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Research article

Animals in an online world: an evaluation of how zoological collections use social media

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Abstract

Social media is a 21st Century phenomenon and its use extends the outreach of scientific, conservation and educational organisations into the lives of interested (and potentially interested) parties more than ever before. When used well, social media can have a positive impact on public awareness of current, important issues, and can be a useful tool in garnering public support for a cause or message. The aim of this study was to determine whether there was a specific trend in the use of social media (Facebook®) by BIAZA-accredited zoos when putting together content to share with an online audience. We calculated the average percentage of mammals, birds, reptiles, amphibians, fish and invertebrates constituting the collections of nine UK zoos. We tested the hypothesis that posts presented on Facebook would not reflect the diversity of the animal collection. Our results show a bias towards mammals, not only in the number of posts but also in engagement (likes and shares) with such posts. Zoos also announce births and hatchings via social media more than expected, which could be a useful way of engaging an online audience with important conservation issues and rationalising why species are housed in captivity. Posts overtly conservation- or education-based were limited in number, and attracted little following. There was a significant relationship between the number of likes received by a post and the number of times it was shared. If zoos diversified the range of subjects in their Facebook posts to highlight key aspects of biology and ecology of their living collections, it is possible that more engagement with key aims of the modern zoo would arise within an online audience.

Introduction

Social media, including Facebook®, Twitter® and Instagram®, are well-known modern phenomena that enable interaction far beyond what is possible in-person. Facebook® is one of the world's most popularly-visited websites, and the most frequently-used form of online social media with 307 million people thought to be using it in Europe alone (Zephoria 2017). As of June 2017, Facebook® has 2 billion monthly active users globally (Welch 2017) and has been the most popular form of online social media since April 2016 (Statista 2016). In the UK, Facebook® is used by an estimated 43% of the population (The Guardian Technology Blog 2010). This huge reach provides an enormous opportunity for conservation organisations, charities and NGOs to engage with, and reach out to, people who may be interested in their causes or supporting their work.

It is possible to measure the interest in conservation work, and the impact of conservation messages on the public, via internet tools (Soriano-Redondo et al. 2017). Such research shows that by monitoring online interest in a specific conservation message it is possible to gauge appeal and find ways to develop further engagement with a wider audience, thus building support for the conservation mission's aims. Social media can also be used to follow up and maintain engagement with a specific conservation message (Hofman and Hughes 2017), allowing the relevance of a specific message to remain active for longer with the original audience.

The educational scope when using social media is similarly vast, and has been demonstrated in higher education institutions as a tool to encourage "greener" behaviour change in staff and students alike (Hamid et al. 2017). With increasing numbers of people seeking information online, rather than

via traditional media of newspapers, radio and television, zoos can reach more people than previously possible, and are able to explain the importance of their work (both with *ex-situ* and *in-situ* populations) to a wider demographic. Young people are traditionally not enraptured by standard zoo education experiences (Randall 2011; Wineman et al. 1996) so there is scope for changing how zoos interact with teenagers to more successfully convey educational messages. As young people are one of the demographics most likely to engage with social media (Lenhart 2015), this opens opportunities for zoos to use such online platforms to reach out and engage with an otherwise overlooked audience.

Many zoological institutions appear to have been on Facebook® for a number of years now, but social media evaluation does not seem to have taken place to determine the efficacy of its usage, or how the online audience responds to the posts that zoos publish. In light of this, we aimed to assess the type and style of Facebook® posts published by British & Irish Association of Zoos and Aquariums (BIAZA) accredited zoos in the United Kingdom and Republic of Ireland over a three-month period. We aimed to see whether bias in the content of posts existed, whether posts would often be published on a specific theme or subject area, and if followers liked or shared particular posts over others.

Methods

Facebook® sample

Nine BIAZA-accredited zoos in the UK and Ireland were chosen for this study. Large zoos (holding over 500 species) were chosen to provide a wide representation in the taxa available for the creation of online content. The Facebook® posting history of each zoo for the three-month period June to August 2014 was assessed retrospectively. The study months (June–August) were chosen to correspond to when social media accounts are likely to be at their busiest over the summer holiday season. The year (2014) was deemed to be sufficiently in the past that interaction with these posts would no longer be occurring and therefore the number of likes and shares noted would be a good overall reflection of the reach and engagement level for that post. Each post was assessed in turn in reverse-date order.

