

## Science outreach in the time of social media: an analysis of the performance of the scientific journal *Barbastella* on Twitter and Facebook

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DOI: <http://dx.doi.org/10.14709/BarbJ.8.1.2015.08> © 2015 Published by SECEMU.

Spanish title: Divulgación científica en la era de las redes sociales: análisis del rendimiento de la revista científica *Barbastella* en Twitter y Facebook

**Abstract:** Social media has deeply transformed the way people communicate ideas and information, shifting from traditional media forms (e.g. newspapers, television and magazines) to digital media; of which, Facebook and Twitter stand out in terms of disseminating academic information and conservation outreach. Broad scientific communication and outreach have been highlighted as one of the most efficient methods to tailor people's behaviour towards environmentally-friendly practices. However, some concerns about the use of social media have been raised, particularly: the potential misinterpretation of inherently brief messages; the fast analysis of complex problems, situations or concepts; the fact that they can trigger misinformation cascades due to the time-sensitive and political nature of some conservation issues; an overestimation of potential outreach due to the homophilic effect; or the likelihood to suffer from information fatigue syndrome (IFS). We evaluated the presence of the scientific journal *Barbastella* - published by the Spanish Society for Bat Research and Conservation (SECEMU) - on Facebook and Twitter during a period of almost two years and its Twitter outreach performance during the Spanish Bat Research and Conservation Conference (SBRCC) in 2014.

Since the launch of its Facebook and Twitter accounts, *Barbastella* has respectively gathered 1,935 and 931 followers. Several posts have potentially reached between 5,000-17,000 (Facebook) and 3,000-5,500 (Twitter) users and whereas the Facebook account presented an audience mostly composed by local researchers and bat enthusiasts from Spain and Portugal, the Twitter account had a much more international audience. During the SBRCC, there were more online (Twitter and Facebook) followers of the conference than in situ conference attendants, even though conference tweets were almost exclusively posted by the Journal committee.

Our analyses reveal the large potential of Facebook and Twitter to disseminate information far beyond more classical tools and highlights that social media can potentially play an important role in conservation science, while serious consideration on its usage must be taken into account to reduce possible social media inherent weaknesses. Both social media platforms were found to be complementary suggesting that cross-posting on multiple networks can considerably improve visibility.

In order to disseminate research without compromising time commitment towards other scientific tasks, it is essential to have a targeted strategy for using social media with an accurate and reasonable planning of online time commitment, addressing all public target time-zones, selecting the most appropriate platform, publishing understandable brief and visual posts with reliable information amongst other optimizing strategies.

**Key-words:** Bats; conservation engagement; online presence; science communication; social media; virtual communities.

received: December 8th 2015  
accepted: December 29th 2015

## INTRODUCTION

### SOCIAL MEDIA IN THE SOCIETY

The recently defined Anthropocene demarks a new time period in which human impacts have elevated environmental parameters to values outside their normal Holocene ranges (Corlett 2014). The Anthropocene will undoubtedly be characterized by one of the largest extinctions and local population extirpation events to have affected the planet's biodiversity (Butchart et al. 2010, Dirzo et al. 2014). Under this scenario, well-developed conservation strategies with efficient science communication and broad outreach have been highlighted as potentially important methods to influence people's choices towards more environmentally-friendly attitudes. Biological conservation encompasses a complex network formed by many inter-related sectors of society: scientists, general public, NGOs, journalists, practitioners, local communities, activists, policy makers (Baron 2010, Papworth et al. 2015), and one of the main constraints that hampers effective action is the limited available information to inform conservation decision-making, which is commonly regionally and taxonomically biased (Di Minin et al. 2015).

For an increasing share of the human population, with frequent Internet access, society is changing as individuals and communities are more connected than ever through online social media platforms. Online extensions of individuals via social media form online communities and, for many, normal day-to-day activities run parallel in both real and virtual worlds (Kaplan and Haenlein 2010, Briones et al. 2011, Takhteyev et al. 2012). Social media has deeply transformed the way people communicate ideas and information, shifting from the traditional media forms (newspaper, television or magazines) to digital media (Darling et al. 2013). Scientists are no exception to this global trend, as it has been reflected by a recent online survey (Van Noorden 2014) in which thousands of researchers were interviewed about their use of social media. Online tools have become extremely popular with an increasing number of academics trying to make use of them as a novel communication strategy for their own research (Bik and Goldstein 2013). However, despite the fact that social media are almost omnipresent in most researcher's daily activities (e.g. Youtube, ResearchGate, GitHub, Academia and LinkedIn) numerous researchers are still reluctant to use these new opportunities, sometimes due to lack of proper guidance or the alienating nature of online interactions (Bik and Goldstein 2013, Di Minin et al. 2015).

Among social media, both Facebook and Twitter stand out due to their rapid and continuous growth worldwide (Darling et al. 2013, Weller et al. 2014, You 2014, Table 1), with Facebook being the most used and widespread in all continents. According to the State of Inbound Marketing (2012), 42% of business owners consider Facebook to be a critical component of their business plan. The massive impact of social media upon the world's population is clearly reflected by the sheer amount of people that use them regularly: over 1.65 billion monthly active users with an increasing 15% rate per year (from those, 1.09 billion users log on daily) generating 4.5 billion "likes"/day (Facebook

04/27/16). Europe has over 307 million users and more than 300 million photos uploaded each day (Search Engine Journal, Facebook 04/27/16). Globally, young people ranging from 25 to 34 years old represent 29.7% of the users, with the highest traffic occurring between 1 to 3 pm (Emarketer 2012). Interactions between users is large with more than 510,000 comments posted per minute. On the other hand, Twitter has a total of 1.3 billion registered users of which 320 million can be considered active (1/3 of which use the site daily), with a similar increasing rate to Facebook. Despite the fact that Twitter was launched several years after Facebook, it became very popular due to the limited word count of each post - which gave rise to the term micro-blogging - tailored for quick information updates using brief and simple messages. Every second, on average, around 6,000 tweets are tweeted on Twitter which corresponds to over 350,000 tweets sent per minute or 500 million tweets per day. Each Twitter user account has a mean of 208 followers, which spend a mean of 170' in Twitter per month.

### SOCIAL MEDIA IN SCIENCE

Taking these numbers into account, a large proportion of academics have already accepted that Facebook and Twitter are too big to ignore (Priem and Costello 2010). As a communication tool, social media can be used to share journal articles, thoughts and concerns, initiate discussions or spread scientific news, not only within academic circles but also to non-governmental organizations, private industry, journalists and decision-makers, eroding boundaries between scientists and broader audiences (Letierce et al. 2010, Darling et al. 2013, Ferguson et al. 2014). It is also used to share updates from scientific meetings and conferences (Shiffman 2012), to disclose professional opportunities and grant applications, or to post upcoming events.

