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Original Research Article

The Harry Potter effect: The rise in trade of owls as pets in Java and Bali, Indonesia

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ABSTRACT

Hundreds of species of wild-caught birds are offered for sale in the bird markets of Java and Bali, Indonesia, to meet the demand for the largely-domestic pet and songbird trade. In the past, owls were offered only in very small numbers in these bird markets but since the release of the Harry Potter series in Indonesia in the early 2000s their popularity as pets has increased. Whereas in the past owls were collective known as *Burung Hantu* ("Ghost birds"), in the bird markets they are now commonly referred to as *Burung Harry Potter* ("Harry Potter birds"). We made a retrospective quantitative assessment of the abundance of owls in the bird markets (1979–2010) and conducted 109 surveys in 20 bird markets in 2012–2016 to quantify owls in trade. In the 1980s, 1990s and early 2000s owls were rarely recorded in Indonesia's bird markets, typically one or two and up to five per survey, and frequently no owls were recorded at all. The trade was largely confined to small scops owls. In the late 2000s more species were offered for sale, including barn and bay owls, and larger owl species such as wood-owls, eagle-owls and fish-owls; typically 10 + owls were observed per survey. In recent years, the number of owl species increased even more, and on average we recorded 17 owls per survey, yielding a total of 1810 owls, and in >90% of the surveys owls were present. In the larger bird markets in Jakarta and Bandung typically 30 to 60 owls are on offer of up to 8 species at a time. The number of owls as a proportion of all birds in the markets increased from <0.06% prior to 2002 to >0.43% post 2008, suggesting a delayed Harry Potter effect. Over this period, common species have become cheaper and less common ones have become more expensive. The owls are largely, if not exclusively, wild-caught and are sold into the domestic pet market. The release of Harry Potter films and novels in Indonesia coincided with the rise of the Internet and social media and, with some delay, the emergence of pet owl interest groups on Java and Bali, thus preventing us to demonstrate a causal Harry Potter effect on the owl trade. The overall popularity of owls as pets in Indonesia has risen to such an extent that it may imperil the conservation of some of the less abundant species. Inclusion of owls on Indonesia's protected species list, alongside all diurnal raptors, may be a first step to mitigate the negative effects of this emerging trend.

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1. Introduction

In the Harry Potter series by J.K. Rowling, first published between 1997 and 2007, different species of owls bridge the magical and muggle ("human") world, carrying messages, packages, and even flying broom sticks to humans and wizards alike. Harry Potter himself gets a snowy owl *Bubo scandiacus*, named Hedwig, in the first novel and she stays with him throughout the series. Other main characters also have owls as companions throughout the series (e.g. Ron Weasley has a very small owl named Pigwidgeon, later depicted in the film series as a common scops owl *Otus scops*, Draco Malfoy has an Eurasian eagle-owl *Bubo* spp and Percy Weasley has a screech owl *Megascops* spp). In 2001 the first Harry Potter film was shown in cinemas, thus introducing the images of owls as human companions and messengers to a worldwide audience. Combined the novels and the films have reached audiences of 100s of millions of people (450 million copies of the books were sold, and combined the series grossed some US$7.7 billion in the box office).

An increase in popularity of certain animals following their appearance on the big screen or in television series is a well-known phenomenon, yet it is rarely quantified and, as ever, correlation does not indicate causation. Furthermore, an increase in popularity seldom is immediate and discernable increases can be delayed for several years. Herzog et al. (2004) compared the popularity of purebred dogs in the US after the release of the Disney film *101 Dalmatians* in 1985, and found that it took seven years before new Dalmatian registrations increased 6.2-fold, which was significantly larger than that of other breeds during that time period. The release of the first *Jurassic Park* film in 1993 led to a one to three year delayed spike in the global trade in green iguanas *Iguana iguana* (Christy, 2008; Nijman and Shepherd, 2011). Finally, following the release of another Disney film *Finding Nemo* in 2003 it was reported that the sales of clown fish increased (Prosek, 2010) to the extent that in 2005 four species of clown fish (*Amphiprion ocellaris*, *Amphiprion percula*, *Amphiprion frenatus* and *Premnas biaculeatus*) were included in the twenty most imported marine aquarium fish into the US (Rhyne et al., 2012). Militz and Foale (2017), however, noted that while there was an increase in imports of clown fish (*A. ocellaris* and *A. percula*) following the release of *Finding Nemo*, most pronounced two years later, this increase was less than the overall increase in imports of marine aquarium fish. On balance they did not find a *Finding Nemo* effect.

We here report on the rise of popularity of wild-caught owls as pets in Indonesia, both in absolute numbers and relative to the numbers of other birds offered for sale, following the release of the Harry Potter series. Owls are known as *Serak* (bay and barn owls), *Celupuk* (scops owls), *Beluk* (larger owls), and collectively they are known as *Burung Hantu* ("Ghost birds"), but in the markets where birds are sold they are now equally commonly referred to as *Burung Harry Potter* ("Harry Potter birds"). In 2000 the first Harry Potter novel was translated into Bahasa Indonesia ("*Harry Potter dan Batu Bertuah*") and from then on most volumes were available in Indonesian shortly after the release of the English original. The film series were shown throughout Indonesia in English with Indonesian subtitles, with the first film released at the very end of 2001.

