# Seasonal abundance and breeding biology of the Velvet Scoter *Melanitta fusca* at Lake Tabatskuri, Georgia

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**Abstract**

Velvet Scoters *Melanitta fusca* from the disjunct Turkey, Georgia and Armenia nesting population were studied during 2017–2020 at what is now their last known breeding site, at Tabatskuri Lake in southern Georgia. Paired birds returned to the lake soon after thaw in April and females and young remained into November in some years. Early failing females and most males migrate to moult elsewhere in late July, although 11–19 males remained to moult on the lake each year, departing in late September/early October. Annual summer maxima ranged from 77–92 individuals, typically comprised of 43–55% females during April–August (although inevitably fewer during incubation). Nests were totally confined to one island, where the number of breeding pairs recorded ranged from 23–33 (in 2018 and 2019, respectively). Nest success (at least one duckling hatched) varied from 74% (in 2018 and 2020) to 52% (2019), recorded for 23 (2018), 33 (2019) and 31 nests (2020), although more females were present early in the season in each year. Camera traps monitoring 11 nests recorded egg predation by Marsh Harriers *Circus aerginosus* on two occasions. Hatching success for all eggs laid was 54% (in 2018), 36% (2019) and 49% (2020), with overall survival of the eggs to fledging ranging from 2% (in 2018 and 2019) to 13% (in 2020). Duckling mortality was likely due to predation by Armenian Gulls *Larus armenicus* soon after hatching and to drowning in fishing nets. Local community engagement has stopped egg collecting on the island and contributed to reduced fishing disturbance for Velvet Scoters in the ducklings' nursery areas, when newly-hatched young are most vulnerable to gull predation. Additionally, gull numbers were lower in 2020, which also likely contributed to the improved breeding success in that year. We urge continued vigilance and further research to confirm the direct causes of the Velvet Scoters' poor breeding success at the site, to improve the conservation status of the species in the region.

**Key words:** conservation, habitat use, hatching success, nesting success, reproductive output.

 

The circumpolar Velvet Scoter *Melanitta fusca* is classified as Vulnerable by the International Union for Conservation of Nature (IUCN) and is generally thought to be declining globally (BirdLife International 2020). The species breeds more or less continuously across Eurasia from Norway to the Yenisey River in western Siberia and winters mainly in north and northwest Europe, where it numbers 202,000–384,000 individuals (Cramp & Simmons 1977; BirdLife International 2020). A small isolated relict population breeds in eastern Turkey, Georgia and Armenia, most probably wintering in the Caspian and Black Sea areas, although its abundance and annual distribution remain unknown (Dagys 2016). This group of birds was put at < 1,500 individuals in the mid-1990s, with estimates more recently revised downwards to 240–420 birds, based on numbers recorded on the wintering grounds (Wetlands International 2020). A rapid drop in water levels at Lake Sevan in Soviet times caused the loss of the Velvet Scoter nesting area there, resulting in the extinction of the species in Armenia (Adamian & Klem 1997). Habitat loss, human disturbance and global warming are considered to have caused the loss of Velvet Scoter as a breeding species in Turkey (Kirwan *et al.* 2014). Ornithologists who have made annual visits since 2012 to formerly-occupied Velvet Scoter breeding lakes on the Anatolian plateau, Turkey, have confirmed that they have not seen the species in this area in recent years (Ortac Onmus & Emin Yoğurtcuoğlu, pers. comm.).

At the end of the 20th century, the Velvet Scoter nested on almost all of the large lakes of the Javakheti plateau in southern Georgia (Janashvili *et al.* 1960; Kutubidze 1985; Jordania *et al.* 1999; Matcharashvili *et al.* 2004; Gavashelishvili *et al.* 2005). In the first decades of the 21st century, however, it disappeared from the most important lakes for waterfowl in the Samtskhe-Javakheti region (at Madatapa, Bughdasheni, Khanchali and Kartsakhi). Probable factors responsible for the decline of Velvet Scoters in these areas include: (1) direct habitat degradation due to increasing water consumption for the irrigation of adjacent agriculture land; (2) mowing on the peninsulas and islands used for nesting; (3) egg collection, causing direct nest loss and disturbance; (4) eutrophication/pollution caused by agricultural intensification and the release of waste water into the lakes; (5) overfishing responsible for reducing food availability and bycatch in fish-nets; and (6) over-harvesting (due to illegal hunting). Lake Tabatskuri is thus believed to be the last surviving breeding area for the species in Georgia and its neighbouring countries (Paposhvili 2018).

