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Popularity of pet otters on YouTube: evidence of an emerging trade threat

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Abstract

In response to growing reports of otters in the pet trade, and suggestions that the popularity of pet otters on social media may be driving demand, we collated YouTube videos of pet otters to test for trends in the number of videos published, their exposure (number of views) and popularity. We used English-language search terms to provide a global overview, as well as local language search terms for four South East Asian countries identified as being of potential importance in the pet otter trade (Indonesia, Malaysia, Thailand and Vietnam), and Japan. We found that not only had the number of videos depicting pet otters increased in the last two to three years (2016–2018), but that their popularity and/or engagement had also increased. Notwithstanding some country-level differences in the details of effects observed, the greatest increases in both the number of videos produced and their popularity occurred in Indonesia and Japan. At a global-level, commercial "viral" video sites appeared to be influential in terms of posting highly popular pet otter videos. At a national level, potentially influential videos tended to be produced by four or five individual otter owners. The appearance of phrases such as "I want one" in the comments section of the English-language videos, although not necessarily a statement of actual intent, suggests that these videos may be driving demand amongst their viewers and followers; similar analyses of video comments in each local language are warranted. Our results show an increase in social media activity that may not only be driving the apparent increase in popularity, but also amplifying awareness of the availability of these animals as pets, as well as creating and perpetuating the (erroneous) perception of otters as a suitable companion animal. At a global level, there are welfare concerns associated with otters in the pet trade, and, in South East Asia specifically, there are serious conservation concerns. We recommend increased regulation of these activities on social media, increased public awareness of the negative impacts of the pet trade on otters, and increased international protection. Specifically, we suggest the need to uplist both small-clawed and smooth-coated otters (*Aonyx cinereus* and *Lutrogale perspicillata*, respectively) to CITES Appendix 1.

Keywords
animal welfare, *Aonyx cinereus*, conservation, *Lutrogale perspicillata,* social media, wildlife trade

Introduction

People have been domesticating wild animals (Driscoll and Macdonald 2010) and keeping exotic species for centuries (Mitchell 2009; Grigson 2016); but recent decades have seen a notable increase in the keeping of exotic (non-domesticated) companion animals (Grant et al. 2017) and global demand for these species is a significant driver of contemporary wildlife trade, accounting for almost a fifth of recent wildlife trade reports (Baker et al. 2013). Animals kept as pets range from parrots, songbirds and falcons, to turtles, lizards, snakes and fish, to small primates and big cats (Bush et al. 2014; Gallagher 2017), and involve vertebrate and invertebrate taxa (e.g. stag beetles in Japan, New 2005). The popularity of specific species appears to be changeable, influenced by cost and availability (Stringham and Lockwood 2018), rarity (and perceived "prestige", Tournant et al. 2012), and fashion fads (Rehfeld 2005) driven by external factors such as celebrity interest. For example, news reports of Paris Hilton and her pet kinkajou (*Potos flavus*) in 2007 were closely followed by increases in exports of kinkajous from their native Guyana to the US (L. Harrington, unpub. data; trade.cites.org). Exotic pets have special requirements in captivity, which owners may not be aware of, or are unable to provide (Grant et al. 2017; Warwick et al. 2018); consequently, exotic pets often end up abandoned or in rescue centres (e.g. Cheyne 2009). Some argue that it is unethical to keep these animals as pets (e.g. on animal welfare grounds, Warwick 2014), and for individuals/species that are sourced from the wild, excessive trapping can endanger wild populations (e.g. Duckworth et al. 2012 and references therein). For some species, the sheer volume of trade means that even non-threatened species may suffer rapid declines (Nijman et al. 2018). Where captive breeding is possible, poor facilities and inadequate management can pose serious welfare concerns (D'Cruze et al. 2014), and can (where corruption and illegality is involved) provide a mechanism for laundering illegally captured wild individuals (e.g. Nijman and Shepherd 2015). The challenge for wildlife protection efforts is being able to predict 1) which species will become the next popular pet, and 2) what impact consumer demand will have on the survival of wild populations and the welfare of the individuals involved. This study addresses the first of these, focusing specifically on otters in the pet trade, and the use of social media to assess current trends.

Pets (cats and dogs) are hugely popular on social media (Kotenko 2013; Porter 2016; O'Connor 2017) and, in parts of the world where there is ready access to computers and the internet, there is a similarly vast online culture of exotic pet videos and posts. Three billion people access, and are exposed to, content on social media every day (as of 2018, wearesocial.com), and the power of social media to influence public attitudes, consumer behaviour and lifestyle choices is well-recognised (Nekaris et al. 2013 and references therein; Diehl et al. 2016). As such, observations of social media activity provide unique and valuable insight into not only the activities of those that

post on social media, but also the influence that they might exert on their audiences (followers, subscribers, etc.) – in particular, the (potential) desire to carry out the behaviours (e.g. purchasing, or otherwise obtaining, an exotic pet) shown in the post. Because much social media activity takes place in the public domain, posts and the responses to posts provide a readily available data source reflecting the activities and views of (potentially) very large numbers of particular groups of people (in this case, those interested in pet otters). Collation and analysis of social media data can therefore be used to assess current interests and influences and to detect trends that, for pets (and other products), may be indicative of emerging markets and potential associated arising threats to the animals involved.

Otters (Mustelidae, subfamily Lutrinae) have long been a popular species amongst the general public, particularly in the western world (for example, as illustrated by popular novels and media productions such as "Tarka the Otter" [Williamson 1927] and "Ring of Bright Water" [Maxwell 1960]). However, whilst there are historical accounts of people taming otters and using them to catch fish (Gudger 1927; an activity still practised by fishermen in Bangladesh, Feeroz et al. 2011), their semi-aquatic habits have largely precluded widespread adoption as "house" pets. Recently, this seems to have changed; most notably (but not exclusively) in South East (SE) Asia. An assessment of online markets in Indonesia in 2012 recorded 63 live otters (small-clawed otters, *Aonyx cinereus*, and smooth-coated otters, *Lutrogale perspicillata*) listed for sale by 46 sellers (Aadrean 2013), and 800 pet otter owners are known in Jakarta alone (IOSF 2014). Following the seizure of 11 live (small-clawed and smooth-coated) otters at Bangkok International Airport, in January 2013 (Shepherd and Tansom 2013), a series of investigative reports by TRAFFIC revealed a total of 13 seizures in four SE Asian countries (Indonesia, Malaysia, Thailand and Vietnam) between 2015 and 2017, involving 59 live otters (predominantly small-clawed otters) and an extensive online market place, selling juvenile otters, operating through Facebook (Gomez and Bouhuys 2018). All four of the otter species that occur in SE Asia (small-clawed otter, smooth-coated otter, hairy-nosed otter, *Lutra sumatrana*, and Eurasian otter, *L. lutra*) face a number of serious potentially interacting and compounding threats associated with increasing human populations and their activities (habitat loss and degradation, over-fishing, and aquatic pollution) as well as poaching for their pelts in parts of their range (Wright et al. 2015; de Silva et al. 2015; Aadrean et al. 2015; Roos et al. 2015). Here, we are concerned predominantly with small-clawed and smooth-coated otters.

Otters have extensive home ranges in the wild, extending over tens of kilometres (depending on species), and spend a proportion of their time in water (Kruuk 2006). In captivity, development of abnormal repetitive behaviours (potentially indicative of stereotypy and poor animal welfare) are common amongst North American otters (*Lontra canadensis*) – the precise reasons for which are unknown but may be associated with predictable feeding times and an inability to actively forage for live prey (Morabito and Bashaw 2012). Individuals of social otter species (e.g. small-clawed otters) should not be kept alone (Heap et al. 2008), and the recommendations for zoos and aquaria housing otters are that they have a pool at least three times the otters' body length (Conley

2009). These, and other considerations (such as dietary requirements, Maslanka and Crissey 1998, and adequate enrichment, Nelson 2009), present challenges that most domestic owners of otters are unlikely to be able to meet, with potential welfare implications for otters kept in unregulated situations (Reed-Smith and Larson 2017).