Birds of all kinds are commonly traded in Java and Bali, and just about every city has one or more bird markets. While some bird markets are small, the largest market in Jakarta, Pramuka, surveyed on one day in June 2014, had over 16,000 birds on display of some 200 species (Chng et al., 2015). Birds keep a special position in the social life on Java, as keeping a bird is seen as a symbol of accomplishment and settlement. Traditionally, in order to reach a full life, a man had to have a house (*Wisma*), a wife (*Wanita*), a horse (*Turangga*), a dagger (*Curiga*) and a bird (*Kukila*), with the horse representing ease of communication and movement within society, the dagger representing status and power, and the bird all of nature, as well as the need for a hobby in a well-balanced life (Whitten et al., 1996; Jepson, 1997). What type of bird one keeps depends on age and socio-economic factors, amongst others. The proportion of people keeping pigeons *Columba livia* declines with age, whereas that of those keeping zebra doves *Geopelia striata* increases (Jepson and Ladle, 2009). The incidence of keeping expensive birds such as orange-headed thrush *Zoothera citrina* increases progressively from the lowest to the highest income categories (Jepson and Ladle, 2009), and rare and threatened birds are especially favoured by certain upper classes (Nijman et al., 2009). Jepson and Ladle (2005) found that in a household survey of five cities (all but one on Java) over a fifth of people kept a bird as pet (excluding chickens) and that collectively an estimated 2.5 million birds were acquired per year (of which some 665,000 were wild-caught native birds).

We here report on the trade in owls based on a large number of market visits from 2012 to 2016 and compare our observations to data from *ad hoc* market surveys dating back to the late 1970s, with the aim of increasing knowledge and awareness of the trade in these species. In addition we want to explore a Harry Potter effect, i.e. whether or not the Harry Potter novels and films, and in particular the normalization of keeping owls as companions, has led to an increase in owls offered for sale as pets, both in absolute terms and relative to other species of birds in trade.[1]

[1] Widely different 'Harry Potter effects' have been reported in the literature, dealing with how the Harry Potter novels have transfigured bibliophobic children—particularly boys—into avid readers of fiction (Dempster et al., 2015), how children's books have increased in page length (Shemroske, 2016), how best seller lists are constructed (Fitzsimmons, 2012), how the Harry Potter phenomenon (novels, films, merchandise, theme parks, etc.) has affected marketing (Brown, 2002), how enrolment into boarding schools has increased (Beagley, 2009) and how it is that in Anglo-Saxon cultures, child psychosis often goes unnoticed (Sauvagnet, 2005).

2. Methods

2.1. Data acquisition

Surveyors covered 18 markets in fourteen cities on Java between April 2012 and November 2016, and two markets in two cities on Bali between June 2013 and November 2016 (Table 1). All but four markets were visited multiple times in different years, yielding a total of 109 surveys, 64 of which included one or both of the authors. Team members of the Little Fireface Project, an organisation focussing on the conservation of nocturnal animals, conducted the other surveys. Although occasionally we visited individual bird markets on consecutive days or weeks, here we only include surveys that were at least one month apart. The bird markets (known as '*pasar burung*' or '*pasar satwa*' in Indonesian) are open to the public and range in size from the four-story 200 bird shop Pramuka market in Jakarta to smaller, sometimes mobile, markets comprising a dozen or so shops. The cities surveyed are spread out over large parts of Java and Bali; they should be representative for the trade in this part of Indonesia.

In Indonesia, owls are not included on the list of protected species, apart from the Biak scops owl *Otus beccarii* that has been protected since 1978 (Noerdjito and Maryanti, 2001); trade in owls (both domestic and international), however, is regulated through a quota system (see Discussion). Owls were traded openly in the bird markets so there was no need to resort to undercover techniques. We walked through markets slowly, recording owls by typing the species and their numbers using a mobile phone or by memorising numbers and writing them in a notebook directly on leaving the market. Eleven species of owl occur on Java of which six also occur on Bali (Eaton et al., 2016), but the bird trade on these islands involves many species from other parts of Indonesia and even from other countries (e.g. Nash, 1993; Chng et al., 2015). Scops owls (four species on Java, one Bali, 16 throughout Indonesia, with several species having rufous and brown morphs) are difficult to identify to the species when seen briefly under suboptimal conditions (caged, dark, feathers damaged, multiple individuals in one cage) and a large number of owls were traded as chicks or juveniles, again making identification to the species level problematic. We identified two large wood owls as Bornean wood owl *Strix leptogrammica*, a species that occurs both on Borneo and Java, but one or both could have been a brown wood owl *Strix indranee* from Sumatra. We took photographs opportunistically and we obtained asking prices when possible (quoted in Indonesian rupiah, here converted to US dollars and rounded up to the nearest dollar). We did not purchase any owls. For taxonomy we follow Eaton et al. (2016), apart from the barn owl, which, following Aliabadian et al. (2016), we recognize as the Australasian barn owl *Tyto javanica* (including taxa *delicatula*, *sumbaensis*, *stertens* and *javanica*).

Table 1
Owls traded in wildlife markets in Java and Bali, April 2012–November 2016. N = number of surveys conducted. N.I. = owls other than scops owls not identified to species level. T = *Tyto*, P. = *Phodilus*, B. = *Bubo*, O. = *Otus*, N = *Ninox*, S. = *Strix*, G. = *Glaucidium*.

