

Number and distribution of couples Egyptian Geese (*Alopochen aegyptiaca*), and the possibility of diminishing the population through intervention in the number of hatched eggs and/or fledged young on Sabi River Sun Resort and Pine Lake Resort

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Abstract

The Egyptian Goose is a goose that is spreading easily throughout the world and possibly causing multiple problems. At two resorts of the Tsogo Sun Company a population study was done to examine the number of couples of Egyptian Geese, their distribution and the possibility of diminishing the population through intervention in the number of hatched eggs and/or fledged young. The study was conducted from the last week of June to the last week of August. At both research sites multiple couples were found that defended a territory. No nests were discovered at either Pine Lake Resort or Sabi River Sun Resort. Only on the property of the Sabi River Sun Resort young were found. All young were raised in the same area.

Keywords: Egyptian Goose, *Alopochen aegyptiaca*, human-wildlife conflict, intervention, control, golf course, resort, South Africa, Mpumalanga, nests, hatchlings, young, survival.

Introduction

The Egyptian Goose (*Alopochen aegyptiaca*¹) is a half-goose that belongs to the subfamily Tornidae. The adult geese are greyish brown with reddish brown tones on the upper wing coverts, nape, around the eyes and in a blotch on the lower breast. Their beaks are pink with a black 'frame' and their legs vary from light to dark reddish pink. The secondaries are iridescent green and they have a large white facet with a narrow black bar that is present across the front of the greater secondary feathers. These features are hard to notice in rest, but quite easily seen in flight. Their primaries, rump and rectrices are black (Fig. 1 a&b). Males can only be distinguished from females by the sound they make. The males produce a hissing noise whereas the females make a loud honking sound with sounds as 'honk-haa-haa-haa' and are more vocally (Vogelbescherming, n.d.; Johnsgard, 1978; F. Majoor, pers. comm., June 16, 2013; Sinclair & Ryan, 2010). Young Egyptian Geese have a different plumage till they are 1 year old. The brown patches around their eyes and on the breast are absent and they have a double black bar on the white part of their wings. Their beak and legs are colored light orange (Fig. 1c). Before they have all their feathers, the young have creamy-white down with dark brown marks. The legs and beak are dark grey (F. Majoor, pers. comm., June 16, 2013) (Fig. 1d). After 70-75 days the young are able to fly (Siegfried, 1967 (a)).

Egyptian Geese mate for life (Harrison, 1978) and are able to breed when they are one year old (Van Dijk & Majoor, 2011). Despite their ability, they are rarely seen nesting on this age because of the territorial behavior of the older geese (F. Majoor, pers. comm., June 16, 2013). Nests are made on the territory of a couple and can be found almost everywhere (e.g. tree cavities (Beazley, 1964), under vegetation, on islands (Sutherland & Allport, 1991), in cliffs and caves (Harrison, 1978), on nests of birds of prey (Van der Jeugt et al., 2006) or the Hamerkop (*Scopus umbretta*)). They are mostly seen near open water for protection of the young and in sites with short grass for chicks to graze (Sutherland & Allport, 1991). Nest size is mostly 6-10 eggs (Mackworth-Pread & Grant, 1980)

¹ The name of the Egyptian Goose has recently been changed from *Alopochen aegyptiacus* to *Alopochen aegyptiaca* (Sangster et al., 2003)

Figure 1a.

1b.

1c.

1d.



Figure 1. a) An adult female Egyptian Goose with a hatchling. Notice the dark-brown spot on the breast and around the eye of the adult goose. b) An adult male Egyptian Goose. The neck ring and the colors of the plumage are visible. c) A nine weeks old young. Notice the lack of the spot around the eye and on the breast, and the different color of beak and legs. d) A hatchling.

and are incubated by the female (F. Majoor, pers. comm., September 2, 2013) in 28-30 days (Maclean, 1988 (a)). Most young are seen just before the rainy season starts in August through January, but breeding can take place throughout the year in Africa (Eltingham, 1973; Newman, 1980). In regions with two wet periods, there are generally two peaks in breeding (Brown et al., 1982). That Egyptian Geese adapt well and take any opportunity to breed can be seen in the Netherlands where goslings were spotted in January, on frozen water (F. Majoor, pers. comm., June 16, 2013).