There is some evidence that trade in live otters in SE Asia is increasing: for example, seizures in Japan increased from two in 2007 to 32 in 2017 (Kitade and Naruse 2018; see also Siriwat and Nijman 2018 for evidence of increasing online sales in Indonesia), which has raised significant concern amongst conservationists, and animal welfare groups. One suggestion is that this apparent trend may be driven by the popularity of otter pets on social media (e.g. Kitade and Naruse 2018; see also Morgan and Chng 2017) but currently there are no temporal data on social media activity associated with pet otters (as distinct from sales of otters via social media, specifically) to demonstrate potential growing influence. Here, we test the hypothesis that social media activity, globally and specifically in SE Asia, (as well as interest in, and popularity of, this activity) has increased over time, using YouTube videos of pet otters as an indicator of social media activity. YouTube is currently the largest and most popular video sharing website (Malik and Tian 2017). We focus on four SE Asian countries where online trade in live otters was reported by Gomez and Bouhuys (2018) to be high – Indonesia, Malaysia, Thailand and Vietnam – and Japan, where recent findings suggest pet otters are becoming increasingly popular (Kitade and Naruse 2018). For each set of videos, we asked the following questions:

1) Has the number of videos portraying otters as pets increased?
2) Has the exposure ("reach"), popularity of, and engagement with, these videos increased?
3) Who is posting the most popular (and potentially influential) videos?
4) Does the response to videos (as illustrated by viewer comments) suggest that viewers want their own otter as a pet?

Our aim was to provide evidence for the potential role of social media as a driver of the otter pet trade, and, more broadly, to demonstrate how social media data may be used to provide insights into social interests and trends, pointing to potential emerging markets.

Methods

Video selection

YouTube videos portraying pet otters were initially collated using the search term "pet otter", and manually screening all hits for relevance (filtered by view count first and then by upload date to ensure that no recent videos with low view counts were missed). Inclusion criteria were videos showing otters in contact with humans, being touched or picked up, in buildings or other artificial surroundings, such as swimming pools

or gardens, or otters restrained in any way, for example, in cages, or on leads. Videos showing otters in rehabilitation centres or zoos, people playing or interacting with (but not touching) wild otters, people swimming with captive otters through established organisations (e.g. centres that offer interactions with nature to terminally ill children), video compilations, clips from films, animations, or educational videos advising against keeping otters as pets, were excluded. Selected screened videos were saved as a playlist in YouTube. For SE Asian countries we used the following local language search terms: "berang-berang" in Indonesian, "memerang" in Malay, "con rái cá" in Vietnamese, and "นาก" in Thai (translations of the word otter), and for Japan "ペットのカワウソ" (translation of pet otter). Preliminary searches of Japanese videos using the translation of the word "otter" alone identified a large number of irrelevant videos that did not conform to our inclusion criteria (which was not the case for searches for other countries); therefore, we adopted a more restrictive search term for Japanese videos. The difference will have affected only the number of videos screened, not the number of videos selected for analysis. We included reposted videos (even if the original was also selected) because we were interested in the number of videos available to potential viewers rather than the number of unique videos per se. For the same reason, all videos from YouTube channels showing frequent updated videos of the same otter were also included but only if they came up in the original search. Selected videos under each language search term were saved as separate playlists. All videos were retrieved in November 2018.

Data extraction and analysis

All statistical analyses were carried out in R (version 3.5.1, R Core Team 2018). For each playlist created, we extracted publication date, number of views, "likes", "dislikes", and comments, for all videos in the playlist, using the "tuber" package (Sood 2018). To characterise each video, we defined three parameters: "exposure" (or "reach", views), "popularity" (likes) and "engagement" (comments), quantified as the number of total and daily views, the ratio of likes:views, and the ratio of comments:views, respectively (the latter two expressed as ratios to account for the effect of different number of views). To provide context for parameter values, we refer throughout to published benchmark figures for YouTubers (referred to as marketing "metrics of success"): 10,000 total views (the minimum requirement for carrying advertisements, https://youtube-creators.googleblog.com/2017/04/introducing-expanded-youtube-partner.html), a like: view ratio of 0.04 (or 4 likes per 100 views) and a comment:view ratio of 0.005 (5 comments per 1,000 views), and a percentage of dislikes no greater than 40% (Robertson 2014). We used descriptive statistics, and chi-square tests, to characterise the three parameters (exposure, popularity and engagement), and to test for associations between parameters and countries, using simulated p values (based on 2000 replicates) for tests with low expected values. Pairwise post hoc chi-squared tests were performed with the package "fifer" (Fife 2017), p values adjusted for multiple com-

parisons. Because the data were heavily left-skewed, we used non-parametric statistical tests to compare average (median) parameter values among countries, with Bonferroni corrections for multiple tests where appropriate.

For each playlist, we also identified a subset of potential "influencer" videos, defined as those that were both popular (liked; > median like:view ratios) and reached a large number of people (views; > median views). To assess who was posting these potentially influential videos, we manually checked the description of the video, and of the YouTube channel posting the video (including the profile details) and recorded the channel, the type of video (i.e. an original video posted by the owner of the otter, or a reposted video posted by, for example, a "viral" video clips channel), the number of channel subscribers, and the location of the channel (where available). In accordance with ethical research practices (see e.g. Zook et al. 2017), to protect the identity of the individuals posting the videos, collated data files were anonymised by removing user URL (web address), and neither channel names or video titles were reported.

To test for trends over time (in exposure, popularity, engagement and relative dislikes) we considered successive publications of videos by upload date as a time series (with frequency equal to the average number of posts per year), and used the tslm function in the "forecast" package (Hyndman 2017) in R to quantify and test the significance of any underlying trend once cyclical and random components had been removed. Note that because the number of posts per year varied, cyclical components of the time series were meaningless and were not included in the Results (for the purpose of this analysis we were interested only in underlying trends); also, that "trends" in this sense refers to trends in recently published versus older videos, rather than trends over time per se (i.e. the observed response to a particular video could have occurred at any time since its publication and not necessarily at the time of publication). For trends in exposure we used views per day to account for the differing lengths of time since publication, popularity and engagement were quantified as likes:views and comments:views, respectively (as above), and relative dislikes as the number of dislikes as a percentage of the number of dislikes and the number of likes. We excluded videos posted in November 2018 to reduce any possible effect (or lack of effect) due to recent publication (although these videos were counted in the total number of videos published).

Comment content analysis

Finally, we selected all (English-language) ("pet otter") influencer videos that had a minimum of 1,000 comments, to explore the content of comments and thus to assess the extent to which viewers expressed a desire to own a pet otter themselves. For each of the videos selected, we extracted the full text of all comments (also using the tuber package) and exported the text for each video to a text file for further analysis. Comment text was cleaned prior to analysis by removing symbols, numbers and common English stopwords, and transforming the text to lower case. Additional

stopwords and frequent words that had little meaning out of context or that added little to the understanding of the text were identified as part of an iterative process and also removed: this resulted in the removal of the stopwords "actually", "aren't", "can", "didn't", "doesn't", "don't", "isn't", "I've", "just", "know", "probably", "really", "shouldn't", "that's", "think", "que", words used as search terms ("otter/s" and "pet/s") and those appearing in the title of the video, as well as profanities, slang acronyms (e.g. fef), and words related to YouTube ("amp", "com", "href", "http/s", "quot", "video", "watch", "www", "youtube"). Within the cleaned comment text, we identified the ten most frequently appearing words as an indicator of comment content and a reflection of the sentiments of commenters. Where "want" (or other similar words identified post hoc) appeared in the most frequent words, we identified significant word associations (i.e. those words that most often occurred alongside "want"), and verified the context within which the word was originally expressed by searching manually through the text for each occurrence of the term, recording the number of times that the word appeared in a phrase suggesting desire by the commenter to have their own pet otter (e.g. "I want one", as in Nekaris et al. 2013). All text manipulation and analysis was carried out in R using the txt mining package "tm" (Feinerer et al. 2008; Feinerer and Hornik 2018), and comment content visualised using the "wordcloud" package (Fellows 2018).

Results

Number of videos

We identified a total of 64 videos on pet otters using (English-language) search terms, and 173, 35, 115, 58, and 338 for Indonesian, Malaysian, Thai, Vietnamese and Japanese videos, respectively. English-language pet otter videos were first published in 2009 (although the next English-language video was not published until August 2011), SE Asian videos were first published in 2010 or 2011 (depending on country), and Japanese videos in 2012; for all language videos, annual numbers were relatively low before 2016 but (with the exception of those in Thailand) increased thereafter at an annual rate of 1.1–4.3, most notably in Indonesia (where the number of videos doubled each year between 2016 and 2018) and Japan (where it quadrupled), reaching peaks of at least 83 and 215, respectively, in 2018 (Fig. 1).