Market	N	*T. javanica*	*P. badius*	*B. ketupu*	*O. lempij*	*Otus* sp	*Other*	Sum
DKI Jakarta								
Barito	13	14	9	1	13	178	1 *B. sumatranus*, 1 *N. scutulata*, 28 N.I.	245
Jatinegara	17	110	54	7	142	364	6 *S. seloputo*, 1 *N. scutulata*, 48 N.I.	732
Pramuka	5	10	3	1	19	89		124
West Java								
Sukabumi, Pasundan	3					4		4
Bogor, Tan Empang	3	2	1			8	1 *G. castanopterum*	12
Bandung, Sukahaji	17	17	3	3	54	115	1 *B. sumatranus*, 2 *B. leptogrammica*, 3 *S. seloputo*, 4 *N. scutulata*, 68 N.I.	270
Bandung, BIP	14	12	1	1	2	27	1 *G. castanopterum*, 12 N.I.	56
Garut, Mawar	9	2			1	6	7 N.I.	16
Garut, Kerkhof	6	3	4	2	11	10	2 *G. castanopterum*, 1 *B. sumatranus*	32
Tasikmalaya, Cikurubuk	2	1				3	1 N.I.	5
Ciamis, Ciamis	1							0
Kuningan, Cikuray	1							0
Cirebon, Plered	2		1			23		24
DI Yogyakarta								
Ngasem	2	5	2		22	18		47
East Java								
Surabaya, Kupang	2	4				78		82
Surabaya, Bratang	2	13	2	1		19		35
Bondowoso	1					3		3
Banyuwangi, Pujasera	1				2	1		3
Bali								
Mengwi, Bringkit	2					70		70
Denpasar, Satria	6	2	3	2	3	36	1 *G. castanopterum*, 3 N.I.	50
Sum	102	195	83	18	269	1052		1810

2.2. Assessment of past trade in owls

We searched for reports, both in English and in Indonesian, on quantities of owls in trade in Indonesia for the period 1979–2010. We tallied the total number of owls and number of species that were recorded; when the total number of birds observed in the markets was recorded, we calculated the contribution of owls in trade as a percentage of the total number of birds for sale. We combined these data with those collected by the first author in the bird markets in the periods 1994–1995 and 1999–2003. Owls were rarely traded during this period (see below) and were not of particular conservation concern, and data collection in 1994–1995 from the bird markets in Jakarta, Bogor, Purwokerto, Yogyakarta, Surabaya and Denpasar was qualitative only. In the second period the focus was on trade in diurnal raptors and primates in the Jakarta-Bogor-Sukabumi area (5 markets; 38 visits) and along Central Java's north coast (5 markets in Tegal, Pekalongan, Linggo, Semarang, 34 visits). Large owls were displayed alongside diurnal raptors and were duly recorded but smaller species such as scops owls and Javan owlet *Glaucidium castanopterum* were recorded in bins of five.

2.3. Analysis

For each market we calculated the encounter rate (mean number of owls recorded per survey) and species richness; we did the same for cities pooling data from multiple markets when these were present. As predictor values for the variation in these encounter rates and species richness we used market size (large, i.e. typically more than 50 stalls selling animals, medium, 20–49 stalls, and small, fewer than 20 stalls), survey effort (number of visits), and human population of the city in which the market was located. Four markets in two cities surveyed at least twice during each of the five study years allowed some check for annual differences of the owl trade. We used data from six markets, that were surveyed over $\geq$3 years and where we recorded at least 50 owls, to calculate the proportion of non-adults in trade.

Data were log-transformed prior to statistical analysis. We used Pearson's correlations coefficient to test for correlations between encounter rate, survey effort and city size, and mean encounter rate and species richness. We used one-way ANOVAs to test for differences in encounter rates between markets of different size and for difference in encounter rates in the four intensely surveyed markets. Finally, we used chi-square tests to test for species differences in the proportion of adults vs non-adults in trade. All tests were two-tailed and we accept significance when $P < 0.05$.