Data extraction

Data were recorded on a standardised recording sheet, including date, type of animal featured, theme of the post, and the number of likes and shares the post had gained. A pilot study confirmed that post categories were clear/discrete and that post descriptions were understandable (see Table 1), and that it was possible to collect sufficient data from the zoos selected. In the same pilot study, a class of final year undergraduate students worked in groups to categorise posts into each of the topics suggested by the researchers. Feedback was then provided to the lead researcher on what types of posts would be included in which category as "subjects" and as "themes". Animal classes (mammals, birds, reptiles, amphibians, fish and invertebrates) were considered the "subjects" of the posts. A non-taxa category was also included, for posts relating to people, visitors or non-animal features in the zoo (e.g. gardens).

Posts were also classified by "themes" across taxa: behaviour (including enrichment), birth (including hatching, spawning and posts about young animals), death, conservation (e.g. reintroduction or support for an *in-situ* project), new arrivals to the zoo (including a new individual moving in from another collection, or a new species being exhibited), education, health and well-being of the zoo's animals, and anthropomorphic posts (e.g. specific characters or personalities in the zoo). A final category, "general" was included, to cover posts relating to public events, marketing, or advertising that used a specific animal species within the collection itself. The theme of each post was decided prior to the pilot study by the lead author. All data were extracted and assessed by the same individual. Descriptions of each theme are provided in Table 1.

Table 1: Descriptions of post theme categorisation

Theme	Description of type of content
Behaviour	What animals are doing and why. Information on natural history or what a species would do in the wild. Use of environmental enrichment, and what it does, and why it is given to certain animals.
Birth	Photos and stories of animals that have been bred at the zoo. E.g. "We are pleased to say that a new baby *X* has just arrived…"
Death	"Obituary"-style posts of animals that have died at the zoo. E.g. "The zoo is sad to announce the death of…"
Conservation	Posts relating to field work and the zoo's role in conserving species in the wild. Links to ongoing field projects in range states of animals that the zoo works with. Zoo-based conservation themes (e.g. EEP, ESB, or breeding programme posts). Posts related to BIAZA, EAZA, WAZA, the IUCN or other such bodies.
New arrivals	Posts about animals that have been brought into the collection from another institution; what the species is and why they are coming to the zoo. Posts relating to a new species being kept at the zoo.
Education	Visits by educational institutions to the zoo. Work with school, college or university groups by the zoo. Outreach and community engagement.
Health and well-being	Coverage of veterinary procedures. Management and husbandry posts (e.g. why an animal was separated or was undergoing treatment). How the zoo manages its animals to ensure a good quality of life.
Anthropomorphic	Famous or well-known animals at the zoo. Animal birthdays, animals being named, or animals being referred to as personalities.
General	Coverage of public events (e.g. late-night opening) or animal meet-and-greets. Adoption or fund-raising events. Use of specific types of animals in marketing for visitors and promotional materials.

Data analysis

Analyses were conducted in Minitab v. 18 and in R studio (R Core Team 2016). All data were non-normally distributed. To determine any association between the number of likes and shares for each "subject" and for each "theme", a cross tabulation and chi-squared test was used. To determine the strength of association between likes and shares, a Cramer's V-square (ϕ_c) measure was calculated.

To determine any association between the number of posts and the likelihood of the post being liked or shared, fitted line plots were drawn and a Spearman's rho correlation run. To evaluate the

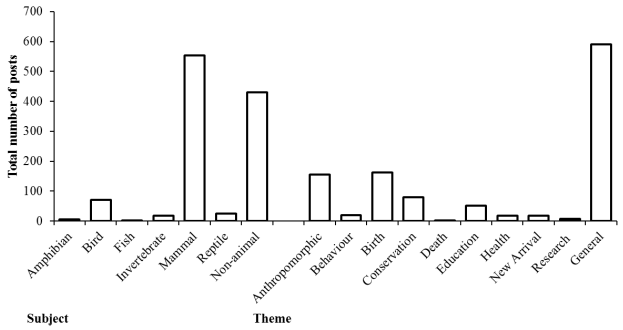

Figure 1. Number of posts in a three-month period on animal-specific subjects (to the left) and overall themes (to the right) in nine large BIAZA-accredited zoos.

