

A preliminary assessment of the scope and scale of illegal killing and taking of wild birds in the Arabian peninsula, Iran and Iraq

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Summary: High levels of illegal killing and taking of wild birds were recently reported for eastern Mediterranean countries, and anecdotal information from other countries of the Middle East suggests this may be a significant conservation issue for the whole region. We quantified the approximate scale and scope of this threat in the Arabian peninsula, Iran and Iraq, using a diverse range of data sources and incorporating expert knowledge. We estimate that at least 1.7–4.6 million (best estimate: 3.2 million) birds of at least 413 species may be killed or taken illegally each year in this region, many of them on migration. This is likely to be an underestimate as data were unavailable for parts of the region. The highest estimated country total, of 1.7 million birds, was for Saudi Arabia despite data being available only for the northern part of the country. Several species of global conservation concern were illegally killed or taken, including Marbled Teal *Marmaronetta angustirostris*, Common Pochard *Aythya ferina* and European Turtle-dove *Streptopelia turtur* (all classified by BirdLife International as Vulnerable on the global IUCN Red List). Of greater concern, Sociable Lapwing *Vanellus gregarius* (Critically Endangered) was also reported to be known or likely to be killed illegally each year in high numbers relative to its small population size. Birds were reported to be illegally killed or taken primarily for sport but also for food, mainly as a delicacy. Our study also highlighted the paucity of data on illegal killing and taking of birds, and more generally on bird population sizes in the region; thus the implementation of systematic monitoring of the numbers of birds illegally killed or taken there is a priority. A number of countries in the region need to improve the clarity of their legislation, and in most countries a much stronger focus on effective detection, enforcement and prosecution is a priority to tackle the illegal killing and taking of birds.

INTRODUCTION

The illegal killing and taking of birds occurs worldwide, *eg* poisoning of vultures in Sub-Saharan Africa (Ogada 2014), shooting of raptors in Europe (Selås *et al* 2017) and North America (Finkelstein *et al* 2014), trapping of songbirds in Asia (Kamp *et al* 2015) and capture for the bird trade in South America (Alves *et al* 2013). Illegal killing and taking poses a global threat to biodiversity and has attracted international attention. For example, in 2014 the Convention on the Conservation of Migratory Species of Wild Animals (CMS) adopted a Resolution on the prevention of illegal killing, taking and trade of migratory birds (UNEP/CMS 2014).

In the Middle East, high levels of illegal killing and taking of birds were recently reported within Mediterranean countries, such as Egypt, Syria and Lebanon, as well as in nearby Cyprus. It was estimated that 11–36 million birds/year may be killed or taken illegally in the whole Mediterranean region, including 6–22 million in the Mediterranean Middle Eastern countries (*ie* Egypt, Israel, Jordan, Lebanon, Palestinian Authority

Territories, Syria, Turkey) and Cyprus (Brochet *et al* 2016). Illegal killing and taking of birds has also been reported in other Middle Eastern countries. For example, Finch *et al* (2017) highlighted the prevalence of illegal shooting in Saudi Arabia as a cause of mortality for European Roller *Coracias garrulus*. Muzaffar *et al* (2017) identified illegal egg collection and illegal hunting as threats to the Socotra Cormorant *Phalacrocorax nigrogularis* (Vulnerable) in its remaining breeding areas in the Arabian peninsula. Mansoori (2009) documented illegal hunting and illegal net-trapping as threats to birds in five Iranian wetlands. Soorae *et al* (2008) reported the illegal bird trade in United Arab Emirates (UAE). Global action plans for globally threatened species, such as White-headed Duck *Oxyura leucocephala* (Endangered; Sheldon *et al* 2018), Ferruginous Duck *Aythya nyroca* (Near Threatened; Robinson & Hughes 2006) and Sociable Lapwing *Vanellus gregarius* (Critically Endangered; Sheldon *et al* 2012) all highlight illegal killing as an important threat. However, the current lack of quantitative data on illegal killing and taking of birds across the Middle East hampers the ability of governments and other stakeholders to set priorities and take effective action to tackle this threat.

In order to understand the issue in the whole African–Eurasian flyway and to provide information for priority setting across the region and within species conservation efforts, we aim here to extend the work of Brochet *et al* (2016, 2019) in the Mediterranean, northern and central Europe and the Caucasus into the Arabian peninsula, Iran and Iraq. We estimate how many individuals of each species may be killed or taken illegally each year, identify the species that may be most affected, assess the most important types of illegal activities and reasons for killing or taking birds, and identify the countries in which this threat is most significant.

METHODS

Study area and study species

For this study, nine Middle East countries were assessed (Table 1, Figure 1). We included all native species regularly occurring (*ie* excluding vagrants) in any season in at least one of the assessed countries.

Data collection

Following Brochet *et al* (2016), the illegal killing and taking of birds (hereafter ‘illegal killing’) was defined as any form of deliberate action that results in the death or removal



Figure 1. Study area with the nine assessed countries. ISO code used for Bahrain (BH), Kuwait (KW), Qatar (QA) and United Arab Emirates (AE).

Table 1. Estimated numbers of birds illegally killed/taken per year in each assessed country in the Arabian peninsula, Iran and Iraq. Values in bold indicate the three countries with the highest numbers in each column (see text).

Country	No. of species regularly occurring (BirdLife International 2017a)	% of species known or likely to be illegally killed/taken (values in parentheses include additional species killed/taken in insignificant numbers)	Mean estimated no. of birds illegally killed/taken per year (min-max)	Mean estimated no. of birds illegally killed/taken per km ² (min-max)	Mean estimated no. of birds illegally killed/taken per year per 100 capita of human population (min-max)
Bahrain	224	4% (14%)	2700 (1900–3400)	3.5 (2.5–4.5)	0.2 (0.1–0.3)
Iran*	473	27% (41%)	801 000 (598 000–1 000 000)	0.8 (0.6–1.0)	1.8 (1.4–2.3)
Iraq	367	24% (80%)	329 000 (135 000–524 000)	0.8 (0.3–1.2)	0.9 (0.4–1.4)
Kuwait	295	25% (48%)	23 600 (13 200–34 000)	1.3 (0.7–1.9)	0.8 (0.5–1.2)
Oman	324	7% (10%)	7800 (1100–14 400)	0.03 (0.004–0.05)	0.2 (0.03–0.4)
Qatar	232	37% (61%)	13 500 (600–26 400)	1.2 (0.1–2.3)	0.6 (0.03–1.2)
Saudi Arabia*	389	Unknown	1 700 000 (708 000–2 700 000)	2.5 (1.1–4.0)	33.1 (13.8–52.3)
United Arab Emirates	296	No consensus	273 000 (207 000–339 000)	0.5 (0.4–0.6)	1.0 (0.8–1.3)
Yemen	342	32% (40%)	3 200 000 (1 700 000–4 600 000)	1.0 (0.5–1.5)	2.5 (1.3–3.6)
Total	607	Unknown			

* Partial coverage

from the wild of a bird (regardless of whether or not it was the target of this action) that is prohibited under national legislation. There is a complete ban on the hunting of all wild bird species in Bahrain, Kuwait, Oman, Saudi Arabia and Yemen. We thus considered all killing of birds in these countries to be illegal.

Legislation in Iran includes detailed hunting and trapping regulations, which were used to define activities that are illegal there. In Iraq, Qatar and UAE, there are hunting/trapping regulations but neither huntable species nor hunting seasons are specified in the legislation and special hunting permits are allowed case by case (BirdLife International & OSME 2019). Given this legislative uncertainty, our assessment of illegal killing of birds may include some legal hunting in some countries, but according to the national experts consulted, legal hunting is likely to be insignificant compared to illegal killing, except in Iran where hunting is well regulated.