The first detailed survey of all potential breeding lakes for Velvet Scoter on the Javakheti Plateau, Georgia, in 2017 showed that nesting (25–35 pairs) was confined to just one traditionally occupied site, Lake Tabatskuri (41°39'N, 43°38'E; see Paposhvili 2018). Since 2017, despite regular visits to all potential lakes on the Javakheti Plateau each spring and summer, the species was not found elsewhere, and none were seen during visits in mid-August 2018 to four Turkish lakes, where BirdLife International reports that Velvet Scoter bred in historical times (at Akta (Khozapin)

 

41°13'N, 43°13'E; Childir 41°03'N, 43°14'E; Aygir 40°46'N, 43°00'E and Kuyuchuk 40°44'N, 43°27'E). All these observations, together with consultations with waterbird experts and recently published articles, strongly suggest that Lake Tabatskuri is the only remaining active breeding site for Velvet Scoter in this formerly widely occupied region. In order to assess the potential cause of the decline of the Velvet Scoter in the region, and ensure the long-term survival of the last breeding population, we therefore launched a monitoring scheme in 2017. Here we present the preliminary results of this monitoring programme and discuss the possibilities of mitigating actions that could be implemented to preserve this relict population.

## Methods

### Study area

Lake Tabatskuri is located at 2,000 m above sea level in the Javakheti plateau region of southern Georgia. The surface area is 14.2 km$^2$, with a maximum depth of 43 m (average depth = 15 m) and it retains a transparent, clean water column. The area experiences cold winters with snow cover extending to 150 days. Mean daily temperatures are –8°C in January and 12°C in July. The lake is surrounded by two villages (one of which extends onto a small peninsula in the lake) and includes a 1 ha island in the northern part, which is now the only remaining breeding site for Velvet Scoters in the Caucasus. A quarter of the island is covered with shrubs, with a few pine, maple and birch trees, which the scoters avoid as nesting habitat.

### Breeding surveys

Weekly surveys were made of Velvet Scoters at Lake Tabatskuri from late April to November, each year from 2017 onwards, to count the numbers present for assessing changes in local abundance, record the adult sex ratio and to collect data on their reproductive success (Figs. 1 & 2). The scoters start laying eggs at the site in mid-June. By late June, most (if not all) of the breeding females are already incubating eggs, so each summer 2–3 observers walking closely abreast searched the entire island intensively for nests in late June–early July. GPS coordinates were recorded for all nests found (Fig. 3), along with the number of eggs in each clutch (Supporting Materials Table S1). We also deployed 5–6 camera traps in 2019 and 2020 at nests where vegetation allowed monitoring of the nest without disturbance to the sitting female (Fig. 4a,b,c). In the post-hatching period (mainly in the first half of August), we re-checked the nests found in June or July and counted the numbers of hatched and addled eggs in each nest. The entire island is checked during each of the weekly surveys, with a view to locating nests missed during the earlier visits. After hatching, daily observations were made of all broods for the first three weeks after they moved to water, and then once a week until the end of October, to determine how many fledged and whether the broods used different sectors of the lake, as well as identifying major threats to the species. Note that in 2017 (due to inexperience) it is highly possible that: (1) we failed to find all nests present (the island was only checked once for nests after hatching), and (2) numbers