We did not formally categorise videos based on content but most could be described broadly as showing an otter: being "petted" (touched but not held) by a person or group of people, eating, swimming (indoors in a bath or outdoors in a small plastic pool), interacting with other pets, walking or playing outside (sometimes restrained on a lead), or doing something considered to be amusing (Fig. 2). Many of the videos showed pups or juvenile otters; we did not attempt to identify the species, but most appeared to be small-clawed otters.

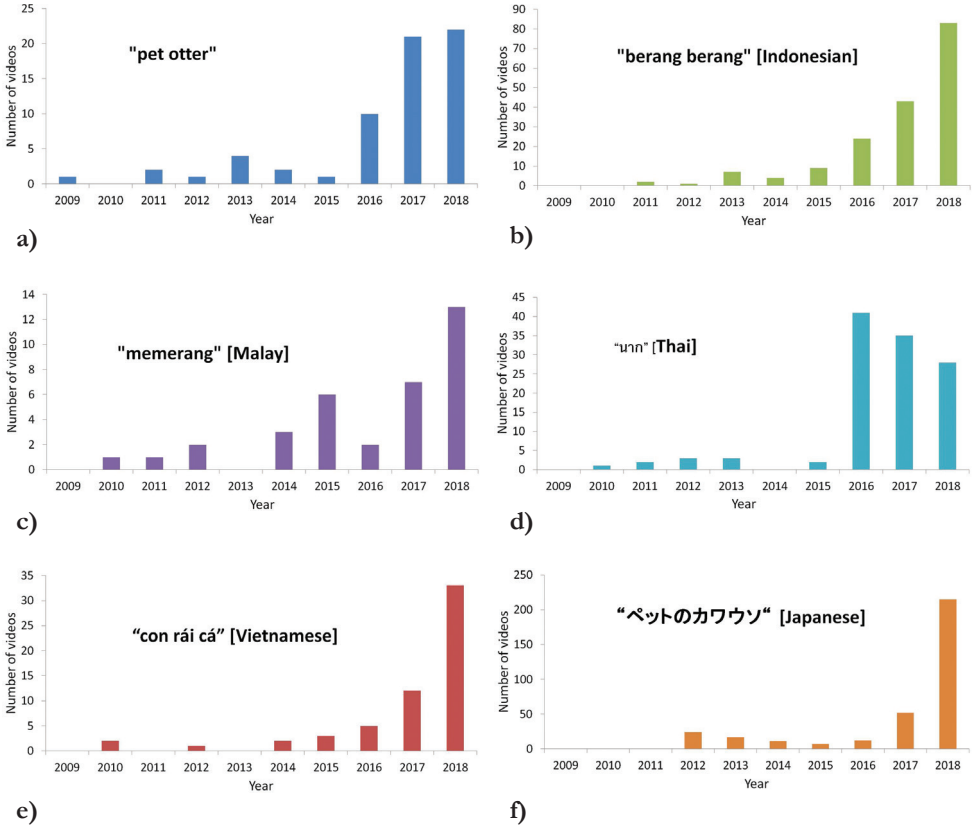

Figure 1. Number of pet otter videos (including reposted videos) published per year for **a** English language **b** Indonesian **c** Malaysian **d** Thai **e** Vietnamese and **f** Japanese search terms. Note that some videos appeared under more than one search term (e.g. many of the Japanese videos appeared under both English and Japanese translations of "pet otter"), and that the numbers published in 2018 are an underestimate since they did not include videos published in December of that year.

Exposure, popularity and engagement

Detailed analyses of SE Asian videos focused on Indonesian and Thai videos as these comprised the largest sample sizes and represented both increasing and decreasing numbers of videos; these were compared with those in English and Japanese languages.

For all four sets of videos, indices of exposure, popularity and engagement were strongly left-skewed, with the vast majority of videos scoring relatively low on all three measures (see Appendix 1). For example, 84.4% (n=54) of English-language pet otter videos received < 400,000 views (exposure), less than one twelfth of the maximum views recorded (5.7 million), and 93.6% (n=162) of Indonesian otter videos received <50,000 views, less than one thirtieth of the maximum views recorded (1.5 million). Compared with benchmark values (see Methods), however, exposure was high (>10,000

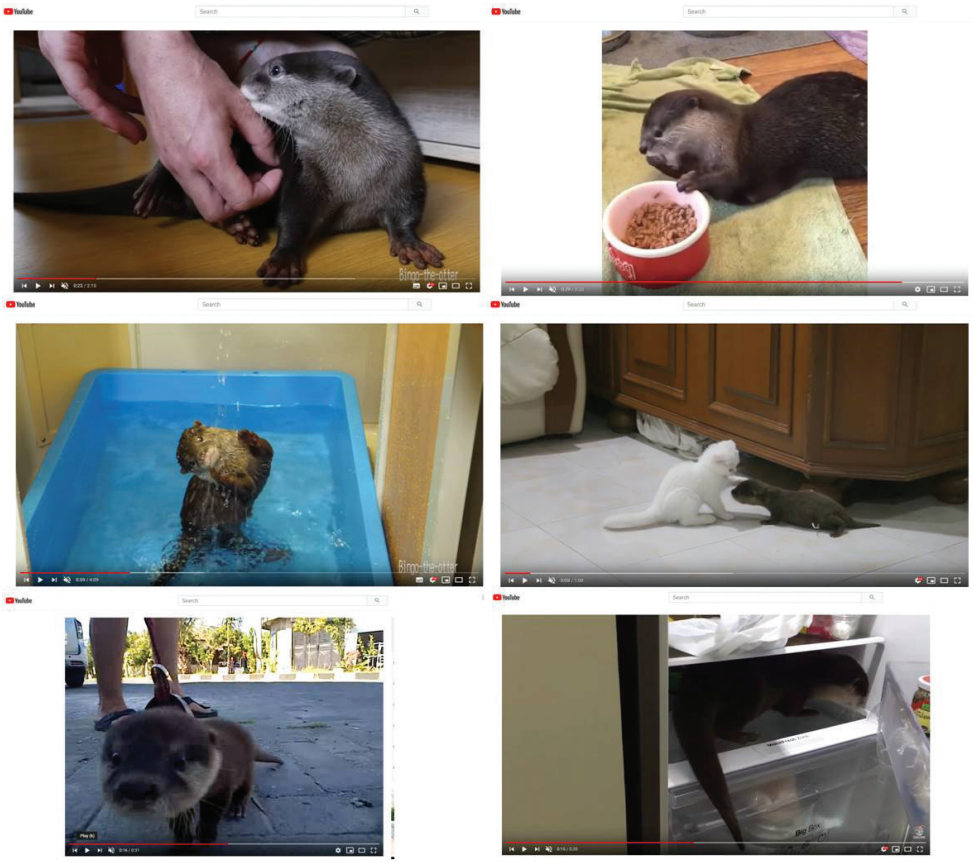

Figure 2. Screenshots of YouTube videos portraying pet otters, under the search terms "pet otter", "berang-berang" (otter in Indonesian) and "ペットのカワウソ" (pet otter in Japanese). Downloaded from www.youtube.com (individual videos anonymised to protect the identity of users).

views) for over half (53.1%, n=34) of English-language videos and between a fifth and a half of local language videos (Indonesian: 18.5%, n=32; Thai: 40%, n=46; and Japanese: 52.1%, n=176). Five English-language pet otter videos and fifteen Japanese pet otter videos received over one million views, as did two Indonesian and two Thai videos. Maximum views per day reached 16,127 for English-language pet otter videos (median = 42) and 2,818 (but with an average – median – of only 1) for Indonesian otter videos, 2,332 (median 11) for Thai otter videos, and 34,091 (median 22.5) for Japanese videos.