Between July 2016 and August 2017, national experts and organisations (within the BirdLife partnership and the Ornithological Society of the Middle East, Caucasus and Central Asia (OSME) membership), from both non-governmental and governmental bodies, were asked to provide quantitative information on the illegal killing of birds in their country. Based on their own data, experience and knowledge, and any available and relevant information (data from publications, grey literature, relevant databases, police reports *etc*), they filled in a standard template. National experts also consulted other individuals and organisations who may have had relevant information (*eg* government departments, hunting associations, local conservation groups *etc*). In

Saudi Arabia and UAE, national authorities opted to hold national workshops on the issue in order to contribute to the regional assessment.

Each species was classified according to whether or not it was known or likely to be illegally killed, with response options being: “Yes (or likely)”, “Yes but numbers killed are likely to be insignificant”, or “No (or unlikely)”. We defined ‘insignificant’ to be when the maximum estimated number of birds illegally killed was ≤ 100 /year for a passerine species or ≤ 50 /year for a non-passerine species that is listed as ‘Least Concern’ on the global IUCN Red List. For species listed as ‘Critically Endangered’, ‘Endangered’, ‘Vulnerable’ or ‘Near Threatened’ on the global IUCN Red List, any number of illegally killed birds was regarded as significant. Red List categories refer to those on the 2017 IUCN Red List (BirdLife International 2017a).

For each species known or likely to be significantly affected by illegal killing, national experts provided a minimum and maximum estimate of the total number of birds killed illegally each year in their country, and an explanation of how the estimate was derived. Estimates with credible wide range limits were permitted, to reflect the level of uncertainty (eg 100–10 000 birds) associated with some estimates. National experts also provided the potential primary and secondary reason(s) for illegal killing (multiple reasons were permitted). The response options, based on Brochet *et al* (2016), were: (i) ‘predator/pest control’: this included the killing of birds of prey by gamekeepers, fish-eating birds by fish-farmers, corvids causing a nuisance *etc*; (ii) ‘sport’; (iii) ‘food’: asking for responses to specify ‘for subsistence’ (*ie* where the kill is a source of affordable protein), ‘for culinary delicacy’ (*ie* where the kill is not a source of subsistence protein, but is prized for its taste, is considered to have health-giving properties or is food of traditional/cultural importance) or ‘for commercial sale’ (eg liming or trapping of songbirds to sell them to restaurants or onto markets or to trade for other supplies); (iv) ‘taxidermy/egg collection’; (v) ‘cage bird’: capture for pets and associated trades (eg finches for use as cagebirds, birds of prey for falconry, birds for use as live decoys, owls and raptors for pets *etc*); and (vi) ‘other’ (with details requested). National experts also provided the potential primary and secondary types of illegal killing activities affecting the species (multiple types were permitted). The response options, based on Brochet *et al* (2016), were: (i) ‘protected species’: killing of protected species (including for any of the reasons given above); (ii) ‘within a protected area’: killing in national parks, nature reserves or game reserves *etc*, where such activities are forbidden; (iii) ‘outside legal open season’: killing of game species for which open and closed seasons are set in legislation; (iv) ‘illegal method’: with the options of ‘poisoning’ (targeted directly at birds), ‘trapping’ (traps, nets, snares, lime-sticks *etc*) and ‘shooting’ (illegal means such as silencers, and automatic or semi-automatic guns); (v) ‘other’ (with details requested).

For each species likely to be illegally killed in insignificant numbers, we asked for either an estimate of the total numbers killed across all such species, or for estimates for each species. Finally, national experts provided information on up to ten locations that were considered the worst for illegal killing in each country, *ie* minimum and maximum estimates of the percentage of all birds killed illegally each year in the country that are killed at each location.

All the datasets were then made available online for peer-review by external experts from government agencies, hunting associations, conservation/ornithological organisations and international policy instruments. These latter included the CMS, the African-Eurasian Migratory Waterbird Agreement (AEWA), the Memorandum of Understanding on the Conservation of Migratory Birds of Prey in Africa and Eurasia (Raptors MOU) and the African-Eurasian Migratory Land birds Action Plan (AEMLAP). Feedback, corrections, additional information or comments were requested. Our aim was

to ensure that the data were as accurate as possible and included all relevant information. Any feedback was then used by the national experts to revise the data: these revised datasets were used in our analysis.

A national governmental consultation exercise undertaken in the UAE in 2018 reported that UAE had no illegal killing of birds as a result of strong law enforcement and an increased level of awareness among the society on the importance of birds and their conservation. Although there was agreement among wider stakeholders that the scale of the issue in UAE was among the lowest in the region, consensus could not be reached between all stakeholders on quantitative estimates of illegal bird killing in the UAE, and as a consequence estimates from UAE are not included in the results.

Data analysis

For species known or likely to be illegally killed in insignificant numbers, we used species-specific estimates when provided, or where a single estimate was provided for the whole group of species we divided this by the number of such species.

National experts compiled data on illegal killing of birds at species level for all countries except for Saudi Arabia (data collected at the family level for some families; Saudi Wildlife Authority & BirdLife International 2018). Analyses were therefore carried out at the family level, except for species of greater concern (threatened and Near Threatened), for which data for Saudi Arabia were excluded. Data were compiled at national level for all the countries except Saudi Arabia and Iran. For Saudi Arabia, data were obtained for six (of 13) northern regions (31% of the country's area). For Iran, data were obtained for 21 (of 31) provinces (56% of the country's area). For both Iran and Saudi Arabia, we took these data as the minimum estimate for the entire country (details available in BirdLife International & OSME 2019 for Iran and in SWA & BirdLife International 2018 for Saudi Arabia). In the results, estimated numbers of birds illegally killed are rounded to avoid spurious precision.

Following Brochet *et al* (2016), we calculated additional variables for inclusion in the analyses from the raw data. We represented the importance of each potential reason for illegal killing as an 'index of importance'. We divided the mean estimated number of birds illegally killed in each family in each country and for each reason by the mean total estimated number of birds killed in the country. We multiplied this ratio by 0.5 if the reason was scored as secondary. We then defined the sum of these values for each reason across all families in the country as the 'index of importance' for the reason in the country. A similar approach was used to calculate an analogous 'index of importance' for each potential type of illegality in each country. We also expressed the total estimated number of birds illegally killed in each country as a total per km² and as a total per 100 capita of human population. Surface areas and populations were taken from the World Factbook (2016). For Iran and Saudi Arabia, we only considered surface areas and populations of the assessed provinces/regions.

Among the 68 globally threatened and Near Threatened species occurring regularly in any season in at least one assessed country (Saudi Arabia excluded as estimates made were not species-specific, see above), all have a global population estimate, except Arabian Bustard *Ardeotis arabs* and Pallid Harrier *Circus macrourus* (BirdLife International 2017a). For these species, we calculated the ratio between the mean estimated number of birds illegally killed in the region and the mean estimated global population, to indicate the relative potential impact of illegal killing on different species of conservation concern. We also calculated the best-case scenario (*ie* the ratio between the minimum estimated number of birds illegally killed and the maximum estimated global population) and the worst-case scenario (*ie* the ratio between the maximum estimated number of birds

illegally killed and the minimum estimated global population), reported as minimum and maximum when presented in the Tables and Appendices. Owing to broad limits in both parameters according to their uncertainty, the ranking of species is more informative than the absolute values; for the same reason, we reported the ratio rather than the percentage.