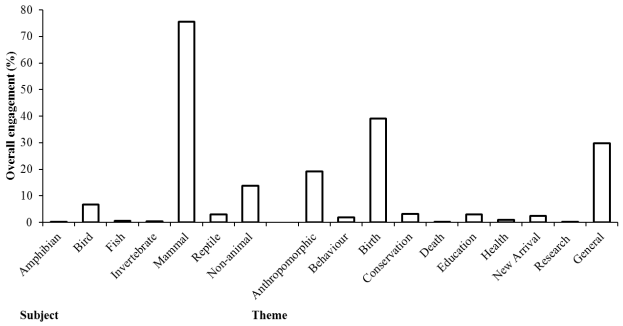

Figure 2. The overall engagement for class subject posts (left) and themes of post (right). Mammals and births account for the most engagement.

influence of post number and interaction (via sharing of posts) on how "likeable" a post was, a generalised linear mode, GLM (Poisson regression) was applied.

To determine any relationship between the diversity of the average animal collection across all nine zoos, and the number of posts made on specific taxa, another Spearman's rho correlation chi-squared testing was used to compare the proportion of classes held with overall levels of Facebook® post engagement. For all multiple P values, a false discovery test to generate a new alpha level of significance was conducted (Benjamini and Hochberg 1995).

Results

A total of 1102 posts were evaluated from all zoos sampled. Figure 1 provides the breakdown of subjects and themes.

There was a significant difference between the number of posts presented by these nine zoos and those expected (average)

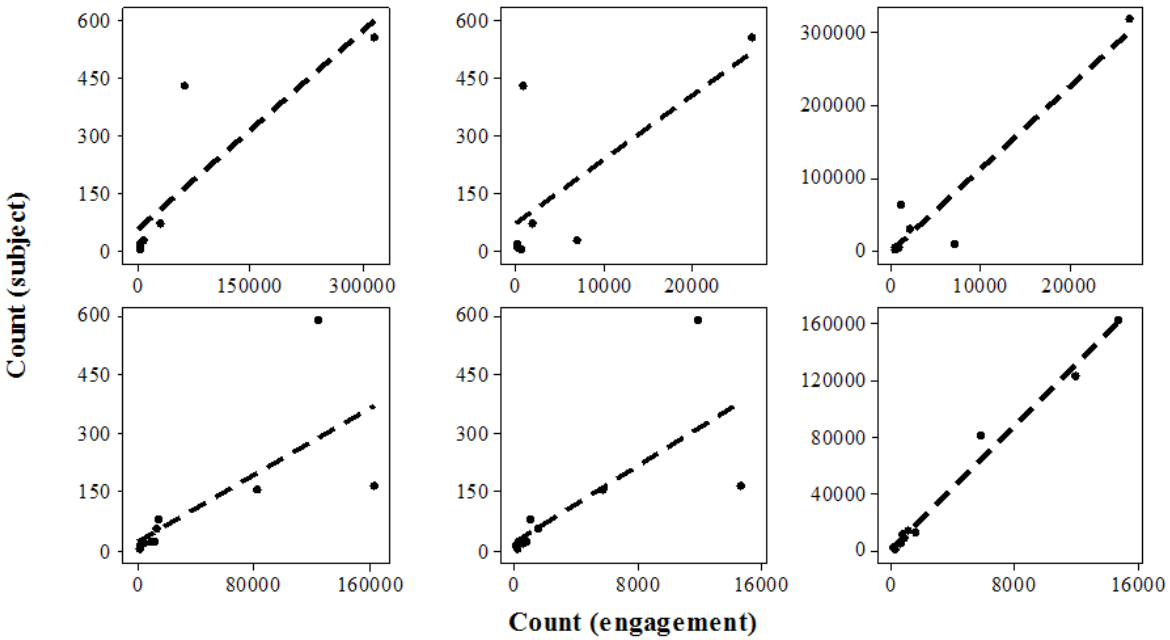

Figure 3. Spearman's rho correlation between subject (species or theme) of the Facebook® posts from nine BIAZA-accredited zoological collections and their engagement (measured as likes and shares). Top left: number of "species" posts against number of likes. Top middle: number of "species" posts against number of shares. Top right: number of likes of "species" posts against number of shares. Bottom left: number of "theme" posts against number of likes. Bottom middle: number of "theme" posts against number of shares. Bottom right: number of likes of "theme" posts against number of shares.