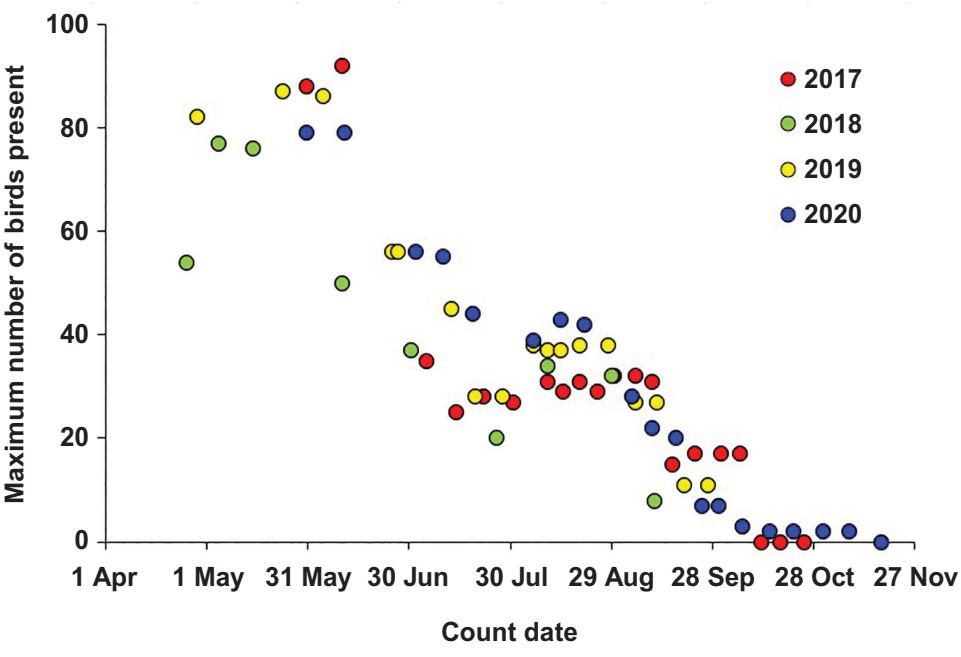


**Figure 1.** Annual seasonal changes in numbers of Velvet Scoter counted on Lake Tabatskuri, Georgia during regular counts made through the breeding season during the summers of 2017–2020.

fledged were fewer than estimated, because of difficulties in differentiating adult female and fully-fledged young at long distance without experience. For these reasons, we are confident the 2018–2020 data are much more reliable than those from 2017.

## Results

Early counts made at Lake Tabatskuri in 2017 found that numbers peaked at 92 Velvet Scoters on 10 June (Fig. 1), with a female sex ratio of 36% (Fig. 2). Subsequent weekly counts located a total of 25–32 birds from 5 July to 10 September 2017, when females constituted between 49% (5 July) and 39% (22 July) of adult birds counted; *i.e.* a little under 50% for this period, and also for most of the breeding season. In 2018, the earliest count attempt on 15 April preceded the arrival of scoters into the study area, but 54 were present on 25 April, numbers peaked at 77 on 5 May, and there were 76 present on 15 May (Fig. 1). There was no obvious increase in the proportion of males in late May and early June (as in 2017), and the proportion of females remained at an average of 45% (range 43–46%) from 10 June to 26 July, but rose to 68–69% during 10–29 August (Fig. 2). In 2019, numbers peaked at 87 Velvet Scoters counted on 24 May (Fig. 1), which included 46% females (Fig. 2). Eighty-six birds persisted up to 5 June, after which numbers declined, but there was an average of 46% females until the end of August (range 29–55%). In 2020, 79 Velvet Scoter were

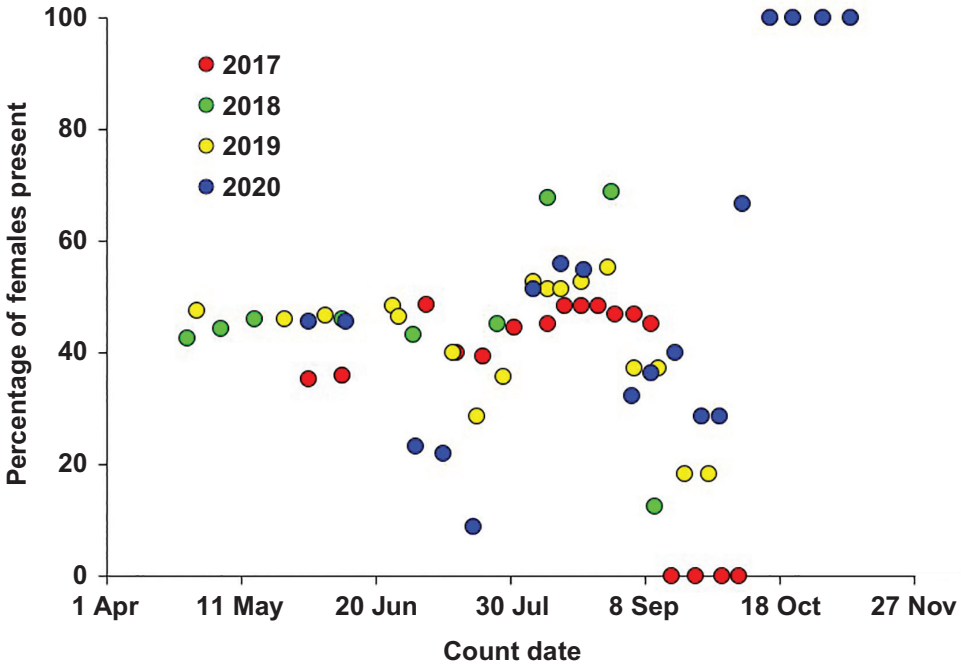


**Figure 2.** Annual seasonal changes in sex ratio (expressed as percentage of adults that are females), based on data collected during regular counts made throughout the breeding season in summers 2017–2020.