When a pair of Egyptian Geese has a territory, they will attack other Egyptian Geese intruding that area. They vocalize, fly or run directly towards the geese that are nearby their territory and will bite and hit if necessary to chase them. Johnsgard (1978) reports that they struck human intruders as well when approaching the nest. After a successful chase, the pair will come together, put their necks high in the air and make a loud stuttering 'victory' sound. Because of their territorial behavior, it is commonly said that the Egyptian Goose is chasing indigenous birds. Curtis et al. (2007) found that the productivity of the Black Sparrowhawk *Accipiter melanoleucus* was depended on the presence of the Egyptian Goose. Pairs of Black Sparrowhawks that did not encounter the geese raised an average of 1.58 chicks per breeding attempt, compared with 0.76 chicks for pairs that encountered them.

The Egyptian Goose is one of the most common wide spread waterfowl in its native continent, Africa (Harrison et al., 1997 (a)). Although many people think otherwise, the Egyptian Geese are indigenous in South Africa (Little & Sutton, 2013). They show no regular migration and make irregular movements in response of the wet and dry seasons up to 1000 km (Oatley & Prÿs-Jones, 1985; Siegfried, 1967 (b)). Seasonal differences in number of geese are not seen everywhere, these trends could differ due to the presence or absence of permanent water bodies in the area (Van Niekerk, 2010). It is commonly said that the population of Egyptian Geese is growing. Okes et al. (2008) calculated that between 1978 and 2005 the population of Egyptian Goose in South Africa has increased with 15%. In some areas the growth of the population has been more than in other areas, for example in the Western Cape (Magnall & Crowe, 2002; Magnall & Crowe 2001). On the Dassen Island the population has even increased more than 10-fold between 1988 and 2000 (Underhill et al., 2000).

Populations of Egyptian Geese are also established at various locations outside their natural range. They are found for example in Arkansas (Smith & James, 2012), Florida (Braun, 2004), Britain (Sutherland & Allport, 1991), the Netherlands, Belgium and Germany (Lensink, 1999; Van der Jeugd &

Majoor, 2010; Van Dijk & Majoor, 2011). When colonizing new areas, Egyptian Geese often persist for a long period of time in small populations (Kampe-Presson, 2010). Compared to Belgium and Great Britain, the numbers of Egyptian Geese has been increasing remarkably fast in the Netherlands (Lensink, 1999). The annual increase of the Dutch population in 2006 was 12%. In some areas in the Netherlands the population is stabilizing, but in the neighboring sites in Germany the population is still increasing rapidly (Van der Jeugd et al., 2006; Wink et al., 2005).

Egyptian Geese live in areas where water is found (e.g. dams, lakes, estuaries, pans, sewage ponds and rivers) where the shoreline is preferably exposed and are also seen near the coast and on the sea (Harrison et al., 1997 (b); Hockey et al., 7th edn.; Taylor, 1957; Ryan, 2013; Underhill et al., 2000). They show a tendency to forage in clean dams during winter and in manure affected water bodies during summer rains (Van Niekerk, 2010). The geese switch to a diet of grasses that grow along the waterside and aquatic vegetation during the molting period (Halse, 1984). When there is not enough food during this period, they can live largely on reserves and lose 20% - 25% body mass (Shewell, 1959). During the non-molting period Egyptian Geese are terrestrial feeders, eating grass, grain, aquatic rhizomes and tubers, seeds, leaves, crops and crop seedlings and occasionally insects (Halse, 1984; Maclean, 1988 (b)). The increase in production of crops and changes in farming practice might be responsible for the increase of Egyptian Geese. On the Agulhas Plain in Western Cape the production of barley, one of the two major crops that are consumed by the geese, has increased 10 fold (Magnall & Crowe, 2002). With the new farming techniques more seeds are spilled when sowing and ripe crops are left to dry in windrows after being cut for two weeks (Magnall & Crowe, 2001). Next to that, geese feed on the growing plants until they are taller than 25 cm which causes a 65% loss of the yield (Magnall & Crowe, 2002). Magnall & Crowe (2002) estimated the financial loss in the studied area in 1997 R190 000 and R410 000 in 1998 (respectively approximately €14 000 and €30 000). The most severe annual damage from the geese was received by the farms that were closest near the main resting sites (Magnall & Crowe, 2001). Besides feeding at the crop field they also are known to feed at the feedlots of the livestock in South Africa (Van Niekerk, 2010).