RESULTS

In our overall assessment, and considering the comments of external reviewers, we believe it is helpful to give our ‘confidence rating’ on the data quality, which is ‘good’ for Bahrain, Kuwait, Oman and Qatar; ‘moderate’ for Iraq, Iran and Saudi Arabia (but only partial coverage for the latter two) and ‘poor’ for Yemen.

Number of birds estimated to be illegally killed in the Arabian peninsula, Iran and Iraq

In this partial assessment for the region, 1.7–4.6 million birds were estimated to be illegally killed annually in the Arabian peninsula, Iraq and Iran; the highest estimated numbers were for the assessed northern part of Saudi Arabia (708 000–2 700 000), followed by the assessed provinces of Iran (598 000–1 000 000) and Iraq (135 000–524 000; Table 1, Figure 2). Expressed as birds/year/km² in each country, the estimated highest rates were for Bahrain (2.5–4.5), Saudi Arabia (1.1–4.0) and Kuwait (0.7–1.9; Table 1 and Figure 2). Expressed as birds/year/100 people in each country, the potential highest rates were for Saudi Arabia (13.8–52.3), Iran (1.4–2.3) and Yemen (0.8–1.3; Table 1 and Figure 2).

Among the 79 bird families assessed, 64 (81%) contained species known or likely to be killed illegally in the region each year. In absolute numbers, passerines followed by waterbirds/seabirds appear to be illegally killed in higher numbers compared with gamebirds and raptors (Table 2), but the proportion of each group varied between countries (Figure 3). The highest estimated numbers were for warblers (693 000–2 600 000), ducks, geese and swans (381 000–641 000), rails, gallinules and coots (170 000–312 000) and pheasant, partridges and grouse (125 000–332 000). For all other families, mean estimated numbers/year were reported to be < 100 000.

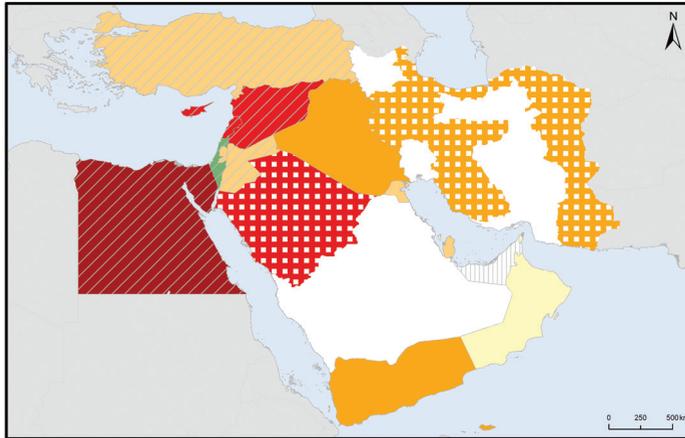
Species of conservation concern

Among the 68 globally threatened and Near Threatened bird species assessed in the Arabian peninsula, Iran and Iraq (Saudi Arabia was excluded as estimates made were not species-specific, see Methods), 45 (66%) were known or likely to be killed illegally each year. In absolute numbers, Marbled Teal *Marmaronetta angustirostris* (Vulnerable) was highest (5000–15 000 individuals estimated to be illegally killed per year). Of greater concern, Sociable Lapwing (Critically Endangered) had a high estimated number (0–300 birds). This species was also known or likely to be killed illegally each year in Saudi Arabia (5–25 birds).

Table 2. Estimated numbers of birds illegally killed/taken per year in the Arabian peninsula, Iran and Iraq for selected species groups.

Group	Estimated no. of birds illegally killed/taken per year (min–max)
Passerines	879 000–3 100 000
Waterbirds/Seabirds	607 000–1 100 000
Gamebirds	168 000–421 000
Raptors	3300–11 700
Other	6 800–30 100

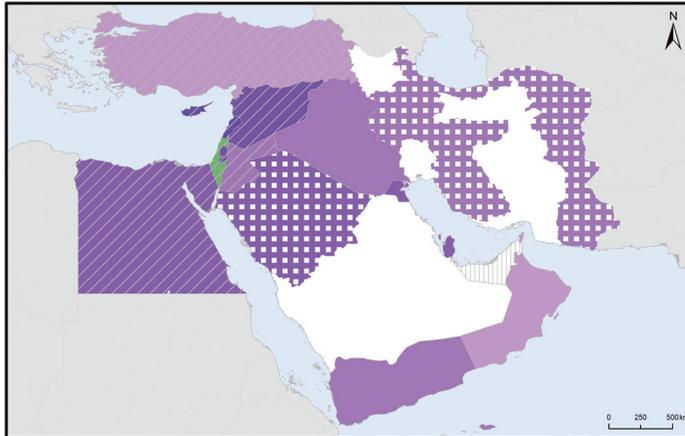
a) Mean estimated number



Mean estimated number of birds killed/taken illegally per country per year

≤ 10,000	100,001 - 1,000,000	> 5,000,000	Birds killed/taken in trivial numbers
10,001 - 100,000	1,000,001 - 5,000,000	Unknown	No consensus on estimates

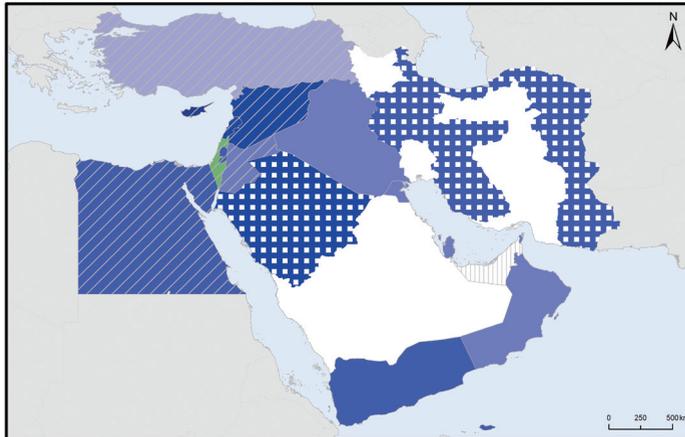
b) Mean estimated number/km²



Mean estimated number of birds killed/taken illegally per country per year per km²

≤ 0.1	1 - 10	> 100	Birds killed/taken in trivial numbers
0.11 - 1	11 - 100	Unknown	No consensus on estimates

c) Mean estimated number/100 people



Mean estimated number of birds killed/taken illegally per country per year per 100 people

≤ 0.1	1.1 - 10	> 100	Birds killed/taken in trivial numbers
0.11 - 1	11 - 100	Unknown	No consensus on estimates

Figure 2. Spatial pattern of illegal killing/taking of birds in Middle East region and Cyprus in terms of the mean estimated number of birds illegally killed/taken per year per country a) in absolute values, b) per km² and c) per 100 people. The chequered pattern for Iran and Saudi Arabia indicates that the assessment was incomplete at the national level (see text), and figures per km² and per 100 people were adjusted for the area covered within these two countries. Diagonal hatching indicates countries covered by Brochet *et al* (2016): Cyprus, Egypt, Israel, Jordan, Lebanon, Palestinian Authority Territories, Syria and Turkey.