counted on 31 May and 11 June (Fig. 1), of which 46% were female (Fig. 2). The sex ratio subsequently was heavily male biased, with an average of 25% females (range 22–30%) from 2–19 July, when many females were likely incubating. It rose again to an average of 54% (range 51–56%) during 6–24 August, but was lower from 4 September to 7 October (average 39%, range 29–67%), after which only two females remained into November (Fig. 2).

Nesting success of individual nests are mapped (with colour-codes illustrating success) in Fig. 3. In 2017, all of the six nests found were successful (although some nests may have been missed in that year). In 2018, 17 nests out of 23 were successful (74%; one was predated, four abandoned and one was a dump nest, *i.e.* a nest without any signs of down or incubating female, where all eggs failed to hatch). In 2019, 17 out of 33 nests were successful (52%; 11 were predated, three abandoned, and two were dump nests, without incubating females, which ultimately all failed to hatch). Finally, in 2020 from 31 nests, 23 were successful (74%), but in that year, three females were killed on nests, two nests were predated, two abandoned and another was a dump nest, containing 22 eggs that were briefly incubated but by 5 August all these eggs had failed to hatch. There was no significant difference between years in the proportion of eggs laid in each nest that went on to

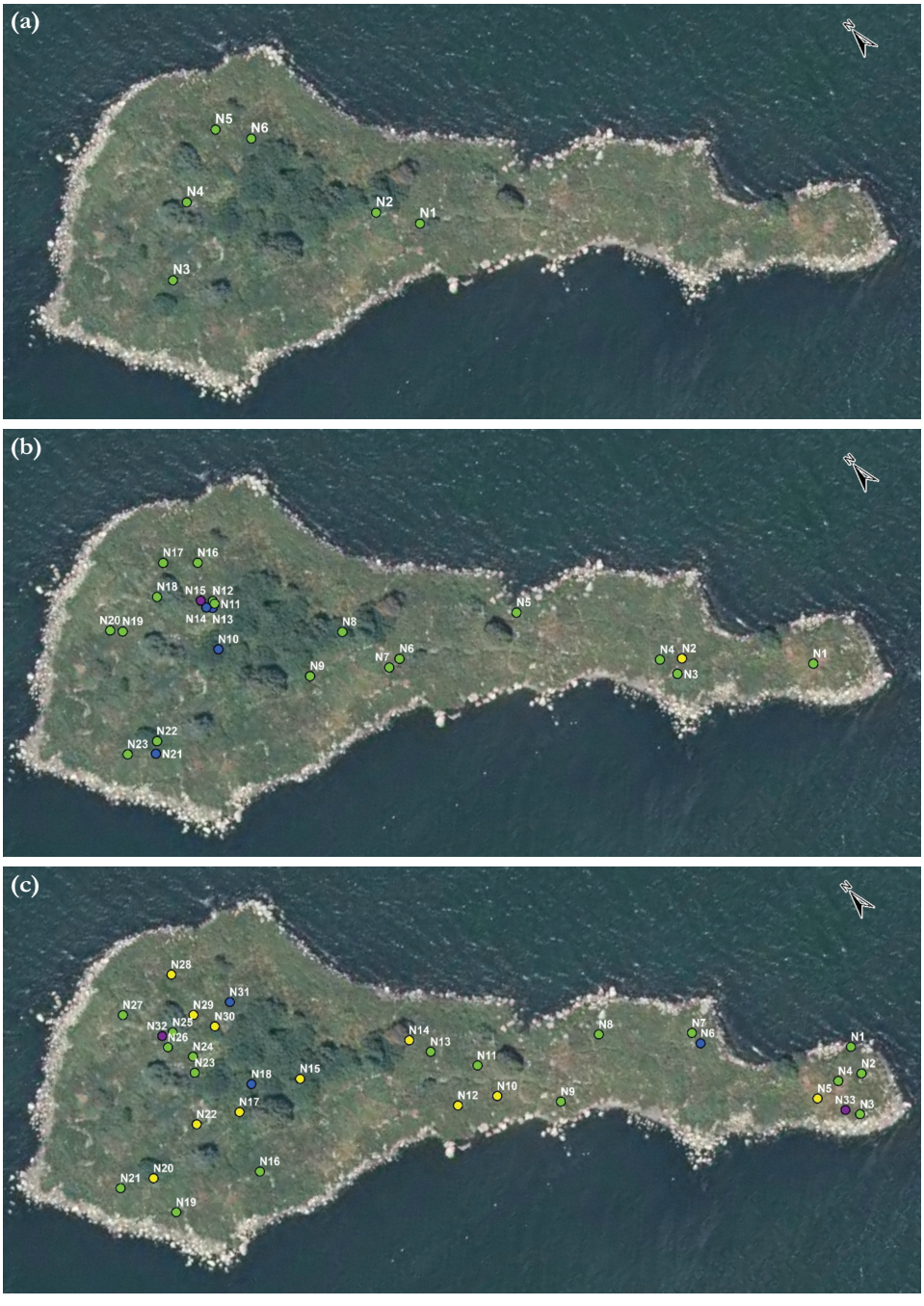


**Figure 3** (*continued opposite*).


**Figure 3** (*continued*). Aerial survey images showing the location of individual Velvet Scoter nests on the island in Lake Tabatskuri during: (a) 2017, (b) 2018, (c) 2019 and (d) 2020. Green points = successful nests; yellow = predated nests; blue = abandoned nests; violet = dump nests; red = nests with predated females.

hatch, nor in overall hatching success (Kruskal-Wallis tests: $H = 4.89$, d.f. = 3, $P = 0.18$ and $H = 6.13$, d.f. = 3, $P = 0.11$, respectively; n.s. in each case).