In contrast with exposure rates, popularity and engagement indices for English-language pet otter videos were relatively low in comparison with benchmark levels (see Methods). Most (84.1%, n=53) like:view ratios (popularity) were <0.02 (two likes per 100 views). The maximum like:view ratio recorded (0.5) was based on very small sample size (1 like, 2 views) and considered to be unrepresentative, only two (3.2%) other videos had like:view ratios ≥0.04. Most of the local language otter videos also had like:view ratios <0.02 (Indonesian: 82.1%, n=142; Thai: 89.6%, n=103; Japanese:

76.3%, n=238) and the proportion of videos scoring 0.04 or more was relatively low (11.2, 4.8 and 5.4%, respectively, for Indonesian, Thai and Japanese videos). However, there was a statistically significant difference in the proportion of "popular" videos among countries(chi-squared test χ^2 = 8.81, df=3, simulated p value = 0.025) and a slight (non-statistically significant) tendency for more Indonesian videos to score highly on popularity indices than other pet otter videos (pairwise comparisons: English-language vs. Indonesian, p=0.072, Indonesian vs. Thai, p=0.050, and Indonesian vs. Japanese, p=0.029, critical value with Bonferroni correction for 6 tests = 0.008), although popularity overall was significantly lower for Indonesian (median likes:views = 0.003 i.e. 3 likes per 1,000 views) and Thai videos (0.004) than for either Japanese (0.007) or English-language (0.009) videos (pairwise Wilcox tests, adjusted p<0.01) and lower for Indonesian videos than Thai videos (pairwise Wilcox test, adjusted p=0.009). There was no statistical difference between the popularity of English-language and Japanese videos (pairwise Wilcox test, p=0.259; overall difference among countries: Kruskal-Wallis χ^2 = 29.1, df = 3, p<0.001). Similarly, most (74.6%, n=47) English-language videos, and most local language videos (Indonesian videos 72.8%, n=126; Thai videos 73.9%, n=85; Japanese videos 65.0%, n=202) received less than one comment per thousand views (engagement). No English-language video received 5 comments or more per 1,000 views (comment:view = 0.005), but 10.4% (n=18) of Indonesian videos, 7.7% (n=24) of Japanese videos and 3.5% (n=4) of Thai videos did (albeit, for Indonesian videos, based on <1,000 views). On average, engagement (comments:views) was significantly lower for Indonesian videos (median = 0) than for all others (medians = 0.0004 for Thai and Japanese videos, and 0.0005 for English-language videos; Kruskal-Wallis χ^2 = 22.0, df = 3, p<0.001, pairwise Wilcox tests: Indonesian videos vs. Japanese p<0.001, Indonesian vs. English-language videos p=0.017 and Indonesian vs. Thai videos p=0.002, all others p > 0.05) but the likelihood of a video receiving high engagement scores differed among countries (chi-squared test χ^2 = 10.49, df=3, simulated p value = 0.019) being significantly higher for Indonesian videos than for English-language videos (pairwise comparison, p=0.008; critical value with Bonferroni correction for 6 tests = 0.008).

Only one each of the English-language, Thai or Japanese videos exceeded the benchmark value of 40% dislikes, whereas 16 (11.7%) of Indonesian videos exceeded the benchmark (chi-squared test χ^2 = 37.5, df=3, simulated p value < 0.001). In all cases, median percentage dislikes were less than 3%.

Influencer videos

Amongst the English-language pet otter videos, we identified 19 influencer videos (those with > median views and > median like:view ratios). Three were original videos published by two otter owners (in 2017 and 2018), both from Japan. A fourth also appeared to be an original post by an otter owner (in 2014), from an unknown location. Most influencer videos (n=14) appeared to be reposted videos; six of these were posted by three different commercial US-based YouTube channels that buy and sell, or licence,

video clips, and one by a Philippine YouTube channel posting trending video clips. One of the US channels reposted three videos from an original Instagram account of an otter owner in Bangkok, Thailand; another reposted the same video of one of the Japanese otters twice in two successive years. Other videos were posted on various animal channels from unknown locations. The five (most viewed) pet otter videos with over a million views comprised two original videos posted by one of the Japanese otter owners (with 147,000 subscribers), and three reposted videos posted on one of the US-based commercial YouTube channels (with >300,000 subscribers), a personal YouTube channel (with a single playlist of funny videos and 0 subscribers) and a dedicated cat channel (with 4,800 subscribers), the latter two both from unknown locations.

Of 30 Indonesian influencer videos, at least six appeared to be original videos by four different Indonesian otter owners, two were selling otters, at least three appeared to be local online TV channels featuring local people with pet otters, and one was an Indonesian educational channel. One of the Indonesian TV channels provided a link to the "Otter lover Indonesian Community" (or "musang lovers", which means civets but also includes otters, and refers to a community group that keep civets and otters as pets and meet socially with their pets). Five Indonesian videos had more than 10,000 views – these included two YouTubers with their own pet otter (although neither was a dedicated otter channel, with 858 and 68,000 subscribers, respectively) and one seller (with 166 subscribers); the only Indonesian video with more than a million views portrayed an Indonesian actress with her pet otter, posted on an Indonesian celebrity channel (with 172,000 subscribers).

Thai influencer videos portrayed predominantly (20 of 29) original videos posted by three otter owners from Thailand on their own dedicated otter channels (16 of which, including one with over a million views, were posted on a single channel, with 13,000 subscribers); three videos were posted on local TV/news and entertainment channels. One other Thai video that received over a million views (but with a relatively low popularity score of 0.003) was posted on a local entertainment channel and differed from most other otter videos in portraying a large adult smooth-coated otter interacting with, and being handled by, its apparent owner (most other videos showed juvenile otters, and often very small pups that were not yet weaned).

We did not attempt to assess the source of all Japanese influencer videos (n=96) due to time constraints but the top 28 (those with > 100,000 views and > median like:view ratios) were posted exclusively by four different Japanese otter owners (two of which also appeared amongst the English-language influencer videos). Eight of these videos received over one million views, and above-median popularity scores.

Trends

Views per day of English-language pet otter videos peaked at 16,127 for a video published in December 2017 but declined in 2018 to levels comparable to those before 2017 (Fig. 3a) and there was no overall trend (Table 1). However, there was a statisti-

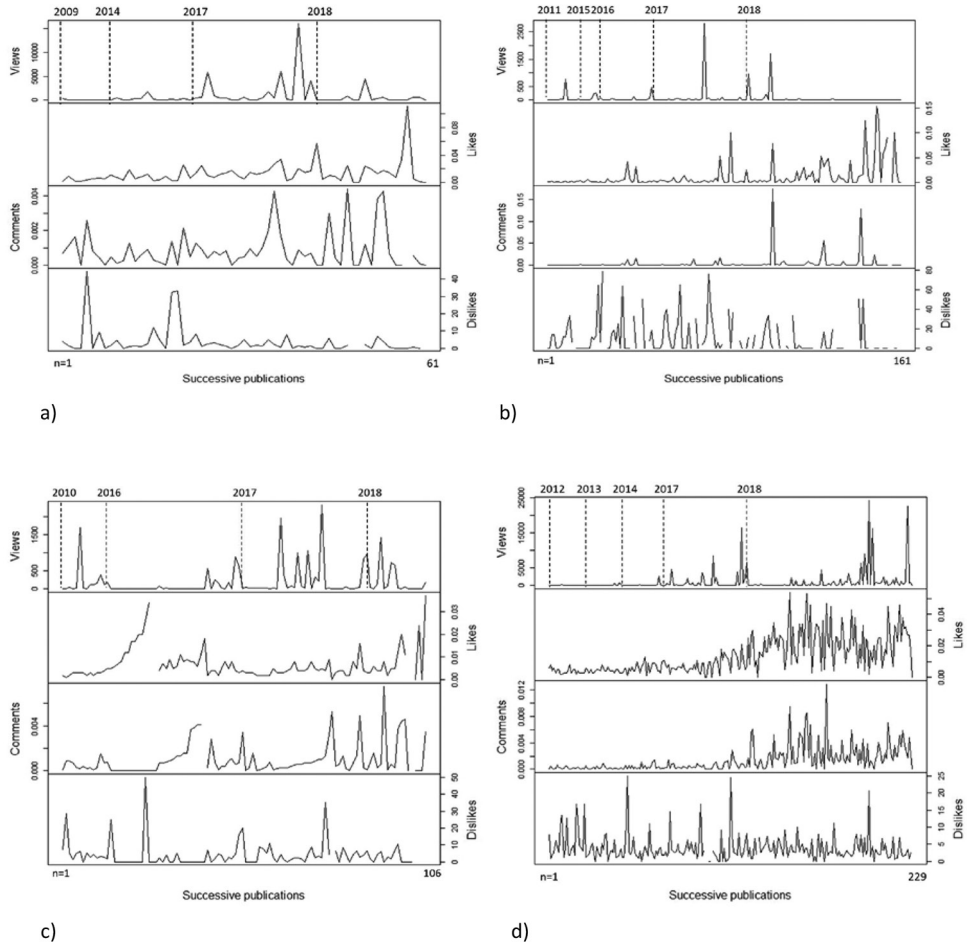

Figure 3. Time series plots showing successive publications of pet otter videos under **a** English language (n=61, 2009-2018) **b** Indonesian (n=161, 2011–2018) **c** Thai (n=106, 2010–2018), and **d** Japanese (n=229, 2012–2018) search terms (see Fig. 1). Views are views per day, Likes and Comments are like:view, comment:view ratios, respectively, and Dislikes are % dislikes relative to the total number of likes and dislikes (see Methods). Searches were carried out in November 2018, and each time series shown includes all YouTube videos published 30 days or more prior to the search date. Note that the time represented in each time series differs because the date of the first video published differed among search terms, and that the timeline is non-linear because increasing numbers of videos were published in each consecutive year (as shown in Fig. 1) – the year of the beginning of each time series, 2017 and 2018, and some of the earlier intervening years, are marked along the top of each graph. Missing values depicted in the graphs are due to the exclusion of peak values based on small sample size (counts of < 5 for likes, comments, or dislikes), or, for Dislikes, videos with 0 likes and 0 dislikes.