Feeding near farms could have effects on some livestock. Avian influenza virus (AIV) isolated from wild birds and farmed ostriches show a polygenetic relationship, which indicate that the wild duck populations are acting as a source of AIV infection for intensively farmed poultry (Abolnik et al., 2010). Thompson et al. (2008) found that in the Klein Karoo area an increasing frequency of contact with Egyptian Geese was associated with an increased risk of seropositivity of AIV in ostriches. In 2004 and 2006 low pathogenicity avian influenza strains from a wild bird reservoir transformed in ostriches to high pathogenicity avian influenza which caused export bans imposed by the European Union and had serious economic effects (Abolnik et al., 2010).

Another field where complaints are heard are the golf courses. These areas, parks and estates are attractive to geese because of the large expanses of irrigated grazing lawns which are interspersed with artificial water bodies and predators are largely absent (Little & Sutton, 2013). Little & Sutton (2013) assessed that 84% of the users of the Steenberg Golf Estate in Cape Town considered that the geese are a problem on the estate. The biggest concerns where the harassment of the geese to other birds and the faecal mess. 52% of the respondents that thought of the geese as a problem rated the problem as severe. More than 85% of all respondents felt that the population of Egyptian Geese required active management and be reduced by 50%. These issues are comparable to the complaints that are heard on the two study areas in this research. The complaints that are often received are dirty courses and noise harassment. Other problems are the seeds of foreign grasses from the faeces of the geese which causes alterations on the special grass of the courses, the possibility of aggressiveness and the loss of (water) bird diversity (C. Nel (deputy general manager SR), pers. Comm., June 27, 2013). Different methods to decrease the nuisance and population at the resorts have been used (e.g. shimmering objects, predatory birds, chasing with dogs, wires on roofs and chimneys and otters), but the attempts did not work or saw to satisfactory results (C. Nel (deputy general manager SR) & S. Mathews-Pheiffer (manager PLR), pers. comm., June 2013).

All these facets lead to the question if there is a possibility to decrease the number of Egyptian Geese. This population study will be a start to investigate if intervention can be done in the early stadium of life of the Egyptian Geese to decrease the population.

Material en Methods

Study area

The research was conducted on the property of Sabi River Sun Resort (SR) and in the area of Pine Lake Resort (PLR) (Fig. 2 & 3). The two resorts both belong to the Tsogo Sun Company.

SR is a golf resort in Hazyview, Mpumalanga, South Africa, with 60 hotel rooms and 104 semi-detached time-share chalets which are surrounded by the 18 hole golf course. The area is bordered with fences of approximately 2m on the east, south and west side. The north side of the resort is bordered by the Sabie river and a fence of tree electric wires to prevent hippopotami and other wild animals to enter. Spread over the property are 5 artificial swimming pools and multiple ponds. One of the ponds is the territory of crocodiles and hippopotami and is fenced with the electric wires (Fig. 5). There are different types of grass on a golf course and most of it is sprinkled and mowed regularly. The Egyptian Geese are chased three times a day at approximately 6am, 4pm and 9pm with a golf cart and three Border collie dogs by the deputy general manager.

PLR is a timeshare resort near White River, Mpumalanga, South Africa, with 34 semi-detached chalets. The approximately 50x200m long grass area in front of the chalets contains mostly LM grass (S. Mathews-Pheiffer (manager PLR), pers. comm., August 2013), is sprinkled daily and is situated at the Longmere Dam. In the middle of the lawn an artificial swimming pool of approximately 10 x 20 m is situated. The Longmere dam is a dam of approximately 250mx3,6km which has different kinds of watersides e.g. reed, small amounts of reed and grass, shrubs, burned grass and shrubs, grass, sprinkled grass and sprinkled grass with or without shrubs and/or trees with houses within 30m of the waterside (Fig. 4). The borders of the research area on the east, south and west side were the limits of the visible range from the lake. Because the Egyptian Geese prefer a habitat with open shorelines with an unhindered view at water bodies, the amount of reed was used as a guideline, the most northern point where data was collected was S 25 15.339, E 31 0.192 (Hockey et al., 7th edn). The surrounding region of SR produces mostly subtropical fruits and nuts. Near PLR are mostly Blue Gum tree (*Eucalyptus grandis*) forests. In both regions are multiple small water bodies (Fig. 2 & 3).

