these problems are not unique to Central and Eastern Europe, the scale and the depth of the problem here means that focussing more on improving the fit and evidence base of agricultural policies in the central and eastern NMS would play a disproportionately large role in sustaining European biodiversity. Promoting pan-European research and monitoring networks, as well as more research targeted on the farmland of Central and Eastern Europe, both within and outside of the EU, would help to formulate better conservation approaches to counteract the increasing pressure on farmland species in Europe.

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Supporting Information

Additional Supporting Information may be found in the online version of this article:

Appendix S1 Web of Science search protocol and results

Appendix S2 Author acknowledgments

Table S1 Results of a Web of Science search on 10.01.2014

499 Figure 1: (a) Map of Europe depicting the total number of studies on farmland biodiversity carried out in each EU country found in a search of the Web of Science database. A larger number of studies is indicated by a darker shade of grey (numbers given in Table S1). Light green labels = Central and Eastern European new EU member states (CEE NMS), dark green labels = rest of EU + Norway and Switzerland. We have included the results for Norway and Switzerland, here grouped with the “old” member states due to the similarities of their agricultural systems. Details of the search are given in Appendix S1 and results and country codes in Table S1. (b) Number of studies per 100 000 ha utilized agricultural area (UAA) carried out in each EU country (+ Norway and Switzerland) between 1991-2013. The dotted line depicts the average number of studies per country. (c) Number of studies per 100 000 ha UAA carried out in CEE new member states compared to the rest of the EU (+ Norway and Switzerland) in each year since 1991.

511 Figure 2: Indices of agricultural intensity in the Central and Eastern EU new member states (CEE NMS), and the rest of the EU (+ Norway and Switzerland). (a) Distribution of farmland area (UAA) according to size classes of farms in 2010 (Eurostat 2013) showing standard error bars. (b) Consumption of N fertilizer in tonnes per 1000 ha utilized agricultural area (UAA) between 1961 and 2010 for CEE NMS and the rest of the EU (+ NO and CH) (FAOSTAT 2013). The categorization N fertilizer changes slightly in 2002, therefore difference between the years 2002 and 2003 are not comparable. (c) Cereal yield in tonnes per ha (FAOSTAT 2013). For FAOSTAT data, countries included in each category vary according to data availability, and excluding countries with incomplete data did not affect trends.

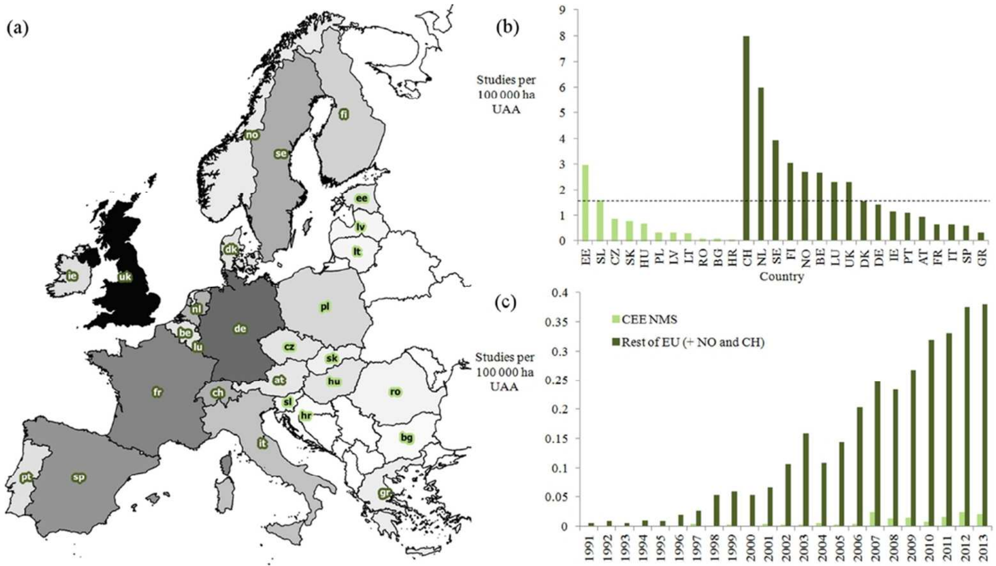

Figure 1
95x54mm (300 x 300 DPI)