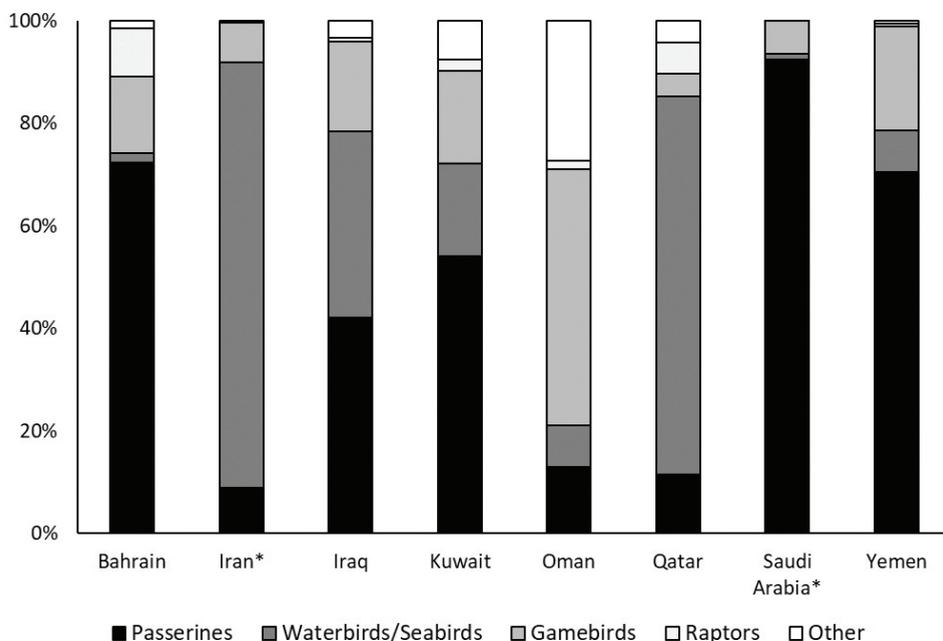


Figure 3. Proportion of the total mean estimated number of birds killed/taken for each assessed country made up of different species groups (* the assessments for Iran and Saudi Arabia were incomplete at the national level; see text).

In terms of the impact on global populations, Marbled Teal may have potentially > 15% of its global population illegally killed in the region each year (ratios of the best- and worst-case scenarios (see Methods): 0.08–0.27; Table 3). Eight threatened and Near Threatened species may have > 1% of their global population illegally killed in the region each year, including Greater Spotted Eagle *Clanga clanga* (Vulnerable) and Asian Houbara *Chlamydotis macqueenii* (Vulnerable; Table 3). We excluded Yemen Warbler *Curruca buryi* (Vulnerable; 0.03–0.29), Yemen Thrush *Turdus menachensis* (Vulnerable; 0.02–0.14) and Socotra Buzzard *Buteo socotraensis* (Vulnerable; 0.01–0.05) from Table 3, as there are uncertainties about population sizes of these non-migrant species restricted to Yemen and Saudi Arabia (see Discussion).

Reasons for killing and types of illegality

Birds estimated to be illegally killed in the region were targeted mainly for sport, with food (delicacy consumption) as the second-most frequent motivation (highest index of importance; Figure 4). Half of all bird families (53%) were reported to be killed for multiple reasons. Among the types of illegalities, illegal shooting and illegal trapping were most frequent (Figure 5). Half of bird families (53%) were killed through multiple types of illegality.

Worst locations reported for illegal killing of birds

Four countries (Bahrain, Oman, Qatar and Saudi Arabia) did not identify any worst locations for illegal killing because of a lack of information/knowledge. Among the 9 potential worst locations across the region (Figure 6), > 100 000 birds were estimated to be illegally killed on average each year at two of them: the Caspian sea coast in Iran (especially in wetland areas) and the mountainous Kurdistan region (Iraq), together

Table 3. The ten globally threatened and Near Threatened bird species with the highest ratio between the estimated number killed/taken illegally per year in the Arabian Peninsula, Iran and Iraq (except Saudi Arabia owing to absence of species-specific estimates, see text) and their global population size. 2016 IUCN Red List category: NT = Near Threatened, VU = Vulnerable, EN = Endangered, CR = Critically Endangered.

Species (IUCN Red List category)	Ratio of estimated no. of birds illegally killed/taken to the global population (min–max)	Country with the largest estimated no. of birds illegally killed/year
Marbled Teal <i>Marmaronetta angustirostris</i> (VU)	0.17 (0.08–0.27) ¹	Iraq
Greater Spotted Eagle <i>Clanga clanga</i> (VU)	0.02 (0.01–0.08)	Qatar
Jouanin's Petrel <i>Bulweria fallax</i> (NT)	0.02 (0.01–0.08) ²	Yemen
Asian Houbara <i>Chlamydotis macqueenii</i> (VU)	0.02 (0.01–0.05) ³	Iraq
Ferruginous Duck <i>Aythya nyroca</i> (NT)	0.01 (0.004–0.03) ⁴	Iraq
Armenian Gull <i>Larus armenicus</i> (NT)	0.01 (0.01–0.02) ⁵	Iran
Dalmatian Pelican <i>Pelecanus crispus</i> (VU)	0.01 (0.01–0.02) ⁶	Iran
Eastern Imperial Eagle <i>Aquila heliaca</i> (VU)	0.01 (0.001–0.05)	Qatar
Sociable Lapwing <i>Vanellus gregarius</i> (CR)	0.008 (0.001–0.02) ⁷	Iraq
White-headed Duck <i>Oxyura leucocephala</i> (EN)	0.008 (0.004–0.01) ⁸	Iran

Notes:

- ¹ This result is largely driven by an estimate of 5000–15 000 birds illegally killed/taken per year in Iraq (100% of the total mean estimate)
- ² This result is largely driven by an estimate of 100–200 birds illegally killed/taken per year in Yemen (100% of the total mean estimate)
- ³ This result is largely driven by an estimate of 800–2000 birds illegally killed/taken per year in Iraq (77% of the total mean estimate)
- ⁴ This result is largely driven by an estimate of 1000–5000 birds illegally killed/taken per year in Iraq (89% of the total mean estimate)
- ⁵ This result is largely driven by an estimate of 1000–2000 birds illegally killed/taken per year in Iran (100% of the total mean estimate)
- ⁶ This result is largely driven by an estimate of 80–170 birds illegally killed/taken per year in Iran (100% of the total mean estimate)
- ⁷ This result is largely driven by an estimate of 10–250 birds illegally killed/taken per year in Iraq (96% of the total mean estimate)
- ⁸ This result is largely driven by an estimate of 50–100 birds illegally killed/taken per year in Iran (100% of the total mean estimate)

accounting for 29% of the mean annual estimated number of birds illegally killed across the region and for all species combined (Appendix 2).

DISCUSSION

This is the first analysis to provide quantitative estimates of the scope and scale of the illegal killing of birds in the Arabian peninsula, Iran and Iraq. The area encompassed by this study is large and in most countries there are few ornithologists, either resident or visiting. There is also little or no systematic monitoring of illegal killing in the region, so estimates were based on expert opinion informed by qualitative information (casual observations in the field, official and unofficial reports, media, information from hunters *etc*), resulting in considerable uncertainty over some estimates. For these reasons the quality of the data must, for some countries, be treated with caution. In addition, global population size estimates for each species, used to indicate the relative impact of illegal killing on species of conservation concern, also had a broad range in many cases, reflecting further uncertainty. The ranking of species presented here is therefore more informative

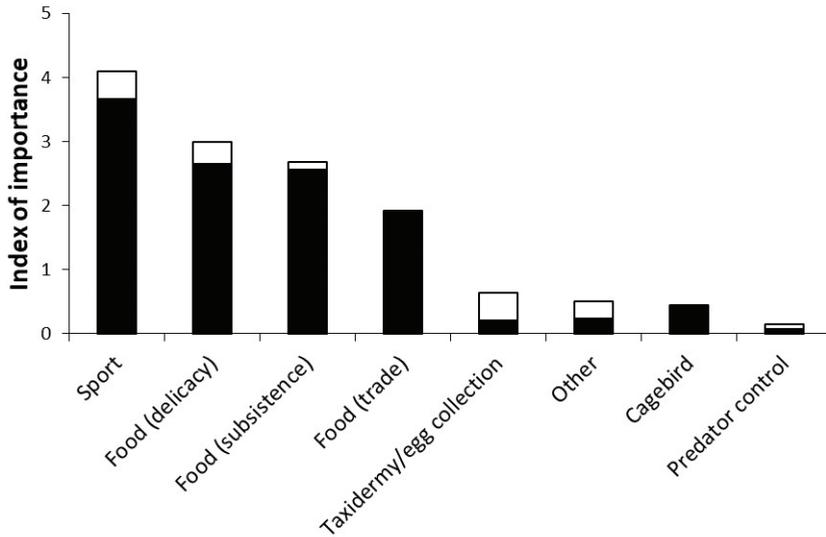


Figure 4. Index of importance of the potential reasons for illegally killing/taking birds in the Arabian peninsula, Iran and Iraq. Solid bars indicate the primary reasons, open bars indicate secondary reasons (see Methods for further details).