From an academic perspective, mounting evidence over the last decade suggests that public visibility among social media might benefit scientists, impacting upon their research in a number of ways, or on the contrary, the lack of online visibility could limit and reduce scientific impact (Darling et al 2013). Additionally, classic scientific impact metrics show how online dissemination might increase the number of paper citations and downloads in a very direct way. Eysenbach (2011) demonstrated that tweeted articles were 11 times more likely to be cited, compared with papers not tweeted, and Priem et al (2012) proved that academic papers circulated through social media obtain more visibility than those that are classically disseminated (e.g. through e-mail, online databases such as ISI Web of Knowledge or through the specific journal access).

Social media's relevance among scientific circles is so evident, that since 2010 the concept of 'altmetrics' (from 'alternative metrics') was created as an alternative to more traditional citation impact metrics such as the Impact Factor Index. 'Altmetrics' are calculated based on the 'hashtag' metrics, evaluating the social impact of any work within the online society beyond traditional journals (Darling et al. 2013). It can be applied to any type of work, not only scientific publications, but also videos, documentaries, photographic articles, books, essays or anything that can be published and shared online. Although its use is still controversial as they are sometimes considered to be too easily misinterpreted

**Table 1:** Brief description of the two different social media that *Barbastella* Journal has been using to disseminate bat-related information and published manuscripts.

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**Twitter** (<http://twitter.com>, founded in 2006 by Jack Dorsey)

Micro social network with 140 character limited posts (short and ephemeral form of information), mostly focused on stream or live discussions, forums and quick information shares. However, it has the capacity to have long-term impact on how scientists create and publish new ideas. It is the best social net to follow conferences or workshops. Among academic circles, Twitter is usually more visited for professional aims than for personal usage. The use of hashtags provides an efficient opportunity to group all information under common purposes or topics, and helps to keep ongoing discussions alive (e.g., #SECEMU14).

To visit the *Barbastella*-Journal twitter profile see:

<http://twitter.com/BarbastellaJ>

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**Facebook** (<http://www.facebook.com>, founded in 2004 by Mark Zuckerberg)

Facebook is the most used social network, joining billions of users, and growing every day. Contrary to Twitter, due to the privacy options and flexibility, Facebook is more commonly used as an academic way to disseminate information and as a personal profile to communicate with colleagues during daily life.

To visit the *Barbastella*-Journal Facebook profile see:

<https://www.facebook.com/Secemu>

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and misused (Weller et al. 2011, 2011b, Thelwall et al. 2013), ‘Altmetrics’ are mainly used to evaluate visibility or engagement (which sometimes is of high importance for funding organizations) rather than to measure the impact to the progress of science (Darling et al. 2013).

#### CONCERNS ABOUT SOCIAL MEDIA

Some concerns about the use of social media have been raised, especially relating to the potential misinterpretation of inherently brief messages and the rapid analysis of complex problems, situations or concepts that can trigger misinformation cascades (Bombaci et al. 2015). These shortcomings can be particularly detrimental due to the time-sensitive and political nature of some conservation issues (Brossard 2013, Bombaci et al. 2015), or due to the inefficiency in influencing people in key positions to change conservation policies (Hall 2014, You 2014). Additionally, over-flow of information has been argued to lead to the well-known ‘Information Fatigue Syndrome’ (IFS). This problem emerges due to a knowledge over-dose, when people start to feel indifferent and disconnected to the information being conveyed. The term refers to our inability to absorb and process all the information we’re exposed to. Moreover, apart from this major problem, sometimes the information has been shown not to reach the general audience, but only highly related audiences within similar academic circles. Social Network Theory describes this predisposition as ‘homophily’, a tendency found when the ‘contact between similar people occurs at a higher rate than among dissimilar people’. Reciprocal ‘homophily’ might then over-estimate outreach potential.

#### BARBASTELLA JOURNAL OUTREACH THROUGH SOCIAL MEDIA

Analyzing to what extent academic information shared through social media is reaching public audience is of relevance for scientists committed to disseminate their findings beyond the walls of academia. The work presented here seeks to study the outreach impact of the scientific journal *Barbastella* - published by the Spanish Society for Bat Research and Conservation (SECEMU) and funded by the Natural Science Museum of Granollers - which has been publishing bat-related research since 2012. Alongside being hosted on the journal’s website ([www.secemu.org/Barbastella-Journal](http://www.secemu.org/Barbastella-Journal)), since 2014 all publications have been disseminated through social media, primarily through SECEMU’s Facebook page (mainly posting in Spanish). This page has also been used to share other relevant bat conservation news. At the beginning of 2015 the journal created its own Twitter account (under the Twitter name @BarbastellaJ, mainly posting in English) as a complementary strategy to disseminate its publications. We hereby present an evaluation of the presence of *Barbastella* on Facebook and Twitter during a period of almost two years and provide some suggestions on how to improve the journal’s ‘altmetrics’ and its social media communication strategy.

## MATERIAL AND METHODS

The assessment of total reach, followers’ trends, languages, countries, and total activity was performed using the analytic tools of Facebook and Twitter Analytic, which are freely available for business purposes within all professional profiles (SECEMU 2015 and *Barbastella*J 2015, respectively). Specifically, total reach and impressions from the Twitter account has been estimated using the ‘TotalReach’ online algorithms (<https://tweetreach.com>). All figures have been adapted and modified from original plots provided by the analytic online services. Temporal trends in *Barbastella*’s publications (number of manuscripts published per year) and citations (number of times each manuscript published in *Barbastella* is cited in total) have been analyzed in order to evaluate the short-term success of the journal since its launch in 2012. Information gathered on the origin of all followers was plotted and georeferenced onto world maps using QGIS v. 2.12.2 Lyon (QGIS Development Team 2015) using the base shape files obtained from Bjorn Sandvik (<http://thematicmapping.org>), with an original shape derived by Schuyler Erle from public domain sources. Word cloud charts have been built through the available Wordle services ([www.wordle.com](http://www.wordle.com)). Plots were carried out using R software, version 3.2.4. (R Foundation for Statistical Computing), with the “ggplot2” package (Wickham, 2009).

## RESULTS

During this four-year period, the journal has published a total of 32 articles, all indexed in the CrossRef system since 2014, and freely available on the website as open-access papers (Fig. 1, Table 2). The publications cover studies carried out in Spain (including also Ceuta, in North Africa), Portugal, France, Italy, Peru and Brazil, thus spanning across three continents (Africa, America and Europe) (Supplementary material, Table 1), focusing on a variety of topics, from bat conservation (i.e. Alcalde et al. 2012, Rocha et al. 2015),

paleontology (i.e. López-García et al. 2012, Salari et al. 2015), species ecology (i.e. Camprodón and Guixé 2013), distribution range expansions (De Pasquale et al. 2014), check lists (i.e. Ubirajara et al. 2014), phylogenetics and systematics (i.e. Salicini et al. 2012) to bat boxes (i.e. Alcalde et al. 2013, Flaquer et al. 2014). The papers published were original research articles (i.e. De Pasquale et al. 2014), short communications (i.e. García et al. 2013) and reviews (i.e. Mas et al. 2015)". On average, 8.25 manuscripts have been published per year (Fig. 1). In total, the journal gathered 14 citations in both indexed and non-indexed scientific publications, with an average of 0.4375 citations/paper.