cally significant positive trend in like:view ratios over time, which increased over successive postings by an average of two additional likes per 10,000 views (Fig. 3a, Table 1). There was no comparable trend in comment:view ratio (Fig. 3a). Percentage dislikes

Table 1. Trend statistics for exposure, popularity and engagement indices for English-language (n=61), Indonesian (n=161), Thai (n=106) and Japanese pet otter videos (n=229), 2009–2018. In all cases, 2018 includes videos posted up until the end of October (videos published in November were excluded, see Methods). The trend is the average increase between successive video publications; F, df, and p values are based on ANOVA of the trend component of the time series. Statistically significant trends are shown in bold.

Videos	Index	Trend	F	df	P
pet otter	views per day (exposure)	14.9	0.74	1, 59	0.394
(English)	**likes:views (popularity)**	**0.0002**	**6.31**	**1, 59**	**0.015**[1]
	comment:views (engagement)	$5.9e^{-06}$	0.51	1, 58	0.477
	% dislikes	**-0.13**	**4.13**	**1, 56**	**0.047**[2]
berang berang	views per day (exposure)	-0.28	0.34	1, 159	0.560
(Indonesian)	**likes:views (popularity)**	**0.0002**	**28.04**	**1, 158**	**<0.001**
	comment:views (engagement)	$5.04e^{-05}$	2.77	1, 158	0.098
	% dislikes	-0.068	2.63	1, 125	0.107
นาก (Thai)	views per day (exposure)	1.41	1.15	1, 104	0.285
	likes:views (popularity)	$1.8e^{-05}$	0.67	1, 100	0.416
	comment:views (engagement)	**$1.25e^{-05}$**	**7.93**	**1, 102**	**0.006**
	% dislikes	-0.012	0.22	1, 101	0.640
ペットのカワウソ	**views per day (exposure)**	**10.6**	**14.54**	**1, 227**	**<0.001**
(Japanese)	**likes:views (popularity)**	**0.0001**	**158.8**	**1, 227**	**<0.001**
	comment:views (engagement)	**$1.47e^{-06}$**	**83.5**	**1, 227**	**<0.001**
	% dislikes	-0.006	2.65	1, 222	0.105

[1] the positive trend in likes:views for English-language videos remains statistically significant if the two outliers (see Fig. 3a) are removed (trend=0.0001, F=4.11, df=1, 57, p=0.047); [2] conversely, the negative trend in % dislikes is dependent on the three videos published with % dislikes > 30%

showed a statistically significant negative trend, although this was driven by three videos with high percentage dislikes (30–40%) posted in 2013 and 2016 (Fig. 3a).

Trends in Indonesian videos were broadly similar to those of English-language pet otter videos with no trend over successive postings for views per day (but a few outstanding videos posted between August 2017 and February 2018, Fig. 3b, Table 1), a statistically significant positive trend in like:view ratios over time (that increased by an average of two additional likes per 10,000 views with each successive posting, Fig. 3b), and no apparent trend in comment:view ratio. In this case, however, there was also no trend in percentage dislikes (Fig. 3b). Thai videos also showed no trend in views per day (with several videos viewed over 1,000 times per day throughout the time series) (Fig. 3c) but, in contrast with both English-language and Indonesian videos, showed a significant increase in comment:view ratios over successive postings but no trend in like:view ratios or in percentage dislikes (Fig 3c). Japanese pet otter videos showed significant increases in views per day, like:view and comment:view ratios; percentage dislikes showed a slight tendency to decline but the trend was not statistically significant (Fig. 3d, Table 1).

Comment analysis

Five English-language pet otter videos were selected for further analysis of comments. In all cases, comments were characterised (based on the ten most frequently appearing

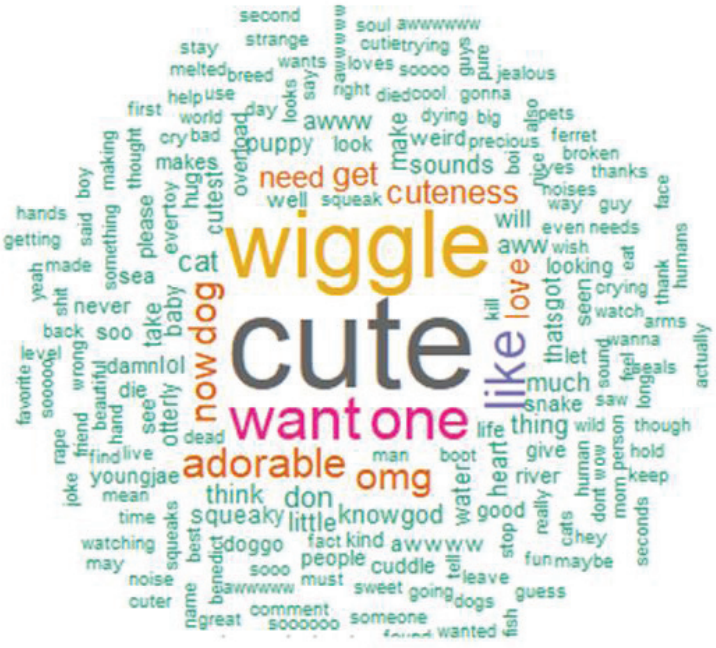

Figure 4. Wordcloud depicting the nature of comments for one of the pet otter influencer videos (defined as the most viewed and the most popular videos; > median views, and > median like:view ratios) selected for comment content analysis (those with > 1,000 comments). The wordcloud shown here is for Video 2 (see Table 2; wordclouds for the other four videos are given in Appendix 3). Font size is relative to the frequency at which each of the words appears in the comments; stopwords and profanities have been removed (see Methods).

Table 2. Most frequently cited words in potential influencer English-language pet otter videos. n is the number of comment lines analysed; freq is the number of times the word occurred in the entire document and was not necessarily the same as the number of comments that the word occurred in. Specific words mentioned in the text are highlighted.

Video 1 (n=3,922)		Video 2 (n=3,254)		Video 3 (n=1,114)		Video 4 (n=945)		Video 5 (n=1,366)	
Word	**freq**	**Word**	**freq**	**Word**	**freq**	**Word**	**freq**	**Word**	**freq**
cute	491	**cute**	600	**cute**	126	**cute**	97	**cute**	146
one	160	**wiggle**	408	**like**	114	**one**	54	**like**	123
want	145	**want**	244	**cage**	113	**like**	53	**love**	70
omg	139	**one**	238	animal	93	water	52	**one**	64
like	131	**like**	204	baby	56	**want**	48	animals	56
dog	124	**adorable**	140	little	51	**get**	33	**get**	55
animal	102	omg	117	**one**	48	people	29	water	45
adorable	95	dog	115	wild	48	sea	27	**adorable**	45
little	86	now	109	**sad**	46	animals	27	best	43
cat	86	**love**	101	water	44	wild	25	good	41

words) by words such as "cute", "like", "love" and "adorable", as well as words such as "want" and "get" (Table 2; Fig. 4), although potentially negative words – "cage" and "sad" – also appeared frequently in Video 3 (see Table 2) that depicted an otter in a cage at night with a stuffed toy. The word "want", "get" and "one" appeared in the ten most frequently appearing words for three, two and five of the five videos, respectively. Want and one were associated where they occurred together (r=0.36-0.45) and (with the exception of Video 3) approximately 40–50% of the comments containing one or all of these words included phrases such as "I want one", "I need one", "I want a pet otter", "where can I get one?" (full list in Appendix 2). For Video 3, only 8.7% of 115 comments containing the word "one" included such phrases.