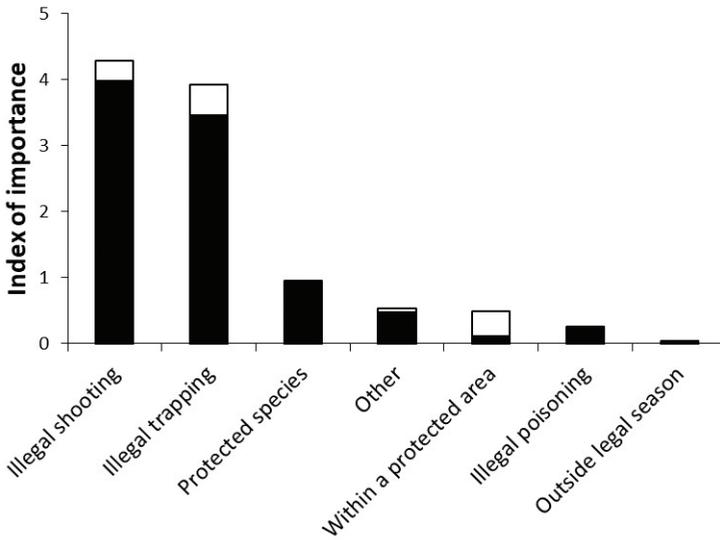


Figure 5. Index of importance of the potential types of illegality in the Arabian peninsula, Iran and Iraq. Solid bars indicate the primary types, open bars indicate secondary types (see Methods for further details).

than the absolute values. The figures presented in this paper should be considered as current best estimates, which should be refined through future work.

Scale and scope of illegal killing in the Arabian peninsula, Iran and Iraq

Illegal killing is widespread across the region and affects all countries assessed, with 1.7–4.6 million birds killed each year. Of greater concern are the ten threatened and Near Threatened species with the highest estimated numbers killed per year relative to their global population size, *eg* Marbled Teal and Greater Spotted Eagle (Table 3); for Saudi Arabia this also includes Asian Houbara (1000) and Sociable Lapwing (Critically

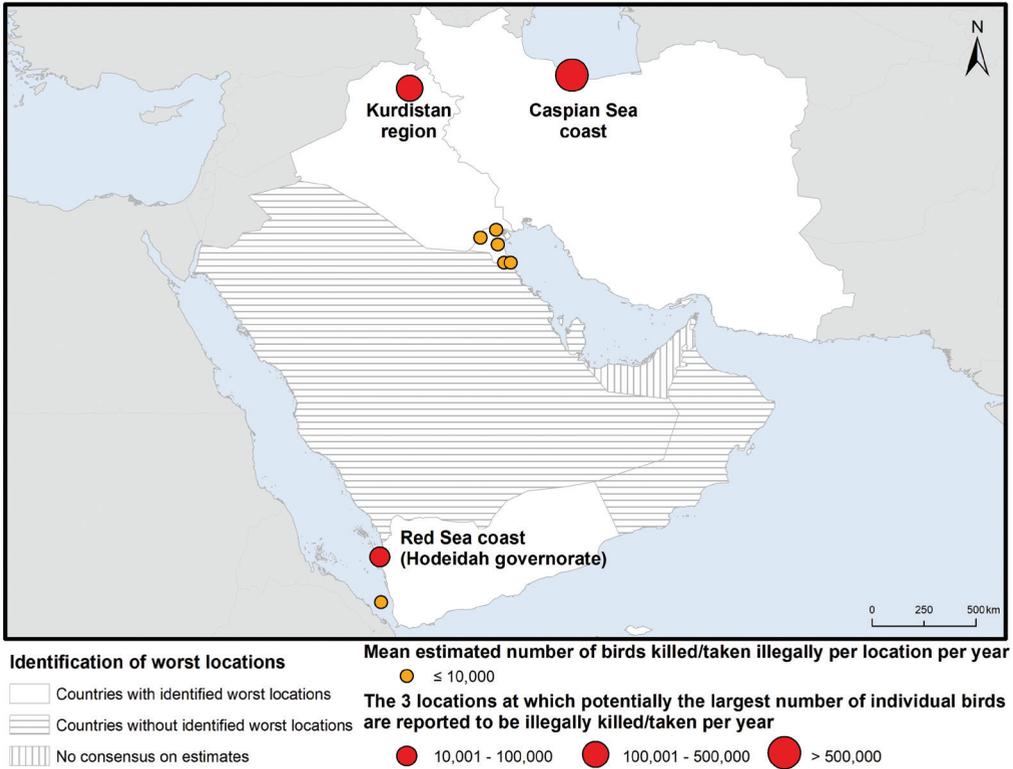


Figure 6. The locations where experts reported that the largest numbers of birds were illegally killed/taken per year in the Arabian peninsula, Iran and Iraq (location information was unknown for Bahrain, Oman, Qatar and Saudi Arabia).

Endangered; 5–25; SWA & BirdLife International 2018). Four of these ten species of conservation concern, White-headed Duck (Endangered), Ferruginous Duck (Near Threatened), Sociable Lapwing and Marbled Teal (Vulnerable) may also have > 1% of their global population illegally killed in the Mediterranean region each year (Brochet *et al* 2016). The first three are the subject of recent international action plans under CMS/AEWA. Over-hunting and illegal killing are important threats to the White-headed Duck (Sheldon *et al* 2018) and Ferruginous Duck (Robinson & Hughes 2006). Large-scale killing at stopover sites is potentially the most important threat influencing the survival of Sociable Lapwing (Sheldon *et al* 2012). The European action plan for Marbled Teal also identified hunting and illegal shooting as a threat of high importance (Iñigo *et al* 2008). Actions are therefore needed to reduce the impact of illegal killing on these and other species and to consider the combined effect of legal and illegal take alongside other threats such as habitat loss/degradation and climate change.

The south Caspian sea coast in Iran was the location with the highest mean estimated number of birds illegally killed per year. Illegal killing has been recognised as an issue in this area for decades and BirdLife International (2003) referred to the area as a “black hole for western Asia’s migratory birds”. More widely, with its numerous wetland systems, the whole of Iran serves as a very important staging and wintering area on the African–Eurasian flyway (Kaboli *et al* 2012). Despite being identified since the 1970s as a significant threat to waterbirds (Nourani *et al* 2015), illegal and highly destructive hunting methods applied throughout Iran have resulted in rapid declines in waterbird populations. High

levels of illegal killing were also reported for Azerbaijan, another country bordering the Caspian sea, especially in Greater and Lesser Gizilagach bays where >200 000 birds are estimated to be illegally killed on average each year (Brochet *et al* 2019). This large location overlaps with the Gizilagach State Nature Reserve, and is a Ramsar wetland of international importance as well as an Important Bird and Biodiversity Area (IBA). It has been identified as one of the top three most important Critical Sites for waterbirds in Africa-Eurasia, being internationally important for at least 49 waterbird populations including a number of globally threatened species (WOW 2011). The issue of illegal killing of birds all around the Caspian Sea may warrant a specific review to assess its magnitude and characteristics in more detail.