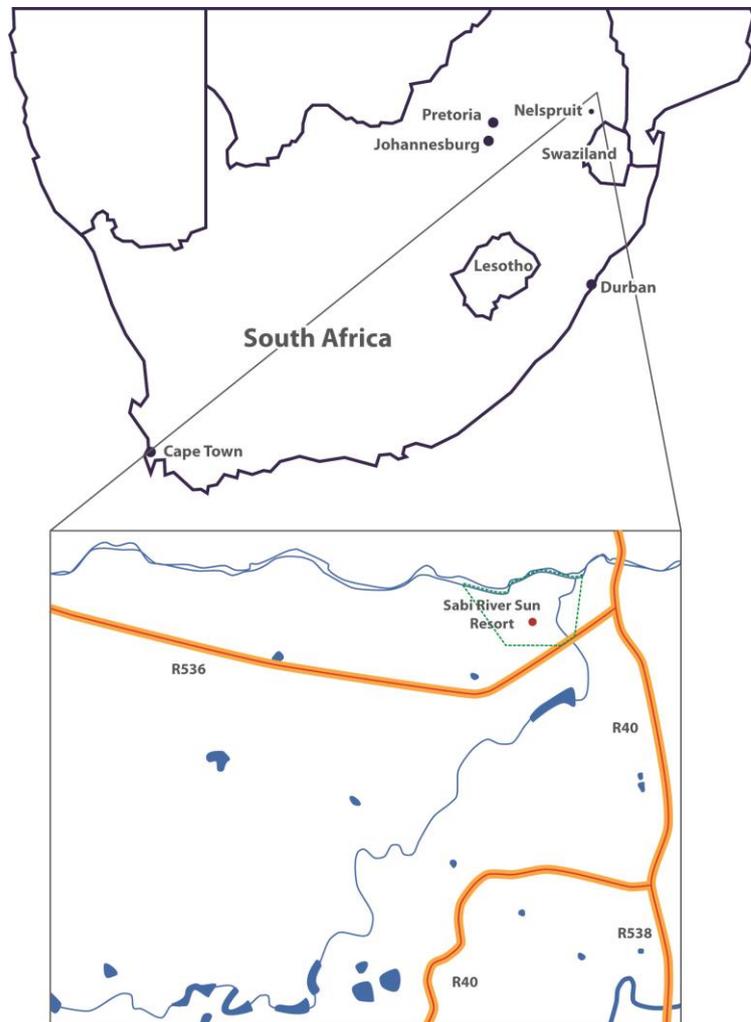


Figure 2. Overview of surrounding of Sabi River Sun Resort. Outlined with the green dashed line: the research area. South-east of this map are many water bodies.

Surveys

Data was collected from the last week of June 2013 to the last week of August 2013. Both study areas have been visited multiple times in this period [additional details in supplement 1].

At SR the surveys were done twice a day. At 6 o'clock by golf cart with the deputy general manager when he was chasing the geese with tree border collies and later in the day without the dogs by a walk (Fig. 5). The surveys at PLR were done ones a day from a rowing-boat (Fig. 4).

In order to find the nesting places, couples and single geese were located every survey. Flying geese were not recorded (Sovon, n.d. (a)). The results were marked on a map to discover if geese were seen in the same area. When a single goose was seen in the same area on multiple sightings, the field was inspected more thoroughly to see if there was a nesting place. The same methodology was used when only one goose was spotted on the territory that used to be occupied by a pair. Territories were determined by spotting a couple multiple times on the same site.

When a pair was seen with hatchlings, the young were counted, and the date of birth was estimated and registered. To estimate the date of birth, the size of the young and the amount of down vs. feathers were used (Table. 1). On the following surveys the number of young geese were recorded as well.