Analysing data from three camera traps involving females with known start dates confirmed that the incubation period was 28–30 days, during which time the sitting female left the nest for an average of 2 h every day to feed, although the timing and duration varied between individuals. Hatching commenced on 18 July among the camera monitored nests and incubation was completed by 5 August for most nests, although there were occasions when ducklings hatched in the second half of August (Fig. 4c). From the time of emergence of the first hatchling, the female stayed on the nest and waited for the other ducklings to hatch for between 15–42 h, after which she led the ducklings to the lake. No active predation of eggs by Armenian Gulls *Larus armenicus*, Hooded Crows *Corvus cornix* or Eurasian Magpie *Pica pica* was observed at the nests monitored during incubation. These species only took addled eggs after incubation or from abandoned nests. The camera traps twice recorded egg predation by Marsh Harrier *Circus aeruginosus*, out of 11 active nests monitored during incubation. Unfortunately, we did not have a camera trap on any of the three nests where the sitting female was predated directly on the nest in 2020. However, given their frequent visits to monitored nests, we infer that the predator was a Marsh Harrier in all three cases (Fig. 4d). Supporting Materials Table S1 lists individual clutch size and hatching success in all four years. In 2017, a total of 48 eggs were found in six nests, of which 17 failed to hatch, a hatching rate of 65%. It was not possible to determine duckling survival rates for individual broods; however, the 31 hatched

 

(a)

(b)

(c)

(d)

(e)

(f)

**Figure 4** (*continued opposite*).

eggs gave rise to nine fully-fledged young, which amounted to a 29% fledging rate, or 19% success rate from 48 eggs originally laid (although it is highly likely that not all nests were found in 2017, and also that the number of fledged young was fewer than we thought). In 2018, we were far more confident that all nests were found, when 213 eggs were counted in 23 nests, of which 99 failed to hatch, a hatching rate of 54%. The 114 hatched eggs gave rise to four fully-fledged young, which amounted to a 4% fledging rate, or 2% success rate from 213 eggs originally laid. In 2019, 280 eggs were found in 33 nests, of which 180 failed to hatch, a hatching rate of 36%. The 100 hatched eggs gave rise to five fully-fledged young, which amounted to a 5% fledging rate, or 2% success rate from 280 eggs originally laid. In 2020, 296 eggs were found

(g)

(h)

(i)