After this two-year period, using Facebook as a communication tool, we gathered a total of 1,935 followers, from several countries worldwide: Spain (56.8%), Mexico (6.6%), U.S.A. (3.5%), Brazil (3.1%), U.K. (3%), Portugal (2.3%), Peru (2.1%), Italy (1.8%), Colombia (1.8%), Argentina (1.7%) and Germany (1.1%), amongst others (Fig. 2A). The user demographics ranged from experienced academic bat specialists to general naturalists simply interested on bats, but also children who worked with bats at school, bat enthusiasts, bat rehabilitation centers' staff, institutional organizations, forest rangers and many others. Language varied according to the country of origin, with a 66.8% of hispanophone followers and only 14.5% of anglophone speakers. This unbalanced proportion of languages strongly corresponds to the fact that most disseminated information is also published in Spanish. Gender was equally distributed during the whole period with 55% and 45% of men and women respectively. The number of followers has been increasing since the creation of the profile in a relatively constant rate over the analyzed period (Fig. 3A). However, at the beginning of 2015 a steady growth on the trends was detected, due to a very rapid increase of followers. The average global daily reach also increased in a similar manner (Fig. 3B), as well as the amount of 'reactions', 'comments' and 'shares' (Fig. 3C). The maximum reach that the Facebook account registered during the whole period was around 17,000 for a single post about general and basic bat ecology information, followed by other posts with 8,000 and 5,500 visits each (Fig. 4A).

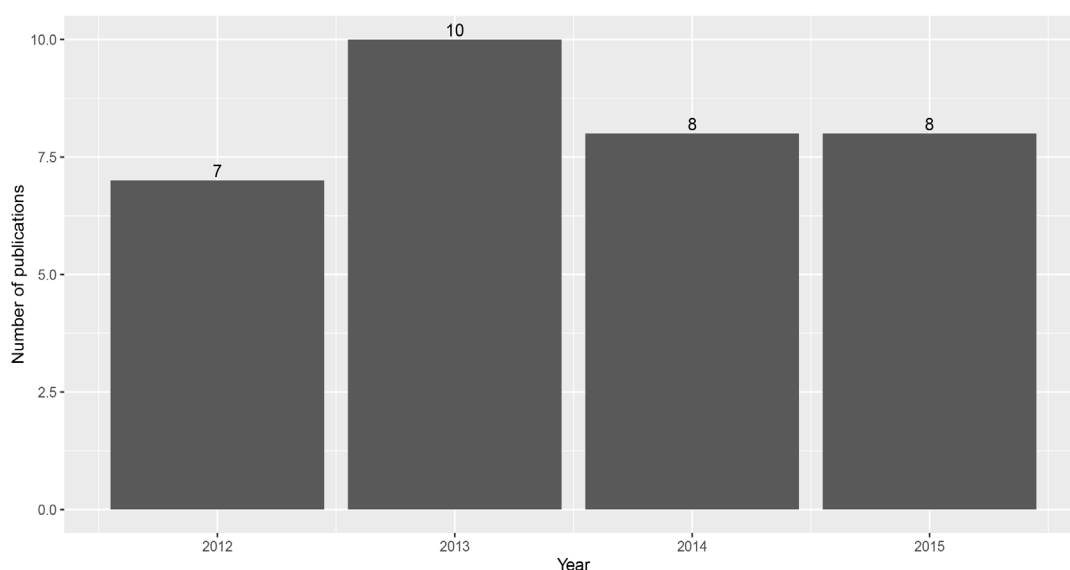
The Twitter account gained 931 followers in slightly more than one year (since mid-2014), from several countries, mostly in Europe and North America: U.K. (44%), U.S.A. (17%), Australia (9%), Spain (7%), Canada (2%), The Netherlands (2%), Mexico (2%), Germany (1%) and Portugal (1%) (Fig. 2B). These proportions were clearly reflected in the follower's languages with 93% of anglophones users, followed by 12% of hispanophones and only 2% of lusophones and Dutch-speakers. All these percentages also strongly matched with the highest proportion of English posts published by BarbastellaJ. Similar to the Facebook account, the gender of followers is currently quite balanced with 58% of men and 42% of women. The amount of Twitter followers has also been increasing at a constant rate during the whole period, and its reach varied little between months (ranging from 100 to 4000 individual visits per day) (Fig. 5). As an example of global reach/month, according to data acquired from 'TweetReach', the user @BarbastellaJ has had an estimated total reach of 29,764 personal accounts and 45,275 total impressions or visits during April 2016. The post that reached the widest audience since its launch received a total of 5,570 visits, followed by several tweets ranging from 3,000 to 4,000 visits (Fig. 4B).

Twitter was used to broadcast the SECEMU National Conference in 2014 with the #SECEMU14 hashtag. Tweets were retweeted a total of 37 times in a single day, and, although nobody apart from the organization used the proposed hashtag, 4,690 people were reached that day, with 100 active followers.

## DISCUSSION

Barbastella Journal has been active for a four-year period with a constant publication rate, fulfilling the main aims of the editorial committee. As a scientific journal, it can be considered a low impact journal with a relatively moderate number of citations but with growing outreach and social impact.

During the last two-years the journal outreach and online presence in social media has rapidly increased thanks to



**Fig. 1** - Trends of number of manuscripts published in Barbastella during the 4-year period since its launch



**Table 2:** Pros and Cons of using social media as a science communication tool for conservation and academic purposes.

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### Social Media Pros

- 1) Social media and virtual communities provide all researchers, independently of their status or country a much larger virtual assemblage of scientists beyond their institution, and access to researchers from other disciplines to speed up multidisciplinary projects (Darling et al. 2013).
- 2) In stream discussions between cutting-edge research could push some ideas forward turning them into real scientific outputs (Darling et al. 2013).
- 3) Pro-conservation and scientific outreach rises massive impact on human beings and worldwide populations, accelerating changes, speeding up behavioural evolution, avoiding the often prolonged times of the traditional peer-review processes. Also, microblogging structure allows to summarize main ideas and results in a more comprehensible format for non-researchers than normal scientific papers (Darling et al. 2013).
- 4) Social media provides an available information source to extract datasets from billions of posts provided by millions of human beings (e.g., they could provide a direct measurement of actual public engagement in biodiversity conservation or interest in specific groups, Roberge et al. 2014, Di Minin et al. 2015).
- 5) Work quality information and outreach can be rated by surrogate measures such as “likes” in Facebook or “retweets” in Twitter (Di Minin et al. 2015). Monitoring of complex environmental issues such as invasive species spreading distributions can be properly monitored through social media and published pictures (Di Minin et al. 2015).