The Middle East has many endemic and restricted-range species and as a consequence has three Endemic Bird Areas (Stattersfield *et al* 1998): the Mesopotamian marshes (2 restricted-range species), the southwest Arabian Highlands (6) and Socotra (5). The region also has 12 nationally endemic breeding species: 11 in Yemen and one in Iran (BirdLife International 2017b). It is possible that illegal killing may be having an impact on these species, which as endemics can be regarded as of high conservation priority, especially as eight are threatened (Endangered or Vulnerable) and one Near Threatened (BirdLife International 2017a). However, estimates made in this review did not in general suggest that endemic species are being illegally killed in high numbers. It remains possible that Yemen Warbler, Yemen Thrush or Socotra Buzzard could be illegally killed in high numbers, but the data for Yemen are poor due to the lack of coverage and the difficulty or impossibility of undertaking meaningful surveys in the last decade. The two passerine species seem unlikely to be targeted: neither is colonial and both are rather secretive although they may, perhaps, be caught as by-catch during illegal trapping. In the case of the buzzard, nestlings have been taken to sell to visitors. However, the removal of any biological material (alive or dead) from Socotra is now illegal, and the taking of birds from the nest is now rare (RP, pers obs). The regionally endemic Jouanin's Petrel *Bulweria fallax* (Near Threatened) was among the 10 threatened and Near Threatened species with the highest ratio between the estimated number killed illegally per year and the global population size (Table 2). In Socotra, where the majority of the population breeds, young birds have been collected for their rich fat for decades (OAS, pers obs), and probably centuries. The fact that only chicks are taken may mean that population impacts are less significant than if adults were also taken. In addition, breeding cliffs are mostly inaccessible.

Consolidating the legislation, increasing effectiveness and monitoring trends

The distinction between legal hunting and illegal killing was not always clear in the countries assessed owing to insufficiently detailed legislation. Even in Iran, where the legislation is sufficiently detailed, enforcement is limited and poaching is widespread. The presence of protected species in bird markets indicates that management of bird-taking is not fully implemented (eg Balmaki & Barati 2006, Ashoori 2008; Plate 1). Illegal killing of birds in Iran results from killing within protected areas, outside the legal season/day for game species, and in excess of the legal quotas (Smit *et al* 2009). Amano *et al*



Plate 1. Illegally trapped Northern Lapwings *Vanellus vanellus* traded at the Fereydoon Kenar Market, Iran. © tici.blogfa.com

(2017) showed strong declines of waterfowl, cranes and rails in western and central Asia. They also showed that the strongest predictor of community-level changes in waterbird abundance in this region (and worldwide) was the quality of national governance, *ie* how effectively the authorities implement and enforce legislation. For species in which the whole population passes through multiple countries on migration and may be subject to mortality through illegal and legal taking in each country, the assessment of cumulative mortality is particularly important. Knowledge of the magnitude of illegal and legal take is therefore a prerequisite for assessing the sustainability of exploitation of birds (Brochet *et al* 2016). However, data on which to base assessments of sustainability are largely lacking in the region.

Action is being taken to address illegal killing in many countries. The establishment of a non-shooting area in Fereydoonkenar (Mazandaran, Iran) aimed to prevent illegal shooting of the Critically Endangered Siberian Crane *Leucogeranus leucogeranus* (Sadeghi-Zadegan 2011). In 2014, Kuwait protected fauna and flora by passing “New Environment Protection Law No 42” (FAOLEX 2017). In Qatar, legislation and law enforcement have improved in recent years (RA, pers obs). In UAE there have been a number of recent successes in relation to detection and prosecution for illegal killing and taking (Jacky Judas in litt 2018). In Saudi Arabia, following this assessment, the SWA is now strongly engaged in tackling illegal killing at all levels, from policy reform to awareness and enforcement (SWA & BirdLife International 2018). In each country, there is a need to scale up efforts to address this issue. An effective approach, especially for the countries with the highest estimated numbers of birds illegally killed, might be to agree, guide and deliver the necessary actions in the framework of a multi-stakeholder national action plan, like those recently completed in Cyprus, Egypt and Italy (Emile *et al* 2014, ISPra 2017, Shialis 2017). In each case, the multi-stakeholder group might involve other ministries, enforcement authorities, environmental organisations, hunting organisations, site managers, educators *etc.* Development of an action plan does not need to be a lengthy process, particularly if stakeholders can be brought together in a workshop to drive it forward. There is already adequate information in all countries on which to base immediate ‘no regret’ action to address illegal killing in parallel with any such action plan development.

As with Brochet *et al* (2016), our study highlighted the paucity of data on illegal killing of birds, and indeed the general paucity of data on bird populations in the Middle East. Amano *et al* (2017) suggested that existing data deficiency in western and central Asia in countries with low effective governance could result in an underestimation of the extent of the biodiversity crisis. The paucity of available data for the region is very likely to result in an underestimation of the scope and scale of illegal killing in some countries in this study. For the two largest countries, Iran and Saudi Arabia, it was possible to achieve only partial coverage. Estimates of the number of birds illegally killed in these two countries and therefore the entire region could perhaps be an order of magnitude higher than indicated by the partial assessments in this study. For example in Iran 0.7–1.0 million birds may be illegally killed annually in Mazandaran province alone (Alahgholi 2015); c400 000 waterbirds were harvested (legally and illegally) in the single province of Gilan (Balmaki & Barati 2006), Iran has 31 provinces, and probably several million Common Coots *Fulica atra*, ducks and other waterbird species were (legally and illegally) taken annually (Smit *et al* 2009). In this study, 598 000–1 000 000 birds were estimated to be illegally killed in the 21 provinces of Iran that were assessed, which were thought to include those provinces where illegal killing is most prevalent, and estimated to represent c90% of the national total of illegally killed birds (SSZ pers obs).

In Saudi Arabia, illegal killing seems to occur also in the south, which was not assessed during this study. Juniper (1988), Nikolaus (1994) and Felemban (1995) reported large-scale

bird trapping in the Farasan islands (especially on Qumamah) in the Red sea. Birds were caught to produce an oil from their fat, usually presented as a gift and used for medicinal purposes or rarely in cooking. This practice was mentioned in the current study in Yemeni islands close to the Farasan archipelago (OAS pers obs), so may still occur on islands of Saudi Arabia. Felemban (1995) reported 8000–11 000 birds trapped in 25 days during each spring migration at Qumamah island in the early 1990s. Büttiker (1988) estimated that >100 000 European Turtle-doves *Streptopelia turtur* may be captured each year in the 1980s at three trapping stations along the Red Sea. More recently, trapping of falcons along much of the Red Sea coast of Saudi Arabia was reported by Sokolov *et al* (2016). Where there are significant knowledge gaps, extrapolation is necessary in assessing the potential scale of illegal killing. It was recently estimated that 50 000–120 000 birds may be illegally trapped each year on a single private farm in Saudi Arabia during autumn migration (Shobrak 2016). There are c100 such farms in the Gulf Cooperation Council (GCC) countries (*ie* Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the UAE), hence 5–12 million birds could be illegally trapped in these countries (Shobrak 2016). In addition, frequent social media posts suggest that many thousands of birds could be illegally killed annually in the Arabian peninsula (Plate 2). This recent trend to share images of illegal bird killing on social media is concerning and it is unclear whether social media is simply being used to document illegal killing being perpetrated for other reasons or whether sharing on social media might itself be a driver of illegal killing in some cases. However, these images could be used as a tool to obtain useful data on the number and species killed, as trialled by Eid & Handal (2018) in Jordan as well as sometimes being of use to authorities in identifying perpetrators. The systematic monitoring of bird populations and of illegal killing at national scale and making the results available nationally and internationally would improve our understanding of the scope and scale of illegal killing. In the region, tackling illegal killing is paramount for maintaining healthy bird populations. In addition, the region plays a vital role for many migratory species of the African–Eurasian flyway, connecting European and Asian breeding grounds with African wintering grounds. High levels of illegal killing could therefore have population level consequences and limit the effectiveness of efforts to conserve these species elsewhere in the flyway.