3. Results

3.1. Historic overview of trade in owls

Data from S. van Balen (in Diamond et al., 1987), who assessed the presence of birds in the bird markets of Bogor in the period 1979–1986, show that only collared scops owls *Otus lempiji* were offered for sale "rarely" (as opposed to "never", "occasionally", "commonly" or "abundantly"). In December 1987 Basuni and Setiyani (1989) estimated that no less than 150,000 birds belonging to 65 species were traded at Jakarta's Pramuka market – apparently not a single one of them was an owl. Nash (1993) conducted 39 surveys of 12 markets in 1991–1992 in Sumatra, Java and Bali (with a strong bias towards Jakarta, with 26 visits to Pramuka and Barito) but in his report he mentions owls once, in relation to the observation of a rarely observed species: "… in May 1992 a specimen of the Javan scops owl *Otus angelinae* … was observed for sale in Jakarta's Pramuka Bird Market, together with specimens of collared scops owl *O. lempiji* and other small owls. The seller was unaware his specimen of Javan scops owl represented one of the few sightings of the species in the last 50 years." No species of owl was amongst the species recorded in at least 10 of 12 markets surveyed, nor were they included in the list of species that were recorded in at least 20 of the 39 surveys conducted (Nash, 1993). Observations at six bird markets in Java and Bali in 1994–1995 support the notion that owls were not abundant in trade, and mostly scops owls and a small number of buffy fish owls, often traded as singles, were on offer (V. Nijman, unpubl. data). In 1996–1997 Anonymous (1997) surveyed eight markets in six towns in Java (Jakarta, Bogor, Semarang, Yogyakarta, Surakarta and Surabaya). In 7/17 visits no owls were present. In total 11 Australasian barn owls were recorded, seven Oriental bay owls *Phodilus badius*, eight buffy fish owls *Bubo ketupu*, three Borean wood-owl *S. leptogrammica*, one spotted wood owl *Strix seloputo*, and 36 scops owls. Shepherd et al. (2004) monitored three bird markets in Medan between 1997 and 2001 and during 168 visits they recorded 42 Australasian barn owls, 12 Oriental bay owls, 20 buffy fish owls, 12 barred eagle owls *Bubo sumatranus*, two brown boobooks *Ninox scutulata*, one brown wood-owl *S. indranee* and 25 scops owls. The highest numbers were observed in 1998, with a total of 48 owls of nine species were recorded and the lowest in 2001 when only three barn owls were recorded; the overall average was less than one owl per survey. These numbers agree very much with data from western Java in 1998–2003 where typically one to five owls per market, primarily scops owls and buffy fish owls, and once a Javan owlet, but no Australasian barn owls or Oriental bay owls (V. Nijman, unpubl. data). Haryoko (2010) surveyed three markets in Bandung, Garut and Tasikmalaya and recorded 9 scops owls in Bandung. ProFauna (2009) surveyed 70 bird markets in Java, focussing on protected species and, in error, included barn owls (but no other owls) in this category. They recorded two Australasian barn owls, one in Malang (East Java) and one in Temanggung (Central Java). Finally, Shepherd (2012) reported on a survey of the three Jakarta markets in 2010 (all visited twice) and 2012 (all visited once). In 2010 he recorded 11 Austalasian barn owls, five buffy fish owls, one brown wood owl and 32 scops owls, or around eight owls per visit, and in 2012 he recorded eight Austalasian barn owls, five Oriental

bay owls, one buffy fish owl, one reddish scops owl *Otus rufescens*, one collared scops owl, and 115 unidentified scops owls, or around 44 owls per visit. Around two-thirds of the owls were on display in Jatinegara market (Shepherd, 2012).

3.2. Contemporary data and temporal patterns

Owls are now are widely traded in the bird markets of Java and Bali and we recorded one or more species of owl in 99 out of 109 surveys. Markets with no owls recorded during individual surveys are Ciamis and Kuningan (both surveyed once), Bandung Indah Plaza (two out of 14 surveys), Mawar, Garut (four out of nine surveys), Bringkit (one out of two surveys), and Sukabumi (one out of three surveys). When we recorded owls, between one and 102 owls per survey were present, and the number of owls recorded per survey followed a negative binominal distribution with ~60% of all owls recorded in ~20% of the surveys (Fig. 1). In total 1810 owls of at least ten species, or around 17 owls per survey, were recorded. The number of owls recorded differed between small markets (mean 6.0, n = 8) medium markets (mean 8.7, n = 6) and large markets (mean 27.5, n = 6) (Anova, $F_{2,17} = 10.74$, P = 0.001). The difference between small and medium markets was not significant (t-test, t = 1.758, P = 0.104) but between medium and large it was (t-test, t = 3.945, P = 0.003). Combined the mean encounter rates suggest that some 265 owls are on offer in these markets at any given time (Table 1). While there was a strong positive correlation between the total number of owls observed in a market and the number of surveys conducted (Pearson's R = 0.765, n = 20, P < 0.001), this relationship was no longer significant when the mean number of owls was considered (Pearson's R = 0.386, n = 20, P = 0.09). The size of the city in which the markets were based was positively correlated with the mean number of owls that were present during each survey (Pearson's R = 0.663, n = 15, P = 0.007) and with species richness (Pearson's R = 0.7397, n = 15, P = 0.002).

The most common owls we observed in the markets were scops owls, with 269 identified as collared scops owl and an additional 1052 scops owls that could not be identified to the species level. The next most common species were the Australasian barn owl and Oriental bay owl with 195 and 83 individuals, respectively. Buffy fish-owl, barred eagle-owl, spotted wood owl *S. seloputo* and brown wood-owl, Javan owlet and brown hawk-owls were all recorded in smaller numbers. An additional 169 owls that were not scops owls could not be identified to the species level, mostly because they were observed under suboptimal conditions or because they were too young to identify. The maximum number of species found in the markets was nine (in Sukahaji, Bandung). Markets with on average a higher number of owls for sale also had a wider range of species on offer, but the relationship was not significant (Pearson's R = 0.3385, n = 18, P = 0.169).

Four markets, Barito and Jatinegara in Jakarta, Sukahaji and Bandung Indah Plaza in Bandung, surveyed over five years show the temporal variation in the numbers of owls offered for sale (Fig. 2). In all markets and for all years does the number of scops owls exceeds that of the other owls combined (binomial test, N = 20, P = 0.0004). The number of scops owls on offer differs between the four markets (Anova $F_{3,16} = 21.78$, P < 0.0001) and non-scops owls ($F_{3,16} = 21.78$, P < 0.0001). There is no support for either an increase or a decrease in the number of owls for sale in these four markets over the period 2012 to 2016. The species richness differs little between Barito, Jatinegara and Sukahaji, but typically only scops owls and barn owls are on offer in Bandung Indah Plaza.