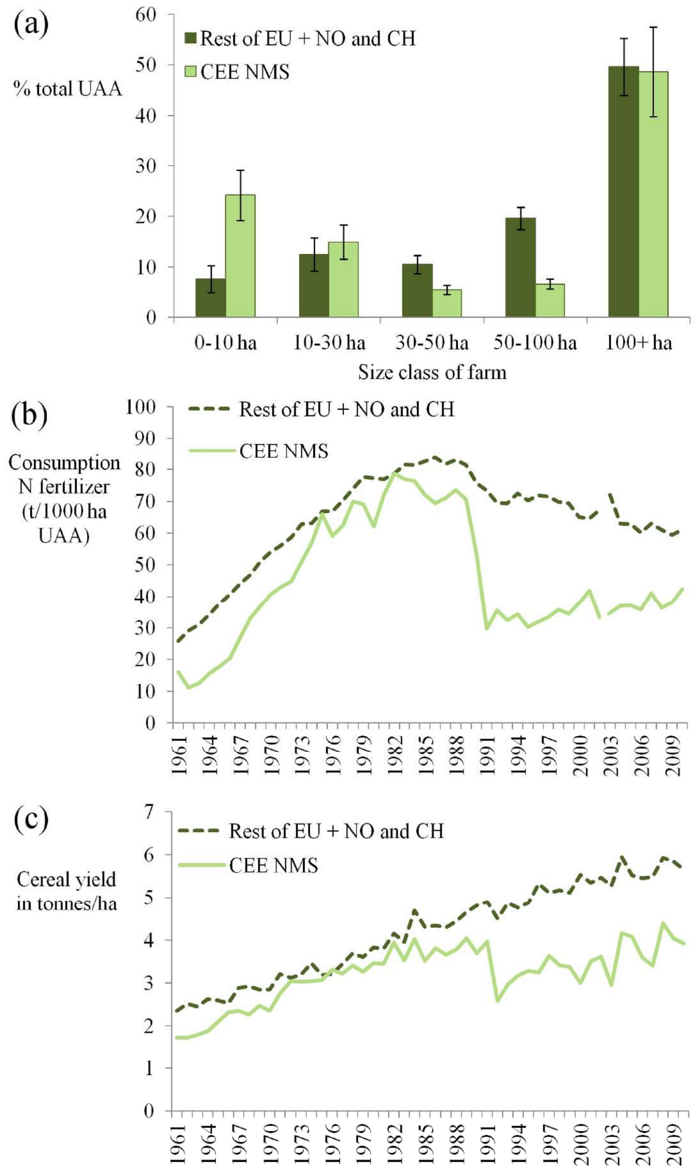

Figure 2
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Supporting Information

Appendix S1: Web of Science search protocol and results

Search of the Web of Science on 10.01.2014 (without social sciences), using the search terms Topic=(agricult* OR farmland) AND Topic=(biodiversity OR "species richness"). Timespan=All years. Databases=SCI-EXPANDED. The results were refined to the research areas “Ecology”, “Environmental Sciences”, and “Biodiversity Conservation”, yielding 4,717 publications. Publication records were downloaded to an Excel spreadsheet, and assigned a country where the research took place (or multiple countries, in the case of international studies), and country of first author. All studies not taking place in the EU, Norway or Switzerland were excluded. Theoretical papers without data from a stated country were excluded, as were papers using global data, literature reviews unless explicitly stated which countries were covered, and all other papers in which the location was not stated in the title or abstract. This left 1952 publications. For papers using data from multiple countries, these were treated as separate studies, yielding 2007 records (assigned to country in S. Table 1).

Appendix S2: Author acknowledgments

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Table S1: Results of a Web of Science search on 10.01.2014. UAA = Utilized Agricultural Area, from faostat.fao.org.

	Country	Country of research (incl. multiple records)	Country 1st author	Average UAA x 1000 ha over period 1991-2011 (where data available)	Studies per 100 000 ha UAA	1st authors per 100 000 ha UAA
AT	Austria	31	31	3328.476	0.931	0.931
BE	Belgium	37	41	1377.167	2.687	2.977
BG	Bulgaria	4	4	5586.810	0.072	0.072
CH	Switzerland	125	120	1563.595	7.994	7.675
CY	Cyprus	0	0	144.71	0	0
CZ	Czech Republic	36	32	4265.526	0.844	0.750
DE	Germany	238	252	17063.095	1.395	1.477
DK	Denmark	41	38	2685.333	1.527	1.415
EE	Estonia	29	23	972.900	2.981	2.364
FI	Finland	70	70	2296.238	3.048	3.048
FR	France	191	171	29733.667	0.642	0.575
GR	Greece	25	23	8071.281	0.310	0.285
HR	Croatia	1	0	1603.380	0.062	0.000
HU	Hungary	39	32	5943.524	0.656	0.538
IE	Ireland	50	48	4374.481	1.143	1.097
IT	Italy	95	92	15089.124	0.630	0.610
LT	Lithuania	9	4	3030.710	0.297	0.132
LU	Luxembourg	3	1	129.395	2.318	0.773
LV	Latvia	6	1	1856.150	0.323	0.054
MT	Malta	0	0	10.4	0	0
NL	Netherlands	117	127	1948.443	6.005	6.518
NO	Norway	28	23	1038.032	2.697	2.216
PL	Poland	56	44	17268.619	0.324	0.255
PT	Portugal	41	39	3795.776	1.080	1.027
RO	Romania	12	7	14463.286	0.083	0.048
SE	Sweden	126	123	3205.952	3.930	3.837
SK	Slovakia	17	13	2198.232	0.773	0.591
SL	Slovenia	8	7	507.790	1.575	1.379
SP	Spain	169	154	29258.107	0.578	0.526
UK	United Kingdom	403	429	17385.190	2.318	2.468