Discussion

Our analysis revealed an increasing number of pet otter videos published under both English, SE Asian (with the exception of Thai), and Japanese, search terms that (for English-language, Indonesian and Japanese videos) were also increasingly popular, and (for Thai and Japanese videos) increasingly engaged with (i.e. more recently published videos were more popular, and more engaged with, than older videos). This increase in social media activity, and response, suggests growing interest in, and popularity of, pet otters, both globally and nationally in some countries in east and SE Asia. Increasing trends were most notable for Japanese pet otter videos (see Fig. 3d), perhaps due to larger sample size, but nevertheless indicating a clear increase in popularity (from 5 likes per 1,000 views in early publications to 2 – 4 per 100 views for videos published in 2018) as well as a statistically significant increase in exposure not seen in other language videos (see Table 1). As in Nekaris et al.'s (2013) study, most comments of the five videos for which we analysed comment content responded to endearing characteristics of the otters shown (most of which were young animals) and appeared to echo the presumed affection of the owner. Whilst the comments overall were variable both among and within videos, the frequent appearance, and relatively high ranking, of words and phrases associated with an apparent desire to purchase a pet otter suggest that some highly popular videos might incite desire to own these animals as pets.

Welfare concerns for pet otters

The short snap-shots of captive otters in domestic settings shown in all YouTube videos viewed created the appearance of an animal that behaves much like a domestic dog – and this was particularly the case in SE Asian and Japanese language videos, where otters were often shown walking unrestrained along the bank of a river accompanied by a person, or (in Japan) outside on a lead (leash), walking amongst crowds of people in a town or city. Almost all videos (regardless of original language or country of origin) portrayed a picture

of an affectionate "easy to handle" animal in the house. The increasing numbers of these types of videos create the (erroneous) perception that otters are suitable animals to be kept as pets (see Ross et al. 2011) but complex habitat and dietary requirements of otters, combined with the potential to cause harm to people (by biting), mean that otters are actually extremely difficult to keep as pets (Warwick et al. 2014). Recent reports by local animal welfare groups of abandoned or rescued otters in poor states of health, having suffered weight loss and malnutrition (see e.g. https://www.facebook.com/petotters/), demonstrate some of the most serious animal welfare issues that can be involved, but the portrayal of otters swimming in very small water containers (often less than the body length of the otter in width) in a number of the videos viewed also raises further questions about whether it is acceptable on animal welfare grounds to keep a wild animal in these (perhaps well-intentioned, but limited) conditions. For animals captured in the wild, there are opportunities for suffering at all stages of capture and transport (Baker et al. 2013) and adults (upon which unweaned young are still dependent) are probably killed (IOSF 2014).

Conservation concerns for otters in SE Asia

We focused on four SE Asian countries and Japan to assess national-level interest in pet otters on social media because an apparent emerging interest in keeping pet otters (predominantly small-clawed otters, but occasionally also smooth-coated otters) had been highlighted in these countries (Gomez and Bouhuys 2018; Kitade and Naruse 2018). For both species (both of which are native to SE Asia) there is a paucity of data on population size but populations of both are believed to be declining and both are listed as Vulnerable on the IUCN Red List of Threatened Species (Wright et al. 2015; de Silva et al. 2015). Because the source of individuals observed as pets is unknown (Gomez and Bouhuys 2018; Kitade and Naruse 2018), it is not currently possible to assess the actual impact of the pet trade on wild otter populations in the region. Nevertheless, the precarious nature of wild populations of all otter species in this region, means that any additional, or increasing, pressure on wild populations, is a serious cause for concern, and, for small-clawed otters specifically the pet trade is considered likely to pose a significant impact (CITES 2019).

Smooth-coated otters are protected in all SE Asian countries considered in this study (enforceable by a prison sentence of up to 4 years for possession and trade – depending on the country and specific national legislation); small clawed otters are similarly protected in Thailand, Malaysia and Vietnam, but not in Indonesia (Gomez and Shepherd 2018). Whilst there is some level of protection for small-clawed otters in Indonesia under national forestry regulations because there are no harvest quotas for otters (which are otherwise required for hunting/capture), it is difficult to enforce because there are no associated punishments (Gomez and Bouhuys 2018). At an international level, both species are protected under CITES Appendix 2, which requires regulation of commercial trade, but because there are no restrictions on domestic trade of CITES Appendix 2 species in Japan (only Appendix 1 species imported into Japan

are protected under the Law for the Conservation of Endangered Species of Wild Fauna and Flora, https://www.env.go.jp/en/nature/npr/ncj/section6.html), and neither small-clawed or smooth-coated otters are native to Japan, once these species arrive in Japan, there are no regulatory means by which laundering can be prevented or traceability established (Kitade and Naruse 2018).

There are reports of otter breeding facilities in Thailand and in Indonesia (Gomez and Shepherd 2018) but these reports are unverified and, if the facilities do exist, they are either operating illegally (Thailand) or contain illegally-obtained animals (Indonesia) (Gomez and Bouhuys 2018). Indeed, Siriwat and Nijman (2018) suggest that online traders in Thailand are aware of the illegality of selling pet otters, but appear not to be concerned about the consequences of selling one or two.

Who are the social media "influencers"?

Amongst the global, English-language pet otter videos, most potentially influential videos (defined here as those that were both popular and reached large numbers of people) were reposted videos, several of which were posted by commercial US-based YouTube channels purporting to host viral or trending videos. As in Bakshy et al.'s (2011) analysis of Twitter users, and contrary to expectation, not all videos posted by users (or on channels) with large numbers of subscribers appeared to be influencers, and, in some cases, potential influencers had very small or non-existent social networks.

Across all local language videos, potentially influential videos tended to be posted by a very small number of individual otter owners, suggesting that whilst the source of influence might be *a priori* unpredictable, it is somewhat limited. Further, and in accordance with other studies of social media activity (e.g. Bakshy et al. 2011; Morgan et al. 2014; Harrington et al. 2018), most YouTube videos in this study actually received very little attention. However, the continually increasing number of videos available (particularly in Japan) raises concerns of multiplier effects, and the possibility that the combined effect of many non-influential videos may together create an effect greater than the sum of their individual parts. In other fields, individual adoption of behaviours has been found to be more likely when participants receive reinforcement from multiple neighbours in the social network (Centola 2010). Increasing numbers of videos showing potentially desirable exotic pets could be considered analogous to "big seed marketing" (Watts et al. 2007), which is extremely efficient with respect to rate of spread (in this case, of interest in pet otters and potentially the desire to own one). If this were the case for exotic pet ownership, everyone posting or reposting pet otters on social media could be considered to be an influencer.

Media influence and links with demand

Apparent surges in the popularity of other exotic pets (clownfish [*Amphiprion* spp.], Fennec foxes [*Vulpes zerda*] and snowy owls [*Bubo scandiacus*]), have previously been

attributed to demand driven by children's films. In these cases, however, scientific studies have failed to find clear evidence of a causative link. For example, the "Nemo effect" (the suggested effect of the children's film Finding Nemo on purchases of clownfish representing the main character of the film Nemo) was more likely linked to media hype referring to the scarcity of the species and the anthropogenic allee effect (Militz and Foale 2015) than the film character itself. Similarly, increases in the trade of fennec foxes pre-dated the release of the Zootopia film with which fennec foxes were associated (Verissimo and Wan 2016), and a study comparing exposure to the Harry Potter films and owl trade in the UK failed to detect evidence of the link that had been widely reported in the media (Megias et al. 2017). At a local level, however, the sale of owls in bird markets in Java and Bali increased massively after the release of the Harry Potter films and books in Indonesia (Nijman and Nekaris 2017), and Macdonald et al. (2017) describe how raccoons became established as an invasive species in Japan as a result of people releasing unwanted pet raccoons purchased during the airing of a Japanese animated TV series "Rascal the raccoon". It is possible that the influence of videos on social media portraying "real" people with "real" pets may differ from that of animated or fictional characters and species, insofar as they are tangible and represent a certain reality; in this context, the links between actual demand and social media interest, and the scales at which they might function, warrant further scrutiny.

In Japan, where the increase in social media activity associated with pet otters was particularly great, the popularity of otters as pets, and the perception that they are easy to keep, is likely also perpetuated by otter cafés (McMillan 2018), a recent phenomenon that itself generates social media coverage by news reporters and visitors. The first otter café reportedly opened in Japan in 2016, followed by a further seven Japanese cafés exhibiting otters in 2017 (McMillan 2018).