Table 2. Output from Spearman's rho correlation for number of posts, with number of likes and shares for species categories and theme of posts.

Variables	Correlation coefficient and P value	Q value
Number of posts (species) against number of likes (species)	R=0.893 P=0.007	0.033
Number of posts (species) against number of shares (species)	R=0.750 P=0.052	0.05
Number of likes (species) against number of shares (species)	R=0.857 P=0.014	0.042
Number of posts (theme) against number of likes (theme)	R=0.976 P<0.001	0.083
Number of posts (theme) against number of shares (theme)	R=0.964 P<0.001	0.017
Number of likes (theme) against number of shares (theme)	R=0.964 P<0.001	0.026

Table 3. Model output for any relationship between number of likes against engagement and total posts for that category.

	Estimate	SE	Z	P	r^2	AIC
Species				values		
Share	1.01e-04	1.89e-06	53.23	<0.0001	95.64	41678.41
Number	5.78e-03	1.96e-05	295.5	<0.0001	--	--
Share* Number	-1.20e-07	3.51e-09	-34.0	<0.0001	--	--
Theme						
Share	3.21e-04	6.40e-07	501.8	<0.0001	97.86	14557.25
Number	1.80e-02	6.15e-05	293.0	<0.0001	--	--
Share* Number	-1.55e-06	5.37e-09	-287.8	<0.0001	--	--

for "subject", with mammals exhibiting the highest number of posts (χ^2=2052.14; df=6; P<0.001). There was also a significant difference between expected and observed number of posts within each "theme" with the majority of posts categorised as general (χ^2=2605.48; df=9; P<0.001). When posts classified as general were excluded, of the animal-specific themes, births or hatching of a new individual in the zoo accounted for the majority of posts (χ^2=550.844; df=8; P<0.001).

Engagement for each subject and theme was calculated as the percentage of likes and shares for that specific category out of the overall number of likes and shares for subject or for theme is shown in Figure 2. Whilst there was a significant relationship between the number of likes and shares for each type of post, this association was weak: for "subject" (Pearson χ^2=35,256.3; df=6; P<0.001; ϕ_c=0.08) and for "theme" (Pearson χ^2=1001.21; df=9; P<0.001; ϕ_c=0.002). The subject of the post significantly differed in the number of likes to shares, but more data are needed to obtain a substantiated influence of the number of post likes on wider engagement (i.e. number of shares).

The relationship between post number / frequency and engagement was then investigated to see if there was any correlation between the subject or theme of the posts and online engagement. Scatter plots showing any relationship between posts, likes and shares is provided in Figure 3 and significance testing of these relationships is provided in Table 2.

Multiple P values in Table 2 were tested against a corrected alpha level of 0.042 to prevent false discovery (Benjamini and Hochberg 1995). Q values show that all P values, except for number of posts (species) against the number of shares (species), were significant and therefore all comparisons were significantly positively correlated.

To determine whether a species or theme's popularity (i.e. the number of likes posts get) can be predicted by how many posts were made, as well as how often posts were shared, a GLM was run. The output is provided below (Table 3). Both the number of shares and the number of posts were significant predictors of the number of likes a post received. This relationship was true across all species and themes. There was also a significant interaction between shares and the number of posts on a given subject. All P values were significant after applying a false discovery test.

As zoos are increasingly posting on Facebook® about particular types of animals, we analysed the relationship between the diversity of classes housed across these nine zoological collections and the percentage of posts relating to each class (Figure 4). On average, birds were the most exhibited taxa (25%), with mammals second (23%); amphibians were the least common class seen in these zoos (<5%). Mammals were posted about the most (82%) and fish were posted about the least (0.3%). There was no relationship between the average number of each class held across these nine zoos and posting rate (r=0.543; P=0.266). There was a significant difference between the observed and expected proportions of a specific class housed and the number of posts about it (χ^2=231.8; df=5; P<0.001).

Excluding the non-animal category, when comparing levels of engagement with the proportion of each class held, there was a significant difference between the number of each class and the level of engagement with the post (χ^2=83.3; df=5; P<0.001). Figure 4 demonstrates the overwhelming popularity of mammals when compared to all other classes.