### Social Media Cons

- 1) Spreading scientific workflow through social media can cause issues of intellectual property ownership, as well as misrepresentations of complex ideas due to the extent limitation (Darling et al. 2013).
- 2) Writing or chatting in social media is public and your words easily spreads far beyond your own circles. Misinterpretations and statements’ confusion is a big issue among conflictive topics or complex situations (Darling et al. 2013).
- 3) Social media usage is nevertheless still geographically biased towards the developed and anglophone countries (Roberge et al. 2014, Di Minin et al. 2015).
- 4) Some results suggest that Twitter users interact about a biased sample of topics, which can lead to unbalanced perceptions on real conservation issues and data usually comes from age-biased study groups (Roberge et al. 2014).
- 5) Social media used in conferences can get rid of the novelty of on-going or unpublished projects.
- 6) Over-flow of information could lead to the well-known ‘Information Fatigue Syndrome’ (IFS) when people start feeling indifferent and disconnected to the information being conveyed.
- 7) Social media is likely to be characterized by ‘homophily’, a tendency found when the ‘contact between similar people occurs at a higher rate than among dissimilar people’.

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the full dedication of Luis Hernández and Ricardo Rocha, responsible, respectively, for the Facebook and Twitter accounts. The broad audience it has reached through social media, with several tens of thousands of visits for some posts and several hundreds of ‘shares’, reflects the high potential of social media as communication channels. Basic and general ecological and conservation information has been mostly posted in Facebook while most Twitter posts had a more scientific focus.

#### AUDIENCE NATURE

A diverse cross-section of the public was reached using both Facebook and Twitter, however, the importance of combining different social media for independent purposes and audiences arises when the followers origin and interests are analyzed. While the Facebook account has mainly been

followed by local researchers and bat enthusiasts from Spain and Portugal with most contributions from hispanophone followers, the Twitter account, on the other hand, had a low percentage of followers from Spain and a largely anglophone community following from countries such as the U.K. and U.S.A.

These differences between Facebook and Twitter audiences and the patterns emerging from our followers’ language analysis might correspond to existing inter-related people circles with already common interests. As stated by Takhateyev et al. (2012), many social media platforms might predominantly serve a purpose in connecting people that are already connected. There are pre-existing ties between places and people that are only somehow reinforced by Twitter and Facebook as well as the limitation of the language, which has an effect on Twitter ties despite the seeming ease with which

long range ties can be formed (Fig. 6). That is undoubtedly one of the biggest social media limitations, and thus, in order to reach and target different groups and audiences, it would be worthwhile posting information in several languages about broad global topics.

Moreover, academic circles are usually more represented on Twitter, than on Facebook, given the public and open nature of Twitter' compared to the more personal usage of the latter. This difference in demographics and audiences can perfectly illustrate the previously described phenomena of homophily, when information flow is found mainly between closely related social circles instead of among the general public. Diversifying topics, languages and posting timing schedules make it possible to substantially increase the journal's outreach through the combined use of both platforms. On the other side, this high degree of reciprocity actually favours the connection among users with mutual acquaintances, in this case between bat researchers and other bat researchers in the world. Thus, specifically Twitter (more

than Facebook) might be exploited as a channel to spread information from scientists to the society, but also to connect bat researchers more closely.

#### CONCERNS ABOUT SOCIAL MEDIA

As indicated by some researchers (Bik and Goldstein 2013), the spread of misinformation is also a problem, where the need for live updates and rapid 'shares' usually replace a more thorough analysis of complex scientific findings. Social media can, in fact, be a double-edged sword: either a powerful channel to spread valuable and scientifically validated information to global audiences, especially when content goes "viral" (Bik and Goldstein 2013), but it might eventually and unfortunately turn into a platform to spread misinformation and non-scientifically validated data. A certain degree of epistemic vigilance might generally be demanded from Twitter users. Extra caution on how the information is communicated is thus recommended. In an increasingly connected, information-infused modern and