Social media insights as a wildlife protection tool

Whilst social media (through driving demand for, and facilitating online sales of, threatened wildlife species) poses a significant risk to conservation and animal welfare, it also offers opportunities as a wildlife protection tool (through the vast repository of data available, and the insight provided into people's interests and activities, Malik and Tian 2017; see also Siriwat and Nijman 2018). This study is one of very few scientific studies of which we are aware examining either the portrayal of exotic pets on social media or the social media response to such posts. Nekaris et al. (2013) - who presented an in-depth analysis of the response to a single particularly influential video of a pet slow loris (*Nycticebus* spp.) being tickled – is one exception, but despite the success of Nekaris et al's study in undertaking, and tracking the response to, educational campaigns, there have been few follow-ups. The use of social media in conservation science is still a relatively underutilised tool (Di Minin et al. 2015). There are data limitations associated with publicly-available data; for example, in this study we were not able to account for potential changes in response to a video over time. Post hoc tests found no evidence of a linear correlation between any

of the indices used and time since publication (Pearson's correlation coefficient < 0.3 in all cases) but this does not fully exclude potential bias due to recency (i.e. the possibility that likes or comments per views is higher in the first weeks or months following publication), and these characteristics of YouTube videos and other social media posts warrant further scrutiny (see e.g. Chatzopoulou et al. 2010). Trawling social media and retrieving associated metadata is also a time consuming process, which can make such studies (particularly where large sample sizes, or multiple search terms, are needed) prohibitive. We used an automatic metadata retrieval process using freely available packages implemented in R (R Core Team 2018) that allowed rapid metadata retrieval once a playlist had been created. Although we manually screened and selected individual videos for each playlist (which added considerably to the time required for processing) this step was necessary to ensure that all videos included in the dataset were relevant. There are a number of automated approaches for the search and retrieval of social media posts (see e.g. Malik and Tian 2017), which, with the employment of machine learning techniques (Di Minin et al. 2018), may further increase the efficiency of similar analyses in the future.

Harris et al. (2015) suggest that species that are being over-exploited through trade can be identified on the basis of market data and observations of increasing prices alongside decreasing supply – notwithstanding data limitations, the use of social media data to detect increasing activity and/or popularity associated with a specific species or product offers a significant advantage over a market based approach by detecting and highlighting trends in interest well ahead of any more serious effects such as decreasing supply. We did not attempt to quantify the number of otters shown in the videos, nor do we suggest that everyone that comments "I want one" on a YouTube video of a pet otter necessarily intends to buy one, rather we suggest that our results are indicative of an emerging threat. Social media analysis in this context can thus provide an early-warning system highlighting potentially problematic wildlife trade issues and enabling targeted mitigation measures to be put in place before they become a problem.

Recommendations

For otters in SE Asia, there is an urgent need to identify where pet otters are being sourced from, via what route, and to clarify the (il)-legality of the situation. Further research is needed on the drivers for the current trend in keeping pet otters, and to assess the role of social media in driving demand (in SE Asia and Japan, as a priority, but also globally). We did not attempt to translate and analyse comments posted in response to the local language SE Asian videos, but such analyses would be useful to assess local level, culturally-influenced, responses, and may be warranted to predict local-level emerging trade risks, detect national differences, and identify geographical priorities. More broadly, the role of social media in driving demand for new products warrants attention. Does social media instigate and create desire for owning a particular product (whether a pet otter, other exotic pet species, or any other illegal or unethical wildlife product), or does it simply respond to an existing desire and further amplify it?

Beyond the use of social media to detect trends and identify potential trade threats, there is a need for targeted interventions by social media companies and users. The commitment by a coalition of technology, e-commerce and social media companies (including Facebook and Instagram), in 2018, to reduce the trade in wildlife products by 80% by 2020 (Global Coalition to End Wildlife Trafficking Online; Bale 2018; see www.worldwildlife.org/pages/global-coalition-to-end-wildlife-trafficking-online) and Instagram's initiative to alert viewers to search terms (hashtags) that might be associated with "posts that encourage harmful behaviour to animals .." (i.e. animal selfies; Daly 2017) provide models for the type of actions that can be taken. These actions should be targeted specifically at key entities (influencers) identified in this, and other similar studies. At the user level, social media provides opportunities for education and awareness raising (Nghiem et al. 2012) - and to encourage behaviour change (e.g. Nekaris et al. 2013; Waters and El-Harrad 2013), which is most likely to be achieved (see Moorhouse et al. 2017) by highlighting the illegality of possessing an otter in many SE Asian countries, and drawing attention to the fact that wild otters bite, have sharp teeth, and are potential carriers of zoonotic diseases (e.g. Hsu and Mathura 2018).

The current proposal to move small-clawed and smooth-coated otters to CITES Appendix 1 (proposed by India, Nepal and the Philippines, and Bangladesh, India and Nepal, respectively, and backed by the IUCN Otter Specialist Group, www.otterspecialistgroup.org; CITES 2019), due to be voted on at the CITES CoP in 2019, will (if upheld) provide protection for these species exported to non-range states where there is no national-level protection (i.e. Japan), and effectively place them on the list of species for which trade is prohibited under the Wildlife-Friendly Online Trade Policy (www.worldwildlife.org/publications/wildlife-friendly-online-trade-2017-a-harmonized-policy-for-e-commerce-and-social-media-companies) adopted by the Global Coalition (above). We urge policy-makers, practitioners and researchers to take these steps.

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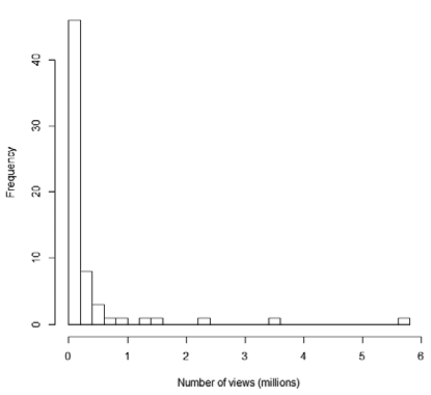
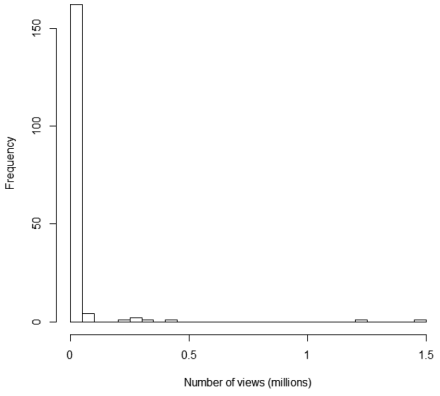
Appendix 1

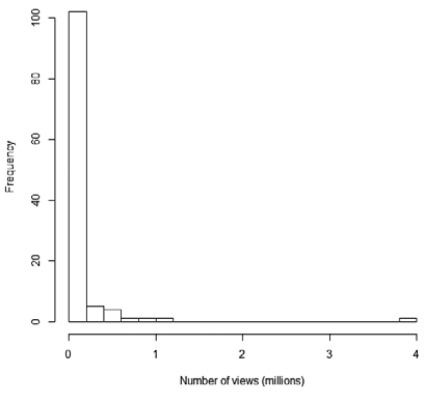
Data distributions – exposure (number of views), popularity (like:view ratios) and engagement (comment:views ratios)



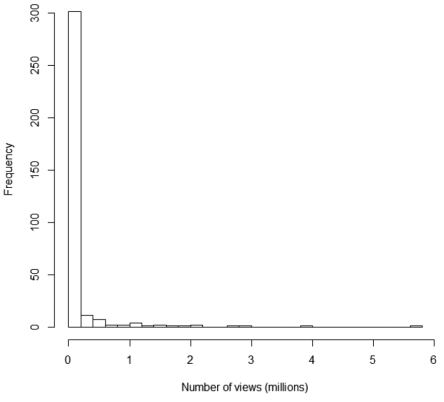
a) “pet otter”



b) “berang berang” (Indonesian)

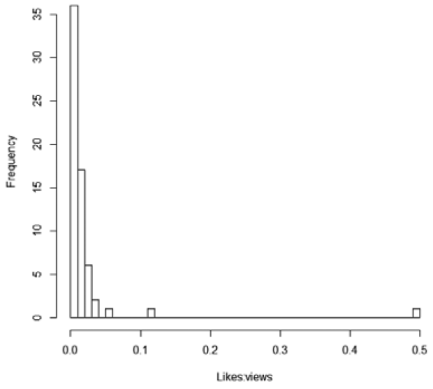


c) “นาก” (Thai)

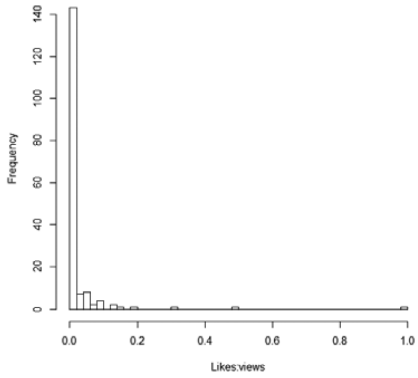


d) “ペットのカワウソ“ (Japanese)

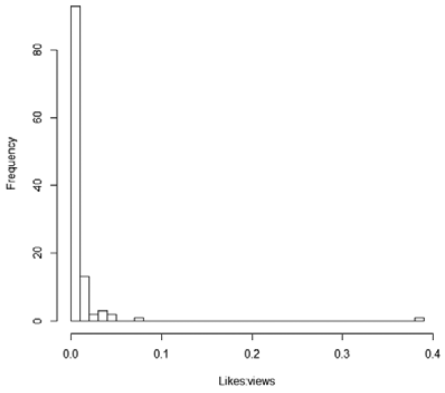
Figure A1. Total number of views.