The median price of the eight species for which we obtained price data is around US$28–38; scops owls can be bought for as little is US$6, especially when it is a very young individual, whereas the larger owls go for US$50 to US$100 or more (Table 2). The size of an owl correlated positively with the asking price (Pearson's R = 0.743, N = 8, P = 0.035). The total value of the owls we observed in the markets was US$14,500-20,100, with 46–51% of this comprises scops owls and 20–26% of this Oriental bay owls. Price data from 1996 (Table 2) suggest that when inflation is taken into account (i.e. US$1.00 in 1996 was worth US$1.51 in 2015) both Oriental bay owl and scops owls, two of the species that are now commonly observed in the markets, have become cheaper. Spotted wood owl and buffy fish owl, species that are offered in intermediate numbers, demand similar (inflation-corrected) prices, whereas the rarely observed Javan owlets appear to have increased in price.

3.3. Temporal change and the relative contribution of owls in the bird trade

Comparing survey data from the 1987–2001 with those from 2008 to 2016 show that not only have the total number of owls in trade increased over time, but also as a proportion of the total bird trade have numbers gone up by at least seven-fold. Thus, Basuni and Setiyani (1989), Nash (1993) and Shepherd et al. (2004) recorded total numbers of birds in the markets (n = 362,706 birds), and owls never made up more than 0.06% of the total number of birds. Haryoko (2010), Chng et al. (2015, 2016), and Chng and Eaton (2015) also recorded total numbers (n = 47,205 birds), and in these studies owls represented between 0.43% and 1.44% of all birds on offer; the difference is statistically significant (t-test, t = 2.827, P = 0.03).

There are clear temporal differences in both the number of surveys that yielded no owls, intermediate numbers of owls (1–15 individuals) and ones that yielded large numbers of owls (>15 individuals) ($\chi^2 = 140.65$, df = 6, P < 0.0001) (Fig. 1). These differences are due to more surveys with no owls and less with large numbers in the studies by Shepherd et al. (2004) and Nijman in 1999–2003, and, conversely, less surveys with no owls and more surveys with large numbers in the 2012–2016 surveys.

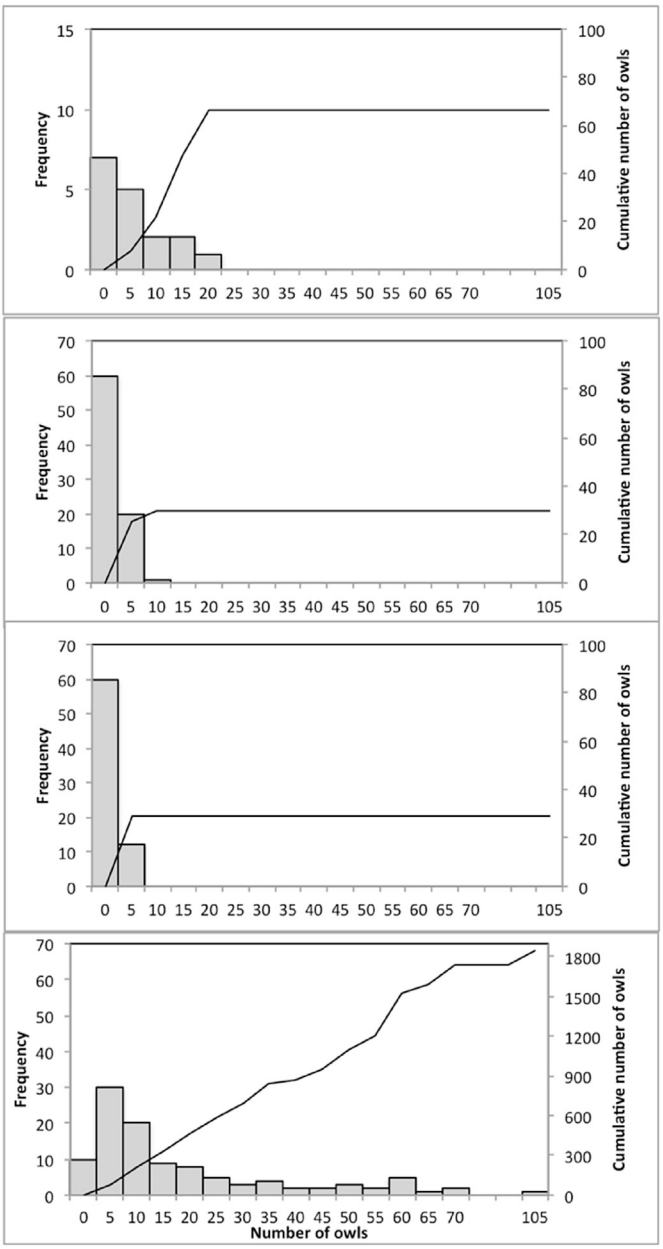

Fig. 1. Number of owls recorded per survey in bins of five, and the cumulative number indicated by the continuous line. Top panel: 17 surveys of eight bird markets in Java in 1996 and 1997 with between 0 and 19 owls recorded per survey (Anonymous, 1997); upper middle panel: 86 surveys of three bird markets in Medan, Sumatra in 1999–2001 with between 0 and 6 owls recorded per survey (from Shepherd et al., 2004); lower middle panel: 72 surveys of ten bird markets in western Java in 1999–2003 with between 0 and 5 owls recorded per survey (V. Nijman, unpubl. data); lower panel: 108 surveys of 20 bird markets in Java and Bali in 2012–2016 with between 0 and 102 owls recorded per survey (present study). Note the different scale on the right-hand y-axis for the lower panel.