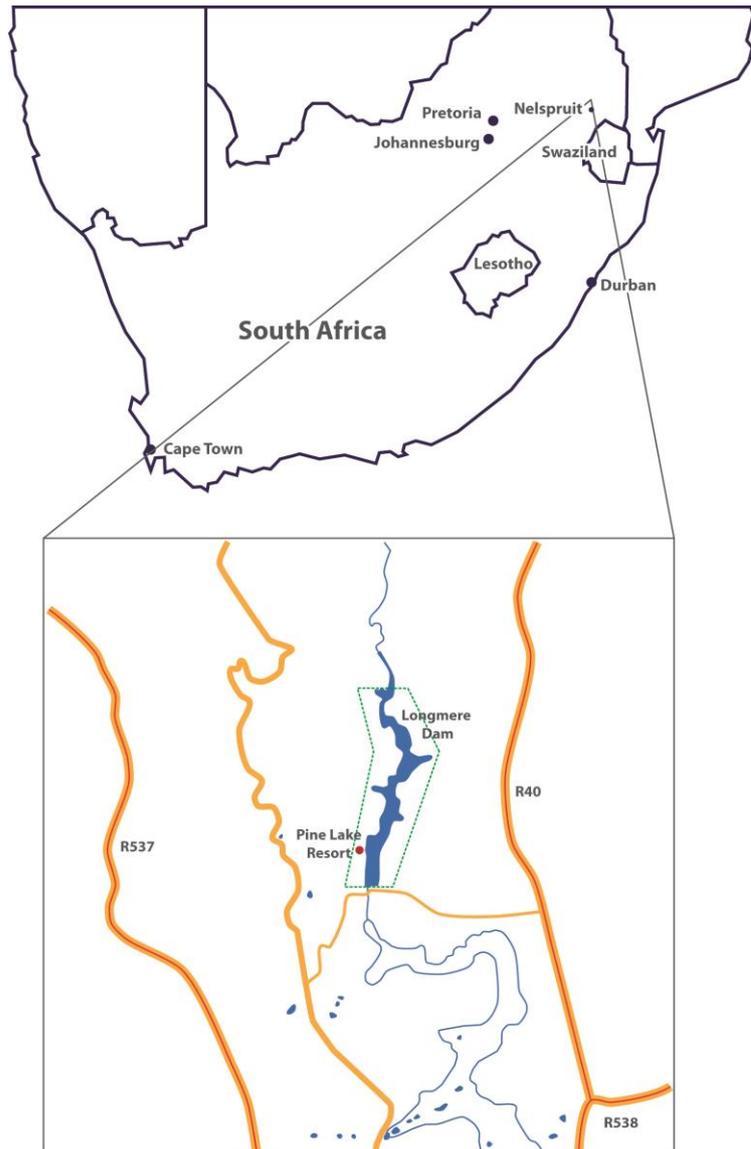
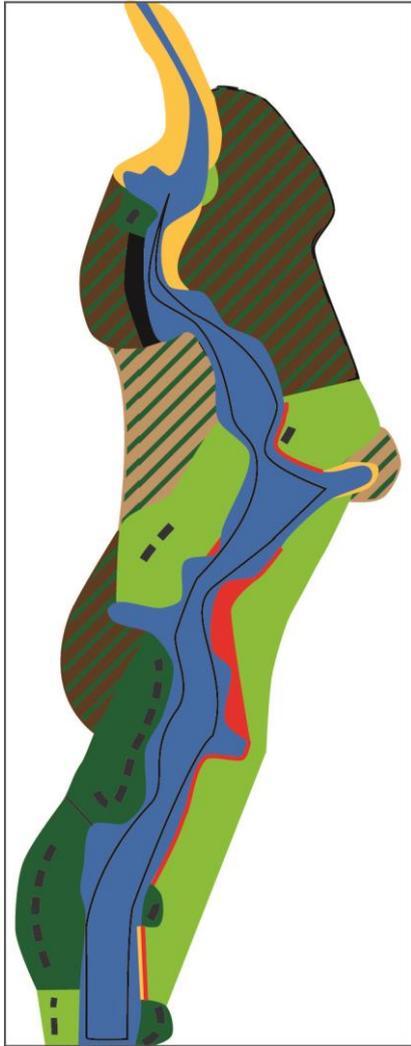


Figure 3. Overview of surrounding of Pine Lake Resort. Outlined with the green dashed line: the research area. In the area outside the map are multiple water bodies present and north of the Longmere dam lays another dam.

Distinctive feature	Age
First feathers visible	5 weeks
Able to fly	≥ 10 weeks
Different colors of the head compared to adult Egyptian Geese	< 1 year

Table 1. Features to distinguish the young Egyptian Goose (F. Majoer, pers. comm., June 16, 2013).



⇐ Figure 4. Longmere dam with different kind of shorelines. Blue: Longmere dam. Light green: unsprinkled grass. Dark green: sprinkled grass. Yellow: reed. Red: shrubs and trees. Dark brown with green stripes: Blue gum tree forest. Light brown with green stripes: forest. Black: burned ground. Grey dashed lines: buildings. The black line in the water shows the route that was used during the surveys.

⇓ Figure 5. Sabi River Sun Resort. Green: golf course and grass surrounding the chalets. Dark green: trees, the smaller the dashed lines, the smaller the trees and/or the concentration of trees. Grey dashed lines: buildings. Light grey facet: hotel, restaurant, bars and stores. Yellow: reed. Yellowish green: high dry grass and dumping ground. Dark blue: water. Light blue: swimming pool. The red line shows the route that was used during the surveys. The biggest pond is fenced off with an electric wire.