**Figure 4** (*continued*). Velvet Scoters at Lake Tabatskuri, Georgia, during the breeding season, illustrating: (a, b, c) suitable nests for deployment of camera traps, (d, e) predated females, (e, f) egg predation, (g) an Armenian Gull *Larus armenicus* attacking a brood, (h) a parent Velvet Scoter defending a brood (such defence behaviour does not always result in duckling survival, particularly when attacking gulls operate as a team), and (i) female protecting her own brood in a creche with ducklings of other females. Photographs by Nika Melikishvili and Nika Paposhvili.

in 31 nests, of which 150 failed to hatch, a hatching rate of 49%. The 146 hatched eggs gave rise to 39 fully-fledged young, which amounted to a 27% fledging rate, or 13% success rate from 280 eggs originally laid in 2020.

A map of the cumulative use of the lake by the broods, based on the birds' location and movements recorded during 2019–2020, is illustrated in Supporting Materials Fig. S1. As previously reported by Paposhvili (2018), adult birds at all stages of the summer, with broods of different age and therefore sizes, never used 75% of the lake area, probably because this area is too deep (local fishermen, pers. comm.), whereas the northern sector around the island was used intensively by the broods. In their first two weeks, broods fed mainly near the shoreline then slowly expanded their use of the surrounding area (marked red on the map in Fig. S1). However, every evening, at dusk,

they returned to the island to roost and in the early morning they returned to the northwest coast again, where they fed intensively throughout the day (from the island to the shore is 600–800 m), being disturbed only by Armenian Gulls and fishermen. After 40–45 days they moved to the extreme northeast corner, which was the area of open water used in all years by the moulting males (blue on the map). The broods remained in this area until shortly before departure.

## Discussion

Observations presented here from 2017–2020 showed that between 6–33 female Velvet Scoter settled annually to nest on Lake Tabatskuri, despite there being slightly more pairs present at the site in each year from May to mid-June. The four-year study suggested that numbers of nesting females on the island grew slowly steadily to reach 31–33 birds in 2019–2020. In 2017, it seems likely that the high numbers of females (33) present at the beginning of the season compared to very low numbers later on (during July–September, when only 10–17 females remained on the lake) was indicative of high nest failure that year, potentially caused by local people actively collecting eggs on the island. Early failing females, like most males, may leave the lake at the end of July to moult elsewhere. In 2018–2020, the number of female Velvet Scoters in late season varied between 8–27 individuals (potentially including a very few sitting on their nests), which indicated higher nesting success than in 2017. In 2020, some females probably were unable to go to moulting places in early September because they still had unfledged ducklings, with the result that some remained at Lake Tabatskuri with their ducklings into November (Fig. 1).

In 2017, we thought that some of the Velvet Scoter present in May and early June at Lake Tabatskuri might be staging there before continuing onwards to breeding areas in Turkey. However, data from our four-year study indicate that all these birds belong to the Tabatskuri population and, after mating, most of the males leave the lake and depart to their moulting sites. Despite this, 11–19 males remain at Lake Tabatskuri every year (probably in the hope of mating with vacant females) and ultimately moult there in August–September in the northeast corner of the lake. Normally, they will depart to their wintering grounds in late September or early October. In all years, Velvet Scoter (males and females) returned in pairs to Lake Tabatskuri after the lake had started to melt during April, consistently peaking in numbers from late May to early June.

Nesting occurred only on the one island in Lake Tabatskuri in all four study years. Velvet Scoters almost never bred in exactly the same nest depression in successive years, with only one female breeding in exactly the same position for two years, in a hole below a large stone. Annual nesting success (at least one egg hatched) for Velvet Scoter breeding at Lake Tabatskuri in the four years of observations (65% in 2017; 54% in 2018; 36% in 2019; 49% in 2020) was lower than the 67–92% reported by Brown & Brown (1981) and 72–89% by Traylor *et al.* (2004) from North American studies of White-winged Scoter *M. f. deglandi*. Fledging success for hatched ducklings was low (29.0%, 4%,

 

5% and 27% in 2017–2020, respectively); almost certainly as a result of predation by Armenian Gulls/Marsh Harriers and ducklings drowning in fishing nets, resulting in low overall reproductive success (19%, 2%, 2% and 13% of eggs leading to fledged birds each year from 2017–2020, respectively). Breeding success of Velvet Scoters at Lake Tabatskuri therefore was lower than that recorded either in Finland in a population subjected to considerable human disturbance, or in North America where disturbance by humans was likewise high (Mikola *et al.* 1994), but was similar to parts of North America (where 5–10% of eggs resulted in fledged birds; Traylor & Alisauskas 2006) where gull predation also played a major part in duckling loss.