3.4. Age and origin of owls in trade

The proportion of adults vs juveniles differed between species ($\chi^2 = 34.54$, df = 4, $P < 0.001$), with 80% of the barn owls being adults, 60% of the oriental bay owls, but only 45% of the scops owls (all that were identified as collared scops owls were adults) and 33% of the other owls combined. The unidentified non-scops owls comprised 46% non-adults. Barn owls have a significantly higher proportion of adults compared to the other species combined ($\chi^2 = 30.24$, df = 1, $P < 0.001$) and scops owls have a significantly smaller proportion of adults compared to the other species combined ($\chi^2 = 19.44$, df = 1, $P < 0.001$); for the other species it does not deviate significantly from what is expected.

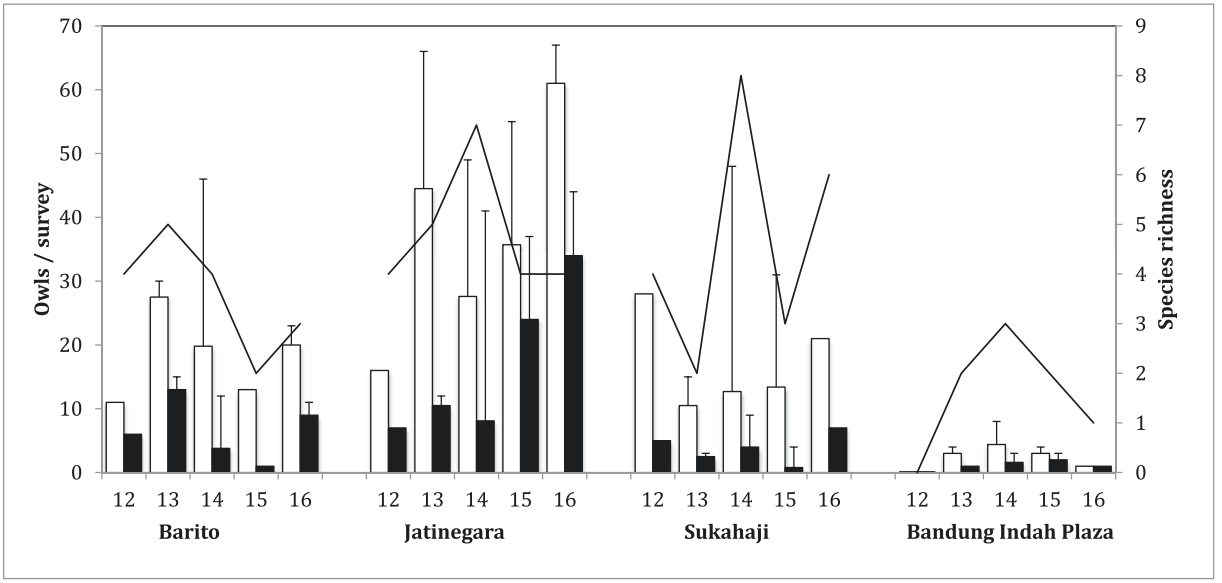

Fig. 2. Temporal variation in owls offered for sale at four wildlife markets in Java (Barito and Jatinegara in Jakarta, Sukahaji and Bandung Indah Plaza in Bandung) between 2012 and 2016. Open bars represent the mean number of scops owls (*Otus* spp) and the closed bar the mean number of other owls (*Tyto javanica*, *Phodilus badius*, *Ninox* spp, *Bubo* spp, *Strix* spp) offered for sale, with the bars representing the maximum number recorded at any one survey. The lines represent the species richness, i.e. the minimum number of species recorded in any given year. Based on 4 surveys in 2012, 8 in 2013, 24 in 2014, 12 in 2015 and 6 in 2016.

Table 2
Numbers and asking prices (in US$) of owls observed in trade in Java and Bali (2012–2016); in addition two Bornean wood owls *B. leptogrammica* were observed but no price data were collected. Online asking prices from Indonesian sites are also from 2015 and are taken from Iqbal (2016) and 1996 market prices are taken from Anonymous (1997).

Species	Total body length (cm)	Number	2015 Market price	2015 Online price	1996 Market price
Australasian barn owl *Tyto javanica*	34	195	23–30	9–32	–
Oriental bay owl *Phodilus badius*	25	83	15–27	7–25	32–86
Scops owls *Otus* spp	16	1321	6–8	3–36	6–19
Barred eagle owl *Bubo sumatranus*	43	3	91	43–129	–
Buffy fish owl *B. ketupu*	44	18	57–76	39–46	32–86
Spotted wood owl *Strix seloputo*	46	9	34–46	64–86	43
Javan owlet *Glaucidium castanopterum*	24	5	45	14–25	6
Brown boobook *Ninox scutulata*	30	6	37	–	–

Conversations with traders reveal that probably all owls on offer for sale originate from the wild; i.e. not once did a trader indicate that owls were bred in captivity. Indeed we did not observe a single owl with a closed legband (in contrast to for instance Bali starlings *Leucopsar rothschildi* that now mainly comprise captive-bred birds with legbands; Nijman et al., 2017). Initiatives have started in various parts of Java, e.g. in Demak and Kebumen, Central Java, to breed Australasian barn owls and/or to boost local populations by providing next boxes (Anonymous, 2017) but these seems to be exclusively targeted towards large-scale plantations or agriculture to reduce pests. We have no indication that these initiatives supply pet traders.