Results

In the area of PLR there were counted at the most 7 couples per survey in June. In the last period of the research there were at least 7 couples counted per survey (Table 2). The pairs were mostly found in areas with sprinkled grass and an open shoreline (Fig. 6). On the last survey there was a single bird seen in one of the territories.

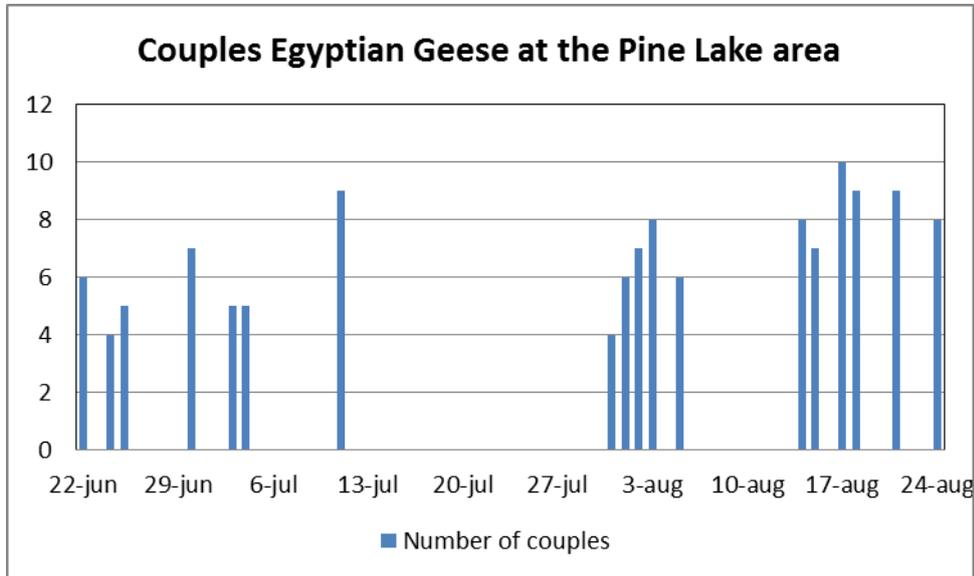


Table 2. Number of couples of Egyptian Geese observed at the Pine Lake area.

At SR there were 2 to 10 pairs spotted each survey with more couples seen in the later period. During the surveys there were some areas where pairs were seen almost every morning visitation but not on the surveys later in the day. There were usually less couples seen during the surveys in the morning. (Table 3). Pairs were mostly seen in the areas where water bodies and green grass were available and sight was unhindered. The group of geese shifted in the last period of the research to the larger pond in the south of SR and the couple that had their territory there left. Single geese were only seen in the eastern part of the property (Fig. 7).

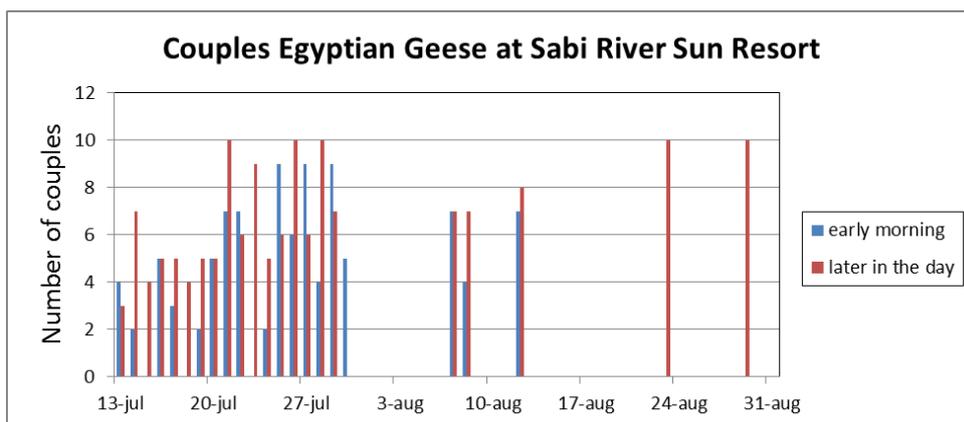


Table 3. Number of couple of Egyptian Geese observed at Sabi River Sun Resort.