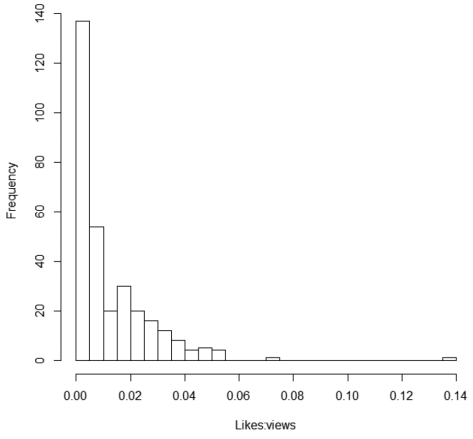
a) “pet otter”



b) “berang berang” (Indonesian)

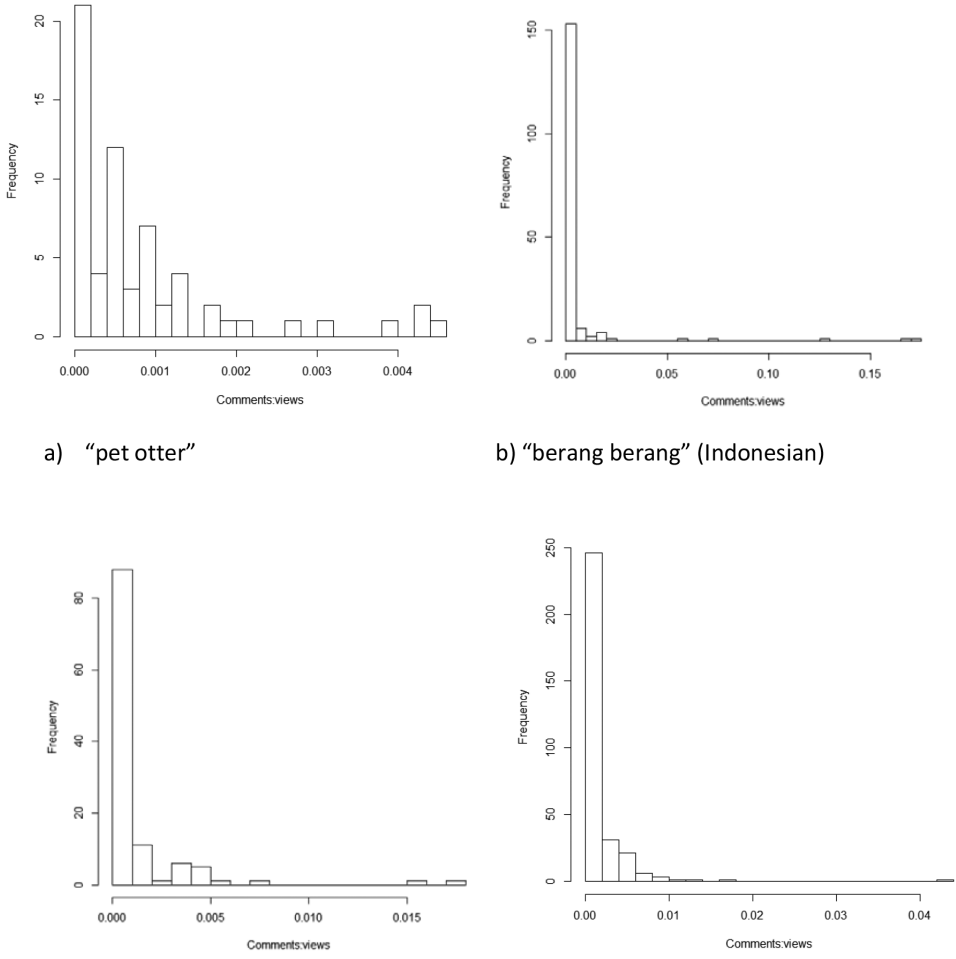


c) “นาก” (Thai)



d) “ペットのカワウソ“ (Japanese)

Figure A2. Like:view ratios.



a) "pet otter"

b) "berang berang" (Indonesian)

c) "นาก" (Thai)

d) "ペットのカワウソ" (Japanese)

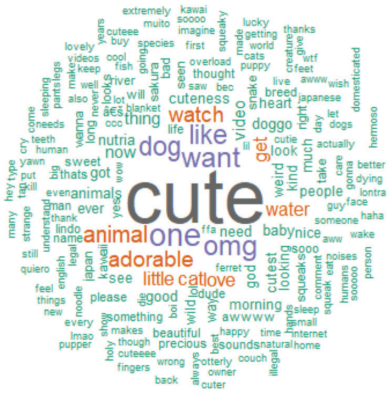
Figure A3. Comment:view ratios.

Appendix 2

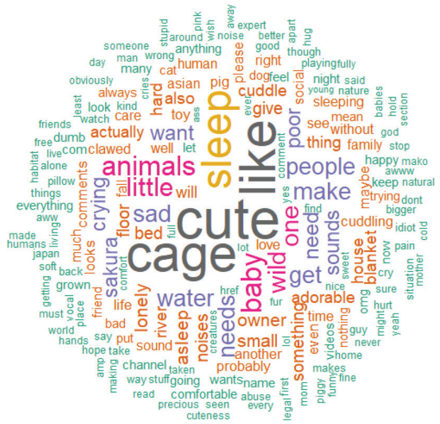
Phrases containing the term one, interpreted as indicating some desire for obtaining a pet otter

I want one, where do I get one, how can I get one, I need one, wish I had one, how do I go about retrieving one, can I have one, why doesn't everyone have an otter, how does one go about getting an otter in Japan, how do you own one of these guys, can you have one of those as a pet, I'm gonna get one, I'd get one [if I could].

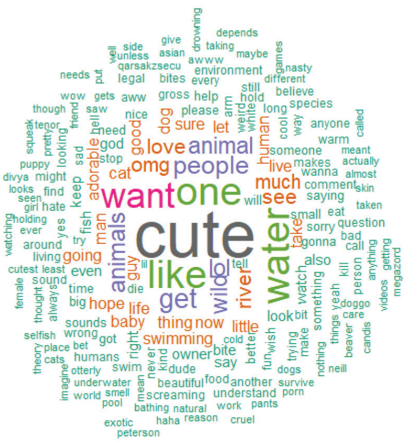
Appendix 3



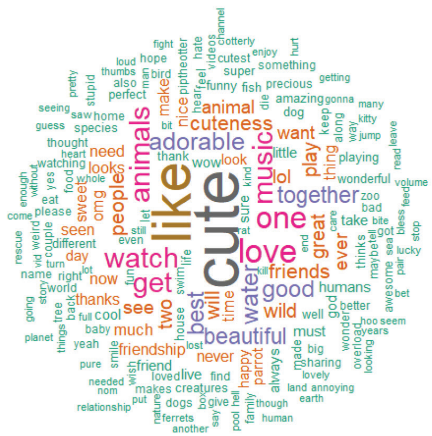
a) Video 1



b) Video 3



c) Video 4



d) Video 5

Figure A4. Wordclouds depicting the nature of comments for four pet otter influencer videos (Videos 1, 3, 4, and 5 in Table 2). "Influencer video' defined as the most viewed and most popular videos with > median views, and > median like:view ratios. Font size is relative to the frequency at which each of the words appears in the comments; stopwords and profanities have been removed (see Methods).