In 2017, direct observations, together with the results of local interview results revealed that one of the biggest impacts on Velvet Scoter productivity was the collection of eggs by the local fishermen. To raise the awareness of locals (especially fishermen) information brochures and posters were circulated to local communities around Lake Tabatskuri giving information about the status of Velvet Scoter, the factors that threaten their future survival and how local people can contribute to reducing these threats. Since then, the impact of humans on the nesting birds has decreased (after 2019 bird eggs are no longer collected on the island). This was a great achievement for us and initially we thought we would solve the problem very easily and in a short time. However, despite this important achievement, breeding success continued to be low (only four ducklings fledged in 2018 and five in 2019). The reason, as our observations revealed, was predation on scoter ducklings by Armenian Gulls, a species which is quite numerous at Lake Tabatskuri. Despite the valiant attempts by brood-hens to repulse these aggressors, in the very first days after hatching, most of the ducklings became victims to Armenian Gulls. A major problem was the disturbance caused by fishing, although many ducklings also may drown and die when caught as by-catch in fishing nets. It is evident that the success of gull attacks was much higher in situations where the broods are disturbed by boats compared to in undisturbed situations. Indeed, boat disturbance sometimes forced brood-rearing females to leave their ducklings alone for short periods, but long enough for Armenian Gulls to be successful in predating ducklings. In recent years, numbers of Armenian Gulls have increased dramatically and their distribution in 2020 extended over the entire Javakheti Plateau in southern Georgia, where the species can now be counted in thousands (compared to a few individuals 3–4 decades ago; A. Abuladze pers. comm.). The specific reasons for the increase in gull abundance is unknown, but it may be associated with increased numbers of landfill sites in the region providing additional, easily accessible food for the gulls.

In 2020, to reduce the local impacts of fishing activities, we paid three key local fishermen to become involved with the project. With their help, no fishing occurred in the Velvet Scoters' duckling feeding area in August 2020. Although the problem remains at the main moulting site which is also used by fully-fledged birds, this has at least reduced the pressure on growing

 

ducklings at critical periods in the summer. From mid-September, local fishermen commence intensive activities in this area, when the risk of death to birds from bycatch increases. It is not feasible to request local people not to fish in this area at this time, because for many of them fishing is the only source of income. In 2020, many Armenian Gulls left the lake prematurely (because they no longer had chicks to feed on the island). Possibly as a result of this, an impressive 39 ducklings fledged in 2020, and although the gulls were still successful in predating some Velvet Scoter ducklings it was evidently at lower levels than in previous years.

Other factors that could potentially affect the Velvet Scoter population include weather conditions and food supply. Unfortunately we have no information about the diet and food resources of the lake, and the weather showed little difference across the four years (although 2020 was a little warmer and drier).

It therefore seems likely that the scoters' poor reproductive success is caused by a combination of predation and human disturbance. The main predator of ducklings on Lake Tabatskuri is the Armenian Gull, the numbers of which have increased rapidly at the site which supports (as well as having a major adverse impact upon) the last breeding small population of Velvet Scoter in the Caucasus. Consequently, the control of the gull population can potentially have a positive impact on the scoters' reproductive success. However, more detailed study is urged before taking such a decision as a means of protecting the Velvet Scoters. In 2020, three sitting females were predated on their nests, most likely by Marsh Harriers. This may have been because Velvet Scoter were forced to incubate without the "umbrella" predator protection provided by nesting gulls nearby, which normally go up to mob any raptor approaching the island. Hence, lower gull numbers could have resulted in the Marsh Harriers having better access to nesting scoters. Against that, in 2020 grass growth in the island was very poor, making it easier in some areas for aerial predators to detect scoters sitting on nests. The population "value" of losing a breeding adult female (taken by harriers) is relatively greater than that of a small duckling (which has high initial mortality and lower first winter survival), but "value" is also compounded by the relative numbers taken, so it is difficult to truly judge the relative and population-level effects. However, gulls take a very heavy toll on ducklings, even if it is during a short time "window" when they are small. Certainly it seems important to elevate duckling survival rate in order to build further upon the successes of other management interventions (such as removal of human egg collection) to protect the site and its parlous Velvet Scoter population for future years.

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