On the first day of survey [June 27th] on SR two pairs with goslings were seen. One couple had four young of approximately 5 weeks old; the four young of the other couple were just hatched. Two weeks later [July 13th] the four older young were still present, the young hatchlings were not found. In week 4, a new couple with 9 young was seen on July 21st. The number of these hatchlings diminished in the following weeks to 6, 5 and 2 in respectively week 5 [July 27th], week 6 [exact date

unknown] and week 8 [August 7th]. In the seventh week of survey a fourth group of young were present on the 12th of August. On the 23rd of August, the number of these hatchlings decreased from 9 to 7. On the last day of survey [August 29th], the couples of nest 1, 3 and 4 had respectively 4, 2 and 7 young (Table 4).

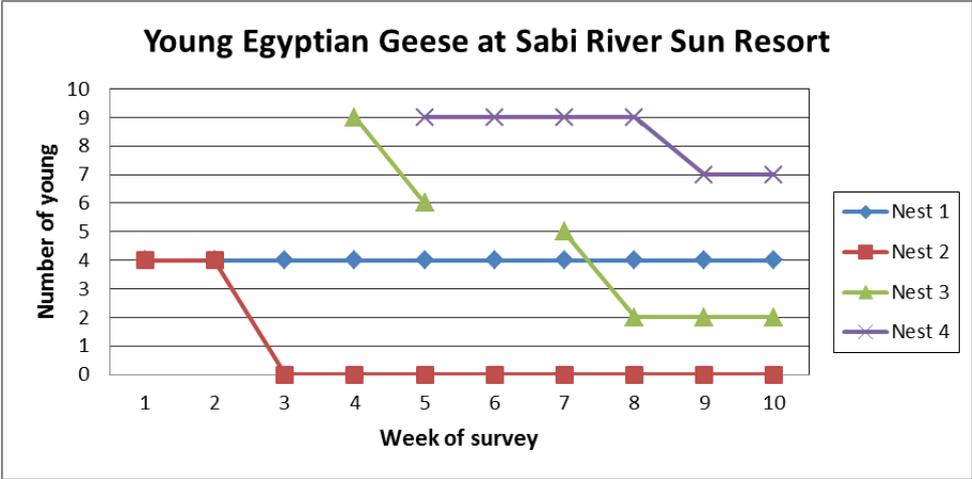


Table 4. Number of young Egyptian Geese observed at Sabi River Sun Resort.

All hatchlings were raised near the pond that was surrounded with the electric wires. A shift was observed in the exact place where they stayed. The older the young were, the more north they lived. The oldest young shifted to the more open grass area on the opposite of the lake in the last week of the research (Fig. 7). In the first period there were two geese that still had the plumage of a young, but already joined a group of adult geese. There were no young seen in the area of PLR. No nests were discovered in the area of both PLR and SR.



⇨ Figure 6. Longmere dam with different kind of shorelines. Blue: Longmere dam. Light green: unsprinkled grass. Dark green: sprinkled grass. Yellow: reed. Red: shrubs and trees. Dark brown with green stripes: Blue gum tree forest. Light brown with green stripes: forest. Black: burned ground. Grey dashed lines: buildings. The orange dots show the area where couples were seen mostly. The white dot indicates the area where the large group resided.



⇩ Figure 7. Sabi River Sun Resort. Green: golf course and grass surrounding the chalets. Dark green: trees, the smaller the dashed lines, the smaller the trees and/or the concentration of trees. Grey dashed lines: buildings. Light grey facet: hotel, restaurant, bars and stores. Yellow: reed. Yellowish green: high dry grass and dumping ground. Dark blue: water. Light blue: swimming pool. Red dots: couples that where almost always present during the surveys. Purple dot: couple that was only present during the morning survey. Black dots: couples with young. White dots: single geese that were almost always present during the surveys. The biggest pond is fenced off with an electric wire.

Discussion

Data collection

As can be seen in supplement 1 the collecting of data has not been regularly. Some couples were seen every day of the research whereas others were seen irregularly. If data would have been collected on a more regular base, it might have been possible to find the territories of the irregularly seen pairs. Not seeing a couple in the area where they were expected does not certainly mean that the couple is not in the whole research area. This can only be known for sure if the geese are marked individually with for example a ring on their legs. Without these individual markings, it could also be possible that birds were counted multiple times during one survey. In the morning because they were chased, and during the day because one walking tour of inspection took 1,5 hours and a survey by boat 2 hours.