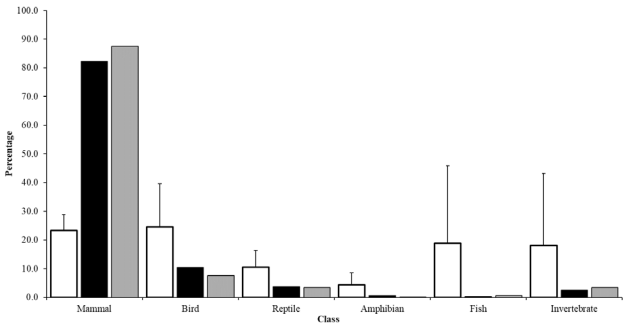

Figure 4.: Comparing the average percentage of each class held by the nine zoos sampled (white bar, +SEM) with the percentage of posts (black bar) and overall percentage engagement (grey bar) for each class. There was a clear trend for mammals to be promoted more than other taxa, even when birds, on average, constituted a larger proportion of the collection.

Discussion

Our results show that zoos overwhelmingly focus their Facebook® posts on mammals, and that the majority of Facebook® posts relate to marketing or advertisements ("general" category, Figure 1). When excluding general posts, zoos most often publish on

births/hatchings of animals within their collection, and are least likely to publish posts on deaths of animals, or about conservation and research. Overall engagement for a post is heavily influenced by the subject or theme of the post (Figure 2), with an online audience more likely to share or like posts on mammals. However, as there is a strong positive correlation between number of posts, liking and sharing (Figure 3), if zoos increased their postings on less popular subjects they may reach a wider audience and interest in these over-looked classes / themes may increase. Whilst the association between liking and sharing for each category is significant, the relationship overall is weak and therefore more data from a wider timeframe, and from more zoos, may be needed to increase the ϕ_c values calculated for these variables.

There are a number of outliers noted in Figure 3 that are worthy of discussion. In correlations of species against likes and against shares, the outlier shows the high posting of zoos on the non-taxa category, for promoting subjects in the zoo other than regarding the animals themselves. These posts are less popular than those on an actual class (i.e. mammals). The same trend is noted for the "general" category in themes (against likes and shares), with zoos posting more about non-animal aspects of their collection. However, these posts do not receive the same levels of engagement with the public as do posts on births or hatchings. Zoos can use these findings to consider how social media is used when deciding how to better promote their animals, as posts that focus on animals in the collection clearly reach more people.

The significant association between post number, likes and shares (Table 3), as well as the interaction between these variables, provides evidence that when a post captures the attention of an online audience it can spread very quickly. The relationship between the number of posts for the "species" category and the number of shares for the same category strongly approaches significance, and it is possible that with an increased sampling of Facebook® posts over a longer time and the inclusion of more zoos, a significant relationship may well become apparent. However, there remains a general trend for engagement with species-related content to increase when more posts of this nature are published. The factors presented in Table 3 are approaching singularity and the independence of the measure is not statistically distinguishable: as the number of times zoos post on a particular species or theme increases, so does the likelihood that the post will be shared and liked. This means that the most popular posts are those with a species and theme that are most often posted and shared.

This case study has identified some key trends in the use of social media by large zoological collections. The diversity of the animal collection is not represented in the zoo's posts and the role of the modern BIAZA-accredited zoo is not fully reflected in the information communicated via social media. There is less variation between zoos in terms of the number of reptilian and amphibian taxa kept, thus indicating that zoos hold a similar number of species of these taxa (Figure 4). Much wider variation is observed between numbers of invertebrate and fish species; zoos with dedicated aquariums are rare (occurring in only three of this sample), and invertebrate-specific houses are also not common (only two zoos in the sample had a dedicated invertebrate house). Zoos hold a similar number of mammals but show wider variation in the number of bird species housed. It is advised that zoos play to their strengths when using social media and promote those species for which they are well-known to house and breed.

A preference for mammals has been shown in ecotourism, where visitors to national parks have found mammals the most charismatic and engaging of subjects to observe and watch (Hausmann et al. 2017). However, the same research also revealed that multiple other factors, aside from the presence of charismatic megafauna, influence how and why people engage with an ecotourism destination (Hausmann et al. 2017). Similarly, there are likely numerous variables influencing what people chose to share and interact with online, as well as what drives them to like or engage with specific content appearing on their social media feeds.