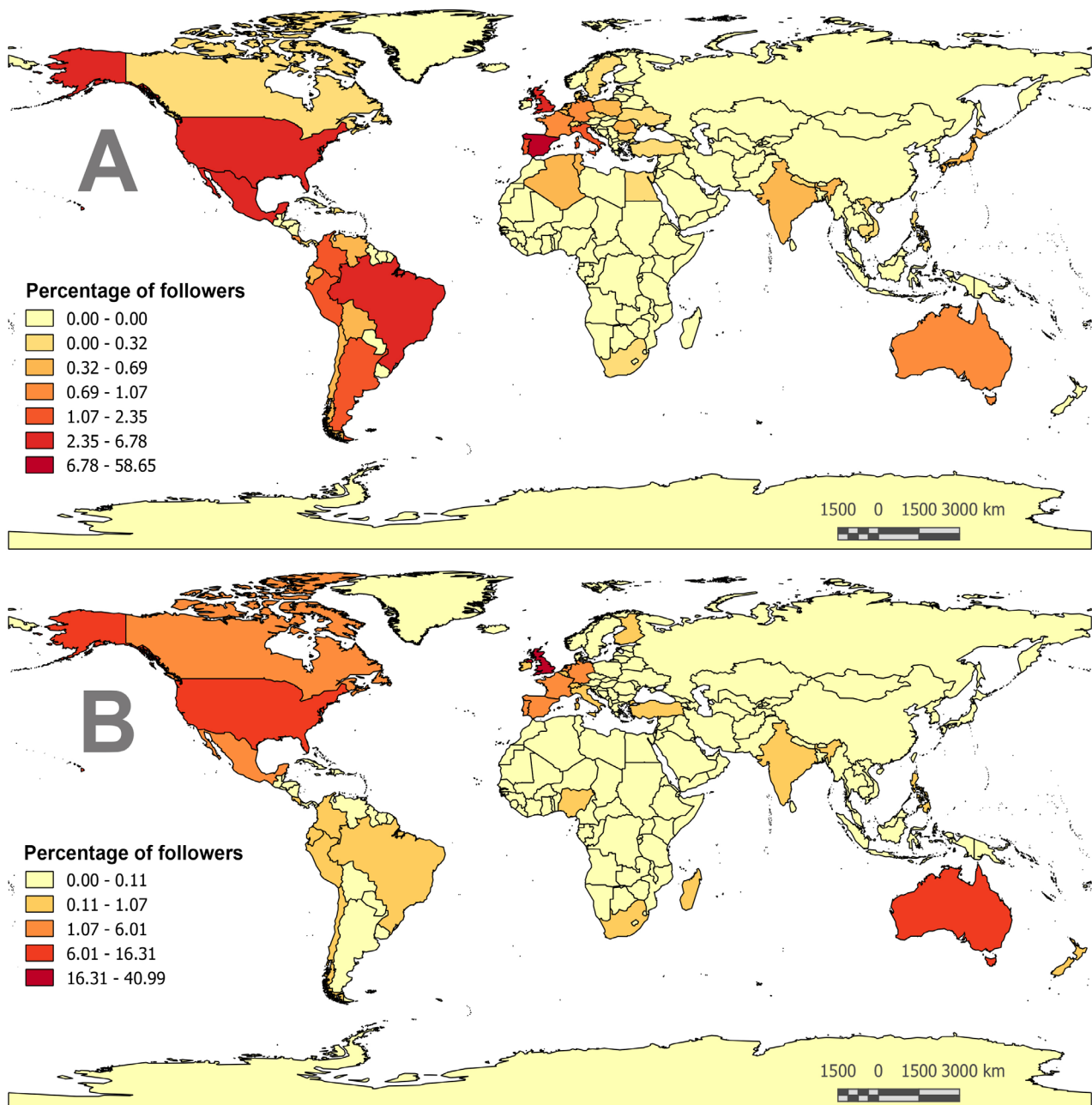
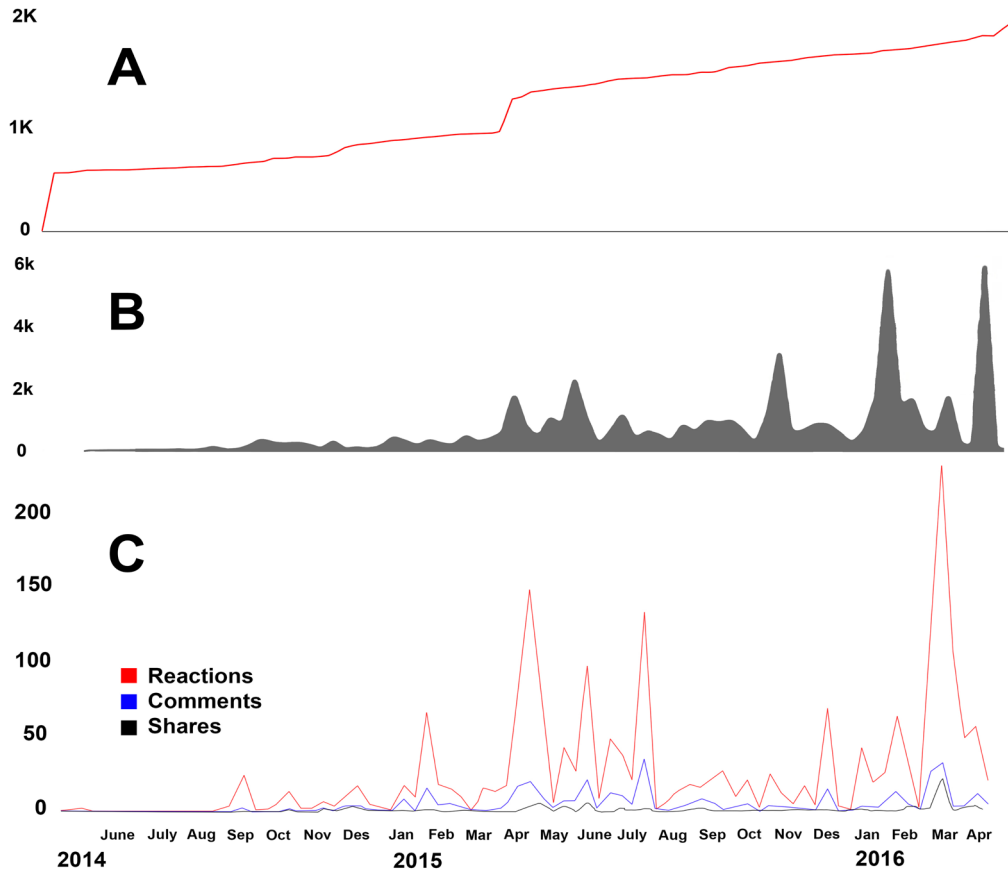


Fig. 2 - World map presenting the origin of Barbastella's followers for A) Facebook and B) Twitter accounts.



**Fig. 3** - Outreach trends through the Facebook account for a 2-year period (2014-2016).

A) Accumulated number of followers in Facebook since the creation of the account; B) Average daily reach considering all published posts; C) Total daily activity.

**A**

SECEMU ha afegit 5 fotografies noves.  
 Publicat per Miguel Angel Monsalve Dolz · 21 febrer · Valencia, Spain ·

La Sociedad Española para el Estudio y Conservación de los Murciélagos (SECEMU) concedió la "Ayuda a la investigación o conservación de los murciélagos 2015-2016" al programa "ACCIONES DE INVESTIGACIÓN Y CONSERVACIÓN DE LOS QUIRÓPTEROS CAVERNÍCOLAS DE LA COMUNIDAD VALENCIANA" presentado por la Federación de Espeleología de la Comunidad Valenciana FECV. En el contexto de este programa los pasados días 23 y 24 de enero, se realizó un censo de los murciélagos presentes en dos ... *Mostrá'n més...*

SEGUIMIENTO DE MURCIÉLAGOS EN LA SIMA DEL CAMPILLO Y SIMA DEL ALTO DE TOUS. Jornada formativa de censo mediante fotografía y video con luz infrarroja.

23 y 24 de ENERO de 2016

1.744 personas d'abast

**B**

Tweet fijado  
 Barbastella Journal @BarbastellaJ · 17 feb. 2015

Look what the #cat dragged in: Felis silvestris catus as predators of #insular #bats - [go.shr.lc/1zKDcCz](http://go.shr.lc/1zKDcCz)

6 retweets, 3 likes

Some recommendations to improve your posts outreach

- Using broad and targetted hashtags (#)
- Writing concise and precise messages with clear information
- Using attracting images or colourful compositions to catch readers attention.
- Providing links to the source of the information, organizations websites, and if applicable, to your own publications.

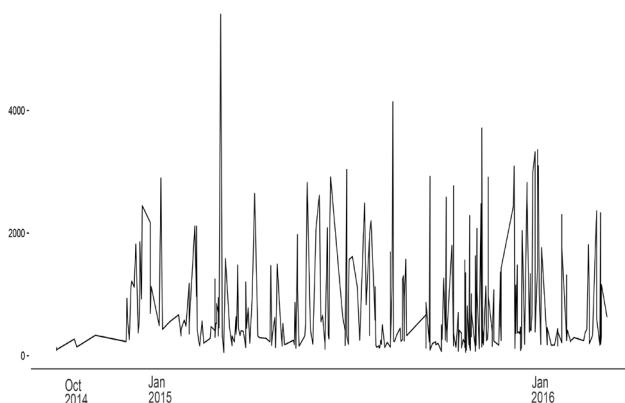
**Fig. 4** - The two most visited posts published by A) SECEMU's Facebook account and B) BarbastellaJ Twitter account with 16.900 and 5590 visits respectively, registered at the 1/05/2016.

electronic era, we should be cautious on the amount, quality and content of information shared in social media if we really want that information to be effective and influential. Otherwise, it could lead to counter-reactive, undesired and less environmentally-friendly values.