Plate 2. Example of a 'hunting bag' (Eurasian Golden Orioles *Oriolus oriolus*) found regularly on social media channels from the Arabian peninsula. Anon.

Drivers of illegal killing

Illegal killing of birds was assessed for Mediterranean countries of the Middle East as part of a previous study (Brochet *et al* 2016). It is now possible to consider the Middle East region as a whole by combining the two assessments. A mean of 17.5 million birds (8.0–27.1 million birds) is estimated to be killed annually across the combined region, of which 18% is in the (partially assessed) Arabian peninsula, Iran and Iraq (Appendix 1). In five of the 17 Middle East countries assessed, >1 million birds may be illegally killed on average each year (Figure 2). For the whole Middle East region, the highest estimated numbers were in

Egypt (0.3–10.6 million), followed by Syria (2.9–4.9 million) and Lebanon (1.7–3.5 million). All of the 20 Mediterranean locations with potentially the largest numbers of birds illegally killed are concentrated in the Eastern part (Brochet *et al* 2016). Combined with the results of this study, this showed that illegal killing is a very significant conservation issue in the Middle East.

The primary reasons for killing birds in the Arabian peninsula, Iran and Iraq appear to be similar to those in the Mediterranean Middle East countries, *ie* for sport and food (Figure 4). BirdLife International (2007) reported (without distinguishing between legal hunting and illegal killing) that taking birds for food occurs only at very low levels in North Africa and Middle East countries, whereas killing for sport is widespread. The number of migratory birds killed overall is thought to be increasing as a result of people's increased leisure time and disposable incomes, easier access to guns, cheaper ammunition and the ownership of 4-wheel drive vehicles enabling access to remote areas. Our study agreed with the suggestion made by Brochet *et al* (2016) in relation to the Mediterranean that illegal killing of birds for food is not primarily for subsistence, but rather for eating as a culinary delicacy, or that birds were killed primarily for sport but subsequently eaten. This was also the case in Northern and Central Europe where birds were mainly killed to be consumed as a delicacy, but not in the Caucasus where birds were illegally killed at similar levels for subsistence, delicacy and trade (Brochet *et al* 2019). In this study, illegal killing of birds for subsistence food had a high importance in Yemen, a war-torn country. As a by-product of the human suffering caused by war, birds can become an important source of protein in conflict areas. In western and northwestern Iraq, illegal killing increased due to political instability especially after the appearance of the so-called ISIS group. People could get guns more easily and used them for killing birds (LAAO pers obs). In Yemen, the Yemen Linnet *Linaria yemenensis* (Least Concern) is a widespread flocking species in the southwest Arabian highlands, and thus is relatively easy to catch (Plate 3). It is unknown how common this activity is, but if frequent, population level impacts could result. Political instability can also weaken legal enforcement, thereby creating conditions where illegal killing can take place even in protected areas (Brochet *et al* 2016). Commercial trade also represented an important reason for illegal killing (Figure 4). In the Middle East, wild birds may supply an important part of the income of people selling (legally and illegally) killed birds in local markets (*eg* Büttiker 1988, Alahgholi 2015, Elhalawani 2016).



Plate 3. Illegally killed Yemen Linnets *Linaria yemenensis* in the Yemen highlands. Anon.

As in Mediterranean Middle East countries, another significant reason for illegal taking of birds in the Arabian peninsula, Iran and Iraq appears to be for use as (and trade associated with) pet cagebirds (Figure 4). In the Arabian Peninsula, there is also a significant demand for Saker Falcon *Falco cherrug* (Endangered) and Peregrine Falcon *Falco peregrinus* for falconry (Shobrak 2014), which is met primarily by international trade, both legal and illegal, of captive-bred and wild-sourced birds (Dixon 2016). The large number of gamebirds at the markets in Tabuk, Saudi Arabia, may be for human consumption, but also to feed captive falcons (Aloufi & Eid 2014). In Kuwait, a survey into the illegal trade in raptors found 17 species for sale, of which three were listed as threatened in the IUCN Red List (Al-Sirhan & Al-Bathali 2010). Although Yemen is not generally considered a major link in the international falcon trade, it is understood there that raptors can be valuable (Stanton 2010). The impact of falcon trapping in Yemen may be underestimated as observations near the Bab al-Mendeb (the main exit point in Arabia for migrating birds of prey in autumn; Porter 2005) in 2006–2007 revealed many trapping teams operating, each having its own trapping territory. Teams apparently trap for the whole post-breeding migration period and are financially supported by falconers from the Gulf countries, to whom they sell the falcons (Jacky Judas in litt 2018).

Raptors are trapped illegally for falconry and sold for high prices in Egypt (up to LE 220 000, ie 12 700 USD for a Peregrine Falcon; Elhalawani 2016), Iraq (Raza *et al* 2011) and Iran (this study). The main destinations for these trapped falcons are countries in the Arabian peninsula. Widespread trapping of Saker Falcon over much of its global range is considered to be an important cause of its decline (Dixon 2016) and a significant proportion of the trapping is illegal. A Global Action Plan for the conservation of this species includes planning for a management and monitoring system that aims to ensure that any trapping of wild falcons is sustainable (Kovács *et al* 2014). Other groups of birds are popular in the local pet markets of Middle East countries; locally caught birds, plus others from Africa, Europe and Asia (including some threatened species) have been seen on sale (*eg* Soorae *et al* 2008, Eid *et al* 2011, Raza *et al* 2011, Aloufi & Eid 2014). For example, a Bali Myna *Leucopsar rothschildi* (Critically Endangered) was in a bird market in Kuwait in 2016 (Plate 4). Illegal bird trade, especially of raptors for falconry, in the Middle East seems to be increasing. Further socioeconomic research is needed to understand the drivers, routes and markets for illegal trade in different countries within the region.

The main component of the 'other' category of reasons for illegal killing was the trapping of birds in Yemeni Red Sea Islands to obtain fat for medicinal and cosmetic purposes (see above; Figure 4). Taxidermy/egg collection and predator/pest control were of relatively minor importance (Figure 4), although taxidermy may affect rare species (targeted in *eg* Iran and Iraq); predator control was listed in Yemen as the primary reason for targeting raptor species. Egg collection by fishermen for food in Yemeni Red Sea Islands was also mentioned, affecting seabirds particularly.



Plate 4. Illegal trade of Bali Myna *Leucopsar rothschildi* at a bird market in Kuwait in 2016. Anon.