During the early surveys at SR, the geese reacted vocally if the dogs and/or golf cart came near. The surveys later in the day and the surveys at PLR were done without dogs; therefore it could be possible that geese in shrubs and green trees were missed if no other geese made them react vocally.

Collection of data at PLR was mostly during the same period of the day. The second surveys of the day at SR were irregular if focused on the time of collecting. When the second surveys are done early in the morning and just before dusk, it is possible that some geese have left the property to feed and/or that other geese visit the area for feeding (Underhill et al., 2000).

Nests & Young

The fact that no nests were found could be a consequence of different factors. Although the Egyptian Geese can breed throughout the whole year, most young are found from just before the rainy season in September till January (Eltingham, 1973; Newman, 1980). Therefore, the period that this research was conducted was slightly early. However, nests for the first young of the rainy season were expected to be present. As can be seen in fig. 2 and 3 outside both research areas are numerous water bodies present. It is possible that these could provide for the raise of the young and nests are made near these waters. Weather conditions could be a factor as well. In the Netherlands the breeding season starts 2 – 3 weeks later after a severe winter and can as well be postponed from the usual date when there is flooding of the feeding grounds and breeding sites (Lensink, 1999). Although the weather in the Netherlands and the Mpumalanga province are not comparable, it should be taken into account that the weather situation can alter the breeding season. This year there had been some rain during the winter which is unusual (Staff PLR, pers. Comm. Staff, August 2013). It is also possible that a (part of) the geese did not have time to build a nest yet because of their territorial behavior. At both research sites there were multiple pairs that did not seem to have their own territory, especially at PLR where a large group of 100 – 200 geese was present (Bastiaansen, unpublished data). Defending a territory takes time and energy which could otherwise be spent to a nest.

Since there were young found during the research period, there could be other elements that are important as well. The area where some single geese were spotted and thought to have a partner on a nest were not always suitable to be investigated. Especially at SR, where hippopotami and crocodiles could be in or near the river. The fenced off pond at SR was the area where most nests were expected to be. No further investigation was possible on that site because this was the territory of the hippopotami. It is also possible that the nesting sites are further away from the water because adults can travel with their just born hatchlings quite a distance before they arrive at the site where they will raise their young (Sovon, n.d. (b)). This is mainly possible at PLR because the domain of SR is fenced off on most sites.

All young that were seen were raised in the same area: the pond where the hippopotami live. This place is surrounded by plenty sprinkled grass that is not mowed as regularly as the grass of the golf course and gives a relatively safe harbor within the electric fence. Pairs have been seen at other

places as well, this raises the question if later this year there will be young in other areas at SR as well. On the site where the young lived that died within two weeks, arrived a new group of hatchlings after approximately 4 weeks. Although it is possible that a pair makes a second nest far off the site of the first (failed) nest (Sovon, n.d. (b)), the outstanding dark colors of the female goose and the time that is needed to incubate the eggs gave reason that the new young in the same area were thought to be the new offspring of the same pair that lost their young.

With the small amount of collected data of young, a sufficient calculation of the survival of the young can not be made. No papers on the survival of young Egyptian Geese in South Africa were found during this research. Eltringham (1973) found that juvenile survival in the first two months was 60% in Uganda. In the Netherlands a decline of only 20,0% in the number of young over the period from hatching until just before fledging was seen (Lensink, 1999).

In Uganda only 47% of the pairs that breed are successful and 10% of the pairs breed more than once a year. Combined with 6,5 young per successful pair and the survival of the young in the first two months a pair of Egyptian Geese have on average less than 2,0 young that fledge per year (Eltringham, 1973). In the Netherlands the number of fledged per breeding pair per year is higher [2,0], despite of the lower average of young per successful pair (Lensink, 1999). Not all young that fledge will turn into breeding adult Egyptian Geese. Van der Jeugd and Majoor (2010) calculated that the survival of juvenile Egyptian Geese from just before fledging till the age of 1 is approximately 41%. In the subsequent year survival is almost 71% and adult geese have a survival rate of 83%.

Differences in predators and predatory pressure are thought to be a factor in the difference of survival numbers. Because predators are fenced out on golf courses and on resorts, this raises the question if survival of young is higher than the average on these premises. At SR, fences keep the big predators of the property, but there are still animals present that can eat the eggs and/or young birds (e.g. iguanidae, monkeys, crocodiles, otters, birds of prey and small cats). The British average of only 1