The bird markets in Java and Bali cater largely, if not almost exclusively, for the domestic pet trade, and throughout the five-year survey period we observed very few visitors to the bird markets that stood out as non-Indonesian. Traders attribute the popularity of owls to the emergence of pet owl interest groups (known as *Komunitas Pecinta Burung Hantu*) that have a strong social media presence and link up via social media such as Facebook, dedicated owl interest websites and WhatsApp.

4. Discussion

4.1. Volumes in trade

We here report on a sustained presence of owls in the bird markets of Java and Bali (Fig. 3), based on the largest survey of its kind. We surveyed 20 bird markets and found a strong positive correlation between the number of owls for sale and the size of the city in which the market was situated, and the size of the markets itself explained the variation in the number of owls on offer. We are aware of at least an additional 11 small bird markets, 23 medium-sized bird markets and 4 large bird markets, the latter being in Malang, Surakarta, Purwokerto and Temanggung, all on Java (Nijman et al., 2015). If the data from the 20 markets we included in our survey are representative for the owl trade throughout Java and Bali this suggests that at any one time around 650 owls are present in the bird markets, with about three-quarters of them scops owls. Nash (1993), using information from traders, indicated that turnover, i.e. how long each individual bird remains within the market before it is sold or before it dies, is less than two weeks. We have no firm data on the turnover of owls, but given the low price of scops owls, and information provided by vendors, turnover must be measured in days or weeks at most, and for the larger species it is probably measured in weeks or one or two months at most. A conservative two weeks turnover for scops owls and a two months turnover for larger owls, leads to estimates of 12,000 scops owls being sold in the bird markets each year in addition to 1000 larger owls.

Three additional studies are available on the owl trade in Java in recent years. Chng et al. (2015, 2016) and Chng and Eaton (2015) surveyed four markets in west Java (Jakarta, Bandung) and five markets in east Java (three in Surabaya, one in Malang and one in Yogyakarta) and found 457 individual of six species for sale. Collared scops owl was the most common owls species on offer (106 individuals in west Java and 262 in east Java), followed by barn owls (nine and 55), bay owls (eight and six), buffy fish owl (two and seven), Javan owlet (one in west Java) and lastly barred eagle owl (one in east Java). Their overall average of around 51 owls recorded per survey was considerable higher than the 17 recorded in the present study, but this is partially explained by their focus on the largest bird markets only. Chng et al. (2015, 2016) and Chng and Eaton (2015) recorded a total of six species in trade, lower that the nine reported by us is best explained by the larger number of surveys conducted by us (108 vs nine) thus increasing the likelihood of recording rare species.

4.2. Owl keeping in Indonesia

It is clear that the vast majority of owls we observed in the markets are directly derived from the wild, similar to conclusions reached by others (Chng et al., 2015; Chng and Eaton, 2015; Eaton et al., 2015; Harris et al., 2015; Shepherd, 2012). Over half of the owls for sale were not yet adult, with significant numbers apparently being young taken from their nests. Chicks were never displayed in the presence of adults, i.e. potential parents. Jepson and Ladle (2005) through household surveys explored the underlying socioeconomic factors of people keeping different species of birds as pets in Indonesia, and their findings correspond to how people keep owls as pets. From online forums, information is available on how to obtain owls, how to best care for them, and which species is best to be kept as a beginner. It is perceived that beginners should start with scops owls, as they are small, cheap, easy to keep, and can be fed on insects such as crickets. Javan owlet, Oriental bay owl, and brown hawk owl are the next level up – they are more expensive to purchase and require a more varied diet (insects and small birds). For the more experienced hobbyist, barn owls and buffy fish owls are recommended; these are more expensive to buy (Table 2), are larger than the previous species, and require an even more diverse diet. Only the most experienced keepers are recommended to keep spotted and barred eagle owls. These differences reflect themselves well in the prices these species command in the markets and online (Table 2). At the end of 2016 we identified at least 15 dedicated Facebook groups, with over 35,000 members, six websites, four blogs, one Instagram and two twitter accounts. Pet owl interest groups are present in Jakarta, Malang, Surakarta, Surabaya, Sitoardjo, amongst others, and members meet up in city centres, especially on car-free Sundays, displaying their pet owls and exchanging information. A gathering of *Komunitas Burung Hantu Indonesia* in Surabaya in March 2016 attracted 250 members (Anonymous, 2016a). Iqbal (2016) gave an overview of the online trade in birds of prey, including owls, showing that the most popular Facebook group offered almost 3000 raptors, a third of which were owls, for sale in the second half of 2015.