Nevertheless, despite the fact that utilization of social media is sometimes questioned (and rejected), in our case study, global outreach has improved greatly, and we would therefore recommend it as a valuable means to raise awareness for bat conservation and disseminate bat-related research. It has been demonstrated that online public pressure can drive policy changes or provide social support (political pressure) towards scientific research on particular conservation issues, which, in essence, highlights the potential of social media as a tool for conservation (Papworth et al. 2015). Further research is needed to explore how such networks may provide a venue to identify misuse or misunderstanding of information.

#### HOW TO SUCCESSFULLY COMBINE SOCIAL MEDIA AND SCIENTIFIC COMMITMENT

Potential advantages of being active and widely known in virtual communities are evident, but it is becoming increasingly difficult to stand out from the crowd (due to the large amount of active users and their frenetic activity), and to optimize the time spent on multiple social media. The popularity of microblogging on social media to amplify scientific impact is enticing many researchers to the virtual skies. According to Priem et al. (2012) one in 40 scientists were active on Twitter and 25,000 blog entries were indexed on the Research Blogging platform (Piwowar 2013). However, this wealth of information can cover up ones work making it difficult to be found (Darling et al. 2013). To make sure ones research stands out from the crowd on each platform, and not devote too much time, one needs to optimize their usage on social media. To increase visibility, it is recommended to take into serious consideration that the global online audience has never been this big and so planning when to post content is necessary based upon the targeted time zone, for example during commuting hours when people use their smart phones. Another important point is to write short and clear messages. The average time spent on Facebook per user visit is around 20 minutes (Infodocket), which means that time dedicated to each post is relatively short and therefore messages should be precise and concise (limited scope for extended details). But more than that, as



**Fig. 5** - Outreach trends through the Twitter account for the period 2014-2016.

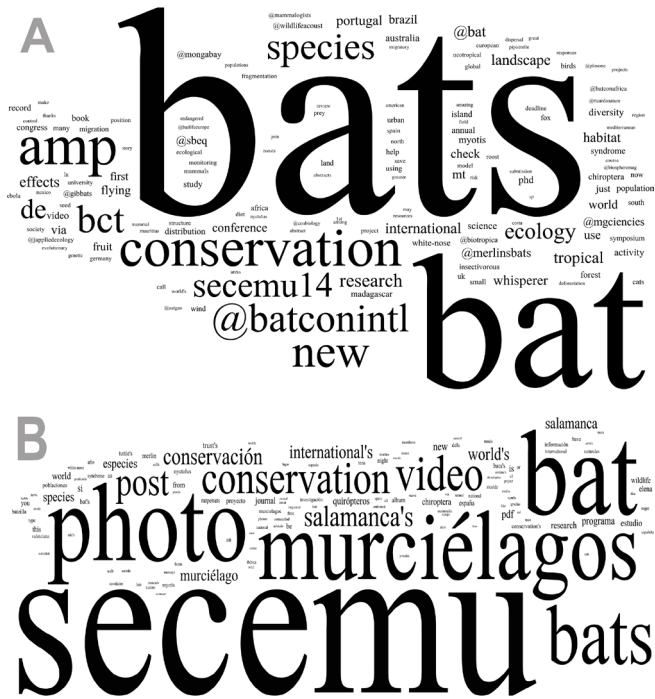
postulated by Bostrom et al. (2013), tailored information that is salient, legitimate and credible, matching local realities, is more likely to be influential. Besides Facebook and Twitter, other professional social media are available online (e.g. Google+, Ozone, Sina Weibo, Hi5, Pinterest, Instagram and LinkedIn) and they also offer greater access to online communities. As our results have shown, most social media platforms are in general complementary, therefore cross-posting on multiple networks can considerably improve visibility (Bik and Goldstein 2013).

If one aims to mobilize scientific knowledge to the critical and compelling arena of conservation action, one should, first of all, try to connect people who understand each other (Cash et al. 2003). Successful translation of scientific concepts to a non-technical language is mandatory. It is not just how much and how fast we share and exchange information, but how good these channels are to provide effective, influential, credible, legitimate, scientifically-validated and salient information. Thus, we strongly recommend carefully considering what information is posted. It is necessary to publish well-summarised and well-written information, under a seriously planned outreach strategy according to the targeted public, choosing the most appropriate social media platforms.

#### SOCIAL MEDIA IN CONFERENCES

Using social media (especially Twitter) in conferences has been widely recognised as a successful tool to evaluate event visibility/success and promote interaction between participants at the conference but also for those unable to attend (Letierce et al. 2010, Weller et al. 2011b, Shiffman 2012, Bombaci et al. 2015). It provides an easily accessible platform to engage in discussions, to develop ideas and to introduce young researchers to specialists within the field (who would otherwise be difficult to engage with) (Letierce et al. 2010, Bik and Goldstein 2013). Broadcasting the SECEMU Conferences on Twitter with the hashtag #SECEMU14 offered free access to presentations and conference debates to other researchers worldwide. As stated by Desai et al. (2012), who studied the efficiency of Twitter to disseminate conference-related information at medical symposia, the most successful posts/tweets were those with 'informative content', 'internal citations' and 'a positive sentiment score'. Other ways to better promote ones' work on Twitter and Facebook are to engage with a broad audience, to tweet repeatedly with similar posts and to make links between one's own work and other media sources. Enriching the posts with pictures, charts or illustrations can increase post popularity (Papworth et al. 2015). However, success is also directly related to local and regional engagement, which can increase the likelihood of one's findings being widely disseminated. The fact that Twitter is not widely used amongst the SECEMU members (in a clear contrast to Facebook) contributed to the relatively low performance of the SECEMU 2014 conference posts. To avoid that, participants should be actively encouraged to sign up and engage with Twitter before attending the conference. Despite this, and although Twitter was mainly used and managed by the Journal committee, active followers of the conferences through Twitter were in higher number than *in situ* conference attendants. However, it is important to notice that in other conferences it is more and more usual to see





**Fig. 6** - Word cloud chart with the most common words used in A) Twitter and B) Facebook accounts. Word is proportional to the amount of times the words appears amongst the published posts (worlds are randomly distributed within the plot).