The result that mammals are popular with a zoo's online audience (Figure 4) is not a new finding and is well-recognised by those in the industry (Moss and Esson 2010). However, other species can also have a direct, positive impact on a zoo's conservation message (Skibins et al. 2017) and zoos should consider promoting non-mammalian classes more frequently on social media. A charismatic nature can be the over-riding factor when the public is considering whether to care about conservation (Colléony et al. 2017) so the presentation of "less charismatic" species needs to change to improve how they are promoted to the audiences that zoos are trying to attract. Zoos could consider an animal's behavioural traits, as well as colour or patterning, or morphology that is eye-catching and sparks interest, and therefore can be emphasised and explained in social media posts. Increasing familiarity with non-mammalian zoo species can be a way of encouraging a deeper understanding of their educational value and conservation relevance amongst an online audience, and promoting their (potentially hidden or overlooked) charisma. This can be achieved by publishing a more varied social media content.

Using social media to encourage positive behaviour change has been demonstrated as effective, and the number of views of a specific subject increases the viewer's understanding of the importance of the issue (Spartz et al. 2017). Zoo visitors may have good intentions after exposure to a specific conservation or ecological message during a visit to the zoo; however, these feelings do not always translate into direct action or changed behaviour (Bueddefeld & Van Winkle 2017). Postings on social media, for further emphasise the message, could help foster good intentions into good deeds by those who also visit, and experience, the zoo in person.

One of the roles of zoos is encouraging behaviour change, and social media can be an excellent platform for this. The views of young people, the demographic most likely to use Facebook® (Zephoria 2017), can be evaluated and measured through an assessment of their social media postings (Andersson and Öhman 2017). By targeting posts to a specific audience, or by encouraging their online followers to share or comment on information relating to climate change, conservation issues, or biodiversity loss, zoos can be at the forefront of active behaviour change. The public may gain a better understanding of the natural world from increased exposure to it via their interactions with social media, as has been shown via an analysis of what people watch on YouTube (Dylewski et al. 2017). This research highlights the usefulness of social media platforms to scientific study and shows that data can be generated on the impact of such media on the public's perception, awareness and understanding of nature. The more that zoos publish on their conservation and research, the more measurable, long-term impact they may achieve on the audiences that engage with them.

Estimates from the models presented in Table 2 are small, so whilst there is a significant influence of each predictor on the breadth of sharing and the number of posts on each subject/theme, there may be other influences affecting how a post achieves increased visibility and interaction. For instance, a post will appear on the Facebook® feeds of people who follow others who follow the zoo, and will therefore receive more engagement. Such nesting of data should be considered. This study compared posts depending upon their subjects and themes and did not consider each zoo's postings individually. It is possible that data from each zoo could be closely correlated. A future study using mixed effects models could offer a useful extension to this type of research and how its findings are evaluated.

Zoos can be perceived both positively and negatively in the mainstream media, and the majority of posts in traditional media are concerned with animal welfare (Maynard 2017). Unfair, or inaccurate, negative criticism could be mitigated by a better, cleverer use of social media to promote more of the science and research undertaken by zoos that support the value of their collections. The small number of posts relating to welfare in our social media survey contrast with the focus on animal welfare in the mainstream media.

Whilst it is clear that Facebook® posts have the potential to reach a massive audience, the fast-changing and fluid nature of social media means that a message can be easily "lost in the crowd" or forgotten by social media user. Given the average time spent on Facebook® per visit is 20 minutes (Zephoria 2017) zoos have a difficult task of capturing a transient audience that is looking to quickly move to something new. The characteristics of this online demographic may go some way to explaining the over-representation of enigmatic and endearing mammals, or new-born posts at the expense of other subject material that may be perceived as too technical and less engaging.

Conclusions

1. Zoological collections are regularly engaging with an online audience via the use of social media.
2. Content relating to mammals is the most often published, and zoos theme their posts around new births and hatchings in the animal collection.
3. Of the zoos studied, birds make the largest proportion of animal classes housed and amphibians the least. However, postings on social media do not represent the full diversity of the animal collection maintained.
4. Conservation and research are amongst the least likely topics to be published about on social media by these zoos.
5. Engagement with content is significantly predicated by the number of published posts on that topic, as well as the number of shares a post received.
6. As there is a relationship between post number, post likes and post shares, if zoos increased their online content on less popular topics (e.g. non-mammals, and non-births/hatchings) interest in these topic areas may grow.

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