4.3. Is there a Harry Potter effect?

During our survey owls were often referred to as *Burung Harry Potter* (Harry Potter bird), and while discussing owls with vendors they often made reference to Harry Potter. But this in itself does not demonstrate a causal link between the Harry Potter novels and films and the rise of popularity of owls as pets in Indonesia, i.e. a Harry Potter effect. If there is such Harry Potter effect on the trade of owls in the wildlife markets in Java and Bali it is a delayed effect, similar to that reported for instance Dalmatians following the *101 Dalmatians* film (Herzog et al., 2004). When the first Harry Potter novels and films became available in Indonesia, i.e. in the early 2000s there was no immediate increase in the number of owls in the bird markets. Later surveys in 2008 and 2009 (ProFauna, 2009; Haryoko, 2010) likewise suggest that in terms of the number of owls and the number of owl species there was not yet a discernable Harry Potter effect, although the proportion of owls of all birds in trade in Haryoko's study (0.43%) already was higher than that reported previously. The first clear indication of an emerging trend of owls in trade was presented by Shepherd (2012) when he published his 2010 survey data from Jakarta. By

Fig. 3. Owls for sale in bird markets in Java. From top, clockwise. Scops owls, juvenile barred eagle owl, Javan owlet, juvenile scops owls, Oriental bay owl. Centre: scops owls.

this time the first Indonesian pet owl community Facebook pages had been set up, and websites offered advice on how to care for pet owls were available, quite possibly also in response to the Harry Potter films and novels. Furthermore, the availability

of the Internet to Indonesians dramatically changed. In 2001 only 2% of the Indonesian population had access to the Internet from home, and most people relied on Internet cafes for access. By 2010 11% had access to the Internet from home or from a mobile device and in 2016 this has risen to 20% (Anonymous, 2016b). The increase in the number of owls offered for sale since 2010 not only in Jakarta but throughout Java and Bali, coincided with an increase in the number and level of organisation of the pet owl communities, online and offline, and this, as much as the Harry Potter films and novels, might explain the popularity of owls as pets in Indonesia. A similar increase in popularity has been documented for civets in Indonesia (Nijman et al., 2014) without having been championed by a fictional character.

4.4. Regulation of trade and conservation implications

Trade in wild-caught animals in Indonesia is regulated through a quota setting system and wild-caught individuals of protected species cannot be traded commercially. The owls we observed in trade are not included on the country's protected species list nor are any of them listed as globally threatened (although some of the unidentified scops owls may have been Javan scops owls *O. angelinae*, listed as Vulnerable). Since 2002 no harvest quota has been allocated for birds, other than the capture of small quantities of a few select species for use as breeding stock for commercial breeding operations (Shepherd, 2006), thereby making trade of any wild birds in Indonesia illegal, regardless of whether the species is listed as protected or not. The majority of owls we observed in trade were wild-caught, as indeed admitted by vendors, and therefore should not have been traded.

Limited data are available on the total number of birds that are traded in the bird markets, but over the last thirty years some appear to have remained stable, some have increased in size and others have greatly diminished. Thus, Pramuka, for which Nash (1993) estimated that on any given day 20,500 birds were on offer and where Chng et al. (2015) counted 16,160 birds, has remained stable in the number of birds it offers. Jatinegara in the early 1990s was virtually non-existent as a bird market (V. Nijman, pers. observ.) is now a thriving market (Chng et al. (2015) counted 1399 birds). Finally, prior to 2001 Jalan Bintang and Petisah markets in Medan were selling large numbers of birds (Shepherd et al. (2004) counted on average 1144 birds during their surveys) but by 2007 these had greatly diminished in size (V. Nijman, pers. observ.; C.R. Shepherd, pers. comm.). It is therefore significant that we observed both an increase in absolute numbers of owls over time, as well as an increase in the proportion of the bird trade that comprises owls.

It is clear from our surveys and observations that the owl trade in the wildlife markets of Java and Bali is poorly regulated. Traders in many markets, especially smaller ones, seem to have a limited knowledge of the rules and regulations that govern trade in non-protected species. With Shepherd (2008) we agree that the authorities should ensure that the wildlife traders are aware of the ban of the sale of wild-caught birds and action should be taken against wildlife traders failing to abide by legislation pertaining to harvest, possession and trade, by arrests and prosecutions which entail sufficient penalties to deter future or repeat offences. The number of Australasian barn owls, Oriental bay owls and scops owls observed in the markets of Java and Bali, these species' omnipresence at many of these markets, and the poor conditions at which they are kept (suggesting high turnovers) raise concerns about the trade's potential impact on wild populations. While these three taxa occur in a wide range of habitats, including cash-crop plantations, and their large extent of potential suitable habitat throughout Indonesia may suggest these species are still abundant, but few recent quantitative data regarding population size are available. The rise in popularity of keeping owls as pets, and the associated rise of the number of pet owl interest groups, organising themselves on social media, suggests the types of people who now want owls as a pet – and have the means to acquire one – have increased and diversified. While what we observed in the bird markets is probably just the proverbial tip of the iceberg, it is clear that in recent years the impact of trade in owls for various reasons has increased dramatically. The current ban on wild-caught birds is failing to limit the commercial trade in owls, and this necessitates a rethink of how best to regulate trade as part of an overall management strategy of owls in Indonesia. As part of this process we suggest that owls are included on the list of protected species (Noerdjito and Maryanti, 2001), and that this information is effectively conveyed to the traders in the markets and to the general public.

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