“no twitter” signs, as many scientists are reluctant to spread their own on-going or unpublished projects and due to the difficulty to monitor virtual discussions. This is of course, up to each researcher to decide if presented data within a conference can or cannot be widely public.

Considering both Twitter and Facebook’s outreach, it becomes possible for a relatively small piece of well-structured information to easily reach a broad and diverse audience beyond the global academic community (Bombaci 2015). The #conservation revolution may not be televised, but if social media continues to gain momentum, it may be shared, liked and (re)tweeted.

## ACKNOWLEDGEMENTS

We would also like to thank Maria Mas and Alba Coronado for their continuous help within the *Barbastella* Journal editorial team, as well as Juan Tomás Alcalde and Carles Flaquer as *Barbastella* Journal co-Editors. And of course we would like to thank all the authors that have submitted a variety of novel manuscripts to the journal during this four-year period of publishing. We would like to thank James Kemp for proofreading the manuscript, and two anonymous reviewers that contributed with constructive comments and suggestions which greatly improved the accuracy of the manuscript.

## CONCLUSIONS

- 1) During this four-year period, *Barbastella* published 32 manuscripts (which have received 14 citations); all manuscripts are in full colour, indexed in CrossRef since 2014 and open-access.
- 2) Some concerns about the use of social media have also been raised, such as the overestimated outreach potential due to the inherent homophily caused by language or topics being shared, or the likelihood to suffer the information fatigue syndrome (IFS).
- 3) The Journal has gathered a total of 1,935 followers in Facebook in slightly more than two years, and 931 followers in Twitter. Several posts reached up to 5,000-17,000 (Facebook) and 3,000-5,500 (Twitter) users, proving the large potential of social media to disseminate information far beyond more conventional methods.
- 4) The success of Twitter usage in conferences and meetings is directly influenced by local and regional engagement, which might exponentially increase the reach of the conference beyond its walls.
- 5) Social media data can potentially play an important role in conservation science. A good combination of social network usage, with an accurate and reasonable planning of online time commitment, addressing several time-zones, selecting the most appropriate platform, publishing understandable concise and visual posts with reliable information, as well as other optimizing strategies make it possible to disseminate research without compromising time commitment towards other scientific tasks and linking knowledge to action and science to society

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## Supplementary material

Table 1: Summary of the papers that have been published in *Barbastella* since its launch in 2012.

Year	Author	Title	DOI
2012	Irene Salicini, Carlos Ibáñez & Javier Juste	The <i>Myotis nattereri</i> complex in Iberia: a long history	<a href="http://dx.doi.org/10.14709/BarbJ.5.1.2012.01">http://dx.doi.org/10.14709/BarbJ.5.1.2012.01</a>
	Pablo Tomás Aguirre-Mendi & Carlos Ibáñez	First data on the distribution of <i>Myotis cf. nattereri</i> and <i>Myotis escaleraei</i> Cabrera, 1904 (Chiroptera: Vespertilionidae) in the Autonomous Community of La Rioja	<a href="http://dx.doi.org/10.14709/BarbJ.5.1.2012.02">http://dx.doi.org/10.14709/BarbJ.5.1.2012.02</a>
	Juan Manuel López-García & Paloma Sevilla	The role of fossils in the reconstruction of bat population dynamics	<a href="http://dx.doi.org/10.14709/BarbJ.5.1.2012.03">http://dx.doi.org/10.14709/BarbJ.5.1.2012.03</a>
	Paulo Barros	Contribution to the knowledge of bat distribution in northern and central Portugal	<a href="http://dx.doi.org/10.14709/BarbJ.5.1.2012.04">http://dx.doi.org/10.14709/BarbJ.5.1.2012.04</a>
	Juan Tomás Alcalde, Alberto Aratácoz & Federico Mejide	Recovery of a colony of <i>Miniopterus schreibersii</i> from a cave, Cueva de Ágreda, in Soria	<a href="http://dx.doi.org/10.14709/BarbJ.5.1.2012.05">http://dx.doi.org/10.14709/BarbJ.5.1.2012.05</a>
	Félix González Álvarez, Óscar de Paz & Monserrat Carbonell	The bats of La Bóveda (Segovia) thirty-two years on	<a href="http://dx.doi.org/10.14709/BarbJ.5.1.2012.06">http://dx.doi.org/10.14709/BarbJ.5.1.2012.06</a>
	Adrià López Bauceles, Carles Flaquer, Xavier Pig-Monserrat, Lidia Freixas & Lofí Mohamed	Updated inventory of bats and their refuges in Ceuta: first record of <i>Pipistrellus pygmaeus</i> in north Africa	<a href="http://dx.doi.org/10.14709/BarbJ.5.1.2012.07">http://dx.doi.org/10.14709/BarbJ.5.1.2012.07</a>
	Francisco Amorim, Pedro Alves, Hugo Rebelo	Bridges over the troubled Conservation of Iberian Bats	<a href="http://dx.doi.org/10.14709/BarbJ.6.1.2013.01">http://dx.doi.org/10.14709/BarbJ.6.1.2013.01</a>
	Paulo Barros, Luis Braz	<i>Barbastella barbastellus</i> (Schreber, 1774) in mines from North Portugal: ¿a case of “swarming”?	<a href="http://dx.doi.org/10.14709/BarbJ.6.1.2013.02">http://dx.doi.org/10.14709/BarbJ.6.1.2013.02</a>
	2013	Jesús Noguerras, José Antonio Garrido-García, Alberto Fijo-León, Javier Juste, Juan Luis García-Mudarra & Carlos Ibáñez	Distribution patterns of the “ <i>Myotis mystacinus</i> ” complex in the Iberian Peninsula
Roberto J. Hermida, Manuel Arzúa, Leticia Santos y Francisco J. Lamas		First report of <i>Myotis alcathoe</i> von Helversen & Heller, 2001 in Castilla y León and first breeding roost in the northeast Iberian Peninsula	<a href="http://dx.doi.org/10.14709/BarbJ.6.1.2013.04">http://dx.doi.org/10.14709/BarbJ.6.1.2013.04</a>
Juan Tomás Alcalde, David Campion, Javier Fabo, Felipe Marín, Alberto Aratácoz, Iñaki Martínez & Inmaculada Antón		Occupancy of bat-boxes in Navarre	<a href="http://dx.doi.org/10.14709/BarbJ.6.1.2013.05">http://dx.doi.org/10.14709/BarbJ.6.1.2013.05</a>