CONCLUSION

Levels of illegal killing estimated for the region of this review and the Mediterranean Middle East are likely to have a negative impact on bird populations within these regions and on migratory species' populations throughout the African–Eurasian flyway. Our analysis represents the first attempt to assess the scope and the scale of illegal killing of birds across the Arabian peninsula, Iran and Iraq; it is likely that we underestimated the magnitude, and the review also highlights significant gaps in information both on illegal killing and the size of bird populations in the region. There is a clear need for systematic monitoring of the illegal killing of birds in the region. Further work is needed to complete national assessments, especially for Iran and Saudi Arabia where assessments covered only parts of those countries but found high levels of illegal killing. The most pressing need is for immediate action by relevant national authorities, enforcement bodies and other stakeholders to implement a 'zero tolerance' approach to illegal killing across the region, building on efforts already underway in some countries. Development of multi-stakeholder national action plans to address illegal killing could be a useful approach to identify priorities and guide effective action. The key actions needed vary between countries but include improvements legislation, improved enforcement of and compliance with legislation, focused action at the worst locations, increasing surveillance and action at markets and in relation to online activities, more consistent application of adequate penalties for illegal killing, education and awareness raising among the general public and key groups such as hunters, and improved monitoring and research into socioeconomic drivers of illegal killing; leading to solutions tailored to the local context. As is clear from the example of illegal trapping and cross-border trade of falcons, there is a need for collaboration between countries on this issue. MIKT (Intergovernmental Task Force on Illegal Killing, Taking and Trade of Migratory Birds in the Mediterranean) under the CMS is providing a useful framework for intergovernmental collaboration on illegal killing in that region. This model is being replicated in Asia, and elements of it may be worth considering to enable sharing of experience, tools and solutions within the region of this assessment and other parts of the flyway to which it is connected.

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Appendix 1. Estimated numbers of birds illegally killed/taken per year in the Middle East region as a whole (combining data from this study with that for Mediterranean Middle East countries and Cyprus covered by Brochet et al 2016, see text), per species group and family, and percentage of the birds illegally killed/taken in the Middle East region as a whole that are taken in the Arabian peninsula, Iran and Iraq.

Group/family of species*	Mean estimated no. of birds illegally killed/taken per year in Middle East region (min–max)	% of birds killed/taken illegally each year in the Arabian peninsula, Iran, Iraq compared to the Middle East region as a whole
Gamebirds	2 000 000 (1 300 000–2 600 000)	15%
Numididae	50 (0–100)	100%
Phasianidae	1 700 000 (1 100 000–2 300 000)	14%
Columbidae	231 000 (150 000–313 000)	14%
Pteroclididae	43 000 (29 600–56 400)	80%
Otididae	4600 (3100–6100)	90%
Waterbirds/Seabirds	1 300 000 (829 000–1 700 000)	67%
Anatidae	577 000 (418 000–736 000)	89%
Podicipedidae	4300 (2300–6300)	56%
Phoenicopteridae	3500 (500–6500)	83%
Rallidae	475 000 (292 000–658 000)	51%
Gruidae	6100 (5300–7000)	76%
Procellariidae	1700 (1100–2200)	100%
Ciconiidae	4600 (2800–6500)	12%
Threskiornithidae	900 (500–1400)	82%
Ardeidae	15 900 (10 100–21 700)	75%
Pelecanidae	700 (400–900)	47%
Sulidae	400 (300–600)	100%
Phalacrocoracidae	12 100 (6400–17 800)	99%
Anhingidae	25 (0–50)	0%
Burhinidae	1500 (700–2300)	0%
Haematopodidae	50 (0–100)	94%
Recurvirostridae	2200 (1300–4500)	25%
Charadriidae	22 100 (12 800–31 300)	38%

Scolopacidae	91 700 (48 800–135 000)	15%
Dromadidae	300 (200–400)	100%
Glareolidae	2300 (1200–3300)	32%
Laridae	33 700 (25 000–42 400)	77%
Raptors	29 500 (13 000–46 000)	26%
Tytonidae	100 (0–200)	34%
Strigidae	1600 (700–2600)	25%
Pandionidae	100 (0–200)	55%
Accipitridae	22 300 (9800–34 800)	18%
Falconidae	5000 (2400–7600)	62%
Near-Passerines	47 700 (16 900–78 600)	39%
Caprimulgidae	1400 (200–2700)	74%
Apodidae	400 (200–600)	0%
Cuculidae	900 (500–1300)	21%
Upupidae	5800 (1600–9900)	48%
Meropidae	25 800 (12 000–39 500)	51%
Coraciidae	1700 (700–2600)	66%
Alcedinidae	5500 (600–10 400)	2%
Picidae	6300 (1000–11 500)	4%
Passerines	14 200 000 (5 800 000–22 600 000)	14%
Oriolidae	82 000 (20 800–143 000)	10%
Laniidae	121 000 (44 200–197 000)	25%
Corvidae	15 500 (8800–22 300)	65%
Paridae	9700 (4800–14 600)	3%
Remizidae	100 (0–200)	63%
Alaudidae	2 100 000 (1 600 000–2 700 000)	1%
Cisticolidae	11 600 (7200–15 900)	<1%
Acrocephalidae, Locustellidae, Phylloscopidae, Scotocercidae, Sylviidae**	4 800 000 (2 700 000–7 000 000)	34%
Hirundinidae	14 300 (9 900–18 600)	1%
Pycnonotidae	46 300 (7400–85 200)	15%
Aegithalidae	25 (0–50)	0%
Leiotrichidae	900 (500–1300)	92%
Certhiidae	50 (0–100)	0%
Sittidae	1300 (700–1900)	17%
Troglodytidae	2500 (1600–3500)	2%
Cinclidae	50 (0–100)	67%
Sturnidae	116 000 (67 600–165 000)	47%
Turdidae	820 000 (594 000–1 000 000)	1%
Muscicapidae	532 000 (214 000–850 000)	12%
Regulidae	25 (0–50)	0%

Hypocoliidae	100 (0–200)	100%
Nectariniidae	200 (100–300)	30%
Prunellidae	5000 (3000–7000)	1%
Ploceidae	1300 (1000–1500)	100%
Estrildidae	50 (0–100)	100%
Passeridae	4 700 000 (179 000–9 300 000)	1%
Motacillidae	157 000 (55 300–258 000)	2%
Fringillidae	383 000 (234 000–532 000)	13%
Emberizidae	212 000 (136 000–288 000)	1%
TOTAL	17 500 000 (8 000 000–27 100 000)	18%

* Only families affected by illegal killing are mentioned in the table

** These warbler families were grouped as they were assessed as a whole in Saudi Arabia

Appendix 2. Worst locations for illegal killing and taking of birds identified in the Arabian Peninsula, Iran and Iraq.

Country	Location name	Administrative region	Latitude	Longitude	Estimated no. of birds illegally killed or taken/year	
					Min	Max
Iran	Caspian Sea coast	Gilan, Mazandaran	36.7568	51.0386	538 000	904 000
Iraq	Kurdistan region	Kurdistan region	36.1833	44.0000	74 100	288 000
Yemen	Red Sea coast	Hodiedah Governorate	15.9201	42.5840	64 100	105 000
Yemen	Hanish group	Taiz	13.7439	42.7550	6 200	10 200
Kuwait	Western Kuwait (includes Al Abraq, Salmi area, Ritqa area)	Western Kuwait	29.6575	47.0654	2 000	5 100
Kuwait	Kuwait Bay	East Kuwait (coastal)	29.3644	47.8186	1 600	4 300
Kuwait	Al Abdaly Farms	North Kuwait (inland)	30.0006	47.7495	1 300	3 400
Kuwait	Al Wafra Farms	South Kuwait (inland)	28.5692	48.0938	1 300	3 400
Kuwait	Khiran area	South Kuwait (coastal)	28.5734	48.3791	1 300	3 400