Year	Author	Title	DOI
	Marie-Jo Dubourg Savage, Joël Bec & Lionel Gaches	First roosts of <i>Nyctalus lasiopterus</i> breeding females in France	<a href="http://dx.doi.org/10.14709/BarbJ.6.1.2013.06">http://dx.doi.org/10.14709/BarbJ.6.1.2013.06</a>
	Jordi Camprodon, David Guixé	Population status, roost selection and spatial ecology of the Greater Noctule Bat ( <i>Nyctalus lasiopterus</i> ) and the Common Noctule ( <i>Nyctalus noctula</i> ) in Catalonia	<a href="http://dx.doi.org/10.14709/BarbJ.6.1.2013.07">http://dx.doi.org/10.14709/BarbJ.6.1.2013.07</a>
2013	David García, Llorenç Capellà & Juan Quejglas	New data of longevity in the Greater Horseshoe bat <i>Rhinolophus ferrumequinum</i> (Schreber, 1774) in the Balearic Islands	<a href="http://dx.doi.org/10.14709/BarbJ.6.1.2013.08">http://dx.doi.org/10.14709/BarbJ.6.1.2013.08</a>
	Adrià López-Baucells, Maria Mas, Xavier Puig-Montserrat & Carles Flaquer	Hypopigmentation in vespertilionid bats: the first record of a leucistic soprano pipistrelle <i>Pipistrellus pygmaeus</i>	<a href="http://dx.doi.org/10.14709/BarbJ.6.1.2013.09">http://dx.doi.org/10.14709/BarbJ.6.1.2013.09</a>
	Gilberto Josimar Fernández-Arellano & María Isabel Torres-Vásquez	An updated list of bats from the Departments of Loreto, Ucayali and Madre de Dios (Peru)	<a href="http://dx.doi.org/10.14709/BarbJ.6.1.2013.10">http://dx.doi.org/10.14709/BarbJ.6.1.2013.10</a>
	Pier Paolo De Pasquale & Andrea Galimberti	New records of the Alcaethoe bat, <i>Myotis alcaethoe</i> (Vespertilionidae) for Italy	<a href="http://dx.doi.org/10.14709/BarbJ.7.1.2014.01">http://dx.doi.org/10.14709/BarbJ.7.1.2014.01</a>
	Ramón Jato, Juan Carlos Albero & Luis Lorente	Presence and reproduction of <i>Myotis bechsteinii</i> confirmed in the Aragonese Pyrenees	<a href="http://dx.doi.org/10.14709/BarbJ.7.1.2014.02">http://dx.doi.org/10.14709/BarbJ.7.1.2014.02</a>
	Ubirajara Dutra Capaverde Junior, Susi Missel Pacheco & Marcos Eugenio Duarte	Species of bats (Chiroptera) in urban area of the Boa Vista, Roraima	<a href="http://dx.doi.org/10.14709/BarbJ.7.1.2014.03">http://dx.doi.org/10.14709/BarbJ.7.1.2014.03</a>
2014	Luis Lorente, C. Llana, J.M. Sánchez	First record of Noctule Bat ( <i>Nyctalus noctula</i> ) in Aragón (NE Spain)	<a href="http://dx.doi.org/10.14709/BarbJ.7.1.2014.04">http://dx.doi.org/10.14709/BarbJ.7.1.2014.04</a>
	Paulo Barros	Agricultural underpasses: their importance for bats as roosts and role in facilitating movement across roads	<a href="http://dx.doi.org/10.14709/BarbJ.7.1.2014.05">http://dx.doi.org/10.14709/BarbJ.7.1.2014.05</a>
	Juan Tomás Alcalde, Inmaculada Antón	Collecting bat guano of soprano pipistrelles ( <i>Pipistrellus pygmaeus</i> ) by red wood ants ( <i>Formica rufa</i> )	<a href="http://dx.doi.org/10.14709/BarbJ.7.1.2014.06">http://dx.doi.org/10.14709/BarbJ.7.1.2014.06</a>
	Miguel Angel Monsalve-Dolz	Accidental mortality events of the European free-tailed bat <i>Tadarida teniotis</i> in high buildings in Valencia (Spain)	<a href="http://dx.doi.org/10.14709/BarbJ.7.1.2014.07">http://dx.doi.org/10.14709/BarbJ.7.1.2014.07</a>

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2014	Carles Flaquer, Xavier Puig, Adrià López-Baucells, Ignasi Torre, Lídia Freixas, Maria Mas, Xavier Porres, Antoni Arrizabalaga	Could overheating turn bat boxes into death traps?	<a href="http://dx.doi.org/10.14709/BarbJ.7.1.2014.08">http://dx.doi.org/10.14709/BarbJ.7.1.2014.08</a>
	Sylvia Ortega, David Merino	First record of parti-coloured bat ( <i>Vespertilio murinus</i> ) in the Iberian Peninsula, southern the Pyrenees	<a href="http://dx.doi.org/10.14709/BarbJ.8.1.2015.01">http://dx.doi.org/10.14709/BarbJ.8.1.2015.01</a>
	Gianna Dondini, Simone Vergari	Range expansion? First record of parti-coloured bat ( <i>Vespertilio murinus</i> Linnaeus, 1758) in Tuscany, Italy	<a href="http://dx.doi.org/10.14709/BarbJ.8.1.2015.02">http://dx.doi.org/10.14709/BarbJ.8.1.2015.02</a>
	Maria Mas, Adrià López-Baucells & Antoni Arrizabalaga	Predation on bats by genetis <i>Genetta genetta</i> (Linnaeus, 1758): a review.	<a href="http://dx.doi.org/10.14709/BarbJ.8.1.2015.03">http://dx.doi.org/10.14709/BarbJ.8.1.2015.03</a>
2015	Ricardo Rocha	Look what the cat dragged in: <i>Felis silvestris catus</i> as predators of insular bats and instance of predation on the endangered <i>Pipistrellus maderensis</i>	<a href="http://dx.doi.org/10.14709/BarbJ.8.1.2015.04">http://dx.doi.org/10.14709/BarbJ.8.1.2015.04</a>
	Hélia Marisa Vale-Gonçalves, Paulo Barros, Luis Braz, João Alexandre Cabral	The contribution of the Barn owl ( <i>Tyto alba</i> ) feeding ecology to confirm bat species occurrence in north Portugal	<a href="http://dx.doi.org/10.14709/BarbJ.8.1.2015.05">http://dx.doi.org/10.14709/BarbJ.8.1.2015.05</a>
	Leonardo Salari, Letizia Silvestri	Holocene bats (Mammalia, Chiroptera) from five caves of Central Apennines (Italy)	<a href="http://dx.doi.org/10.14709/BarbJ.8.1.2015.06">http://dx.doi.org/10.14709/BarbJ.8.1.2015.06</a>
	Antonio Fulco, Ivy Di Salvo, Danilo Russo, Mario Lo Valvo	First record of brown long-eared bat <i>Plecotus auritus</i> (Chiroptera: Vespertilionidae) for Sicily island (Italy)	<a href="http://dx.doi.org/10.14709/BarbJ.8.1.2015.07">http://dx.doi.org/10.14709/BarbJ.8.1.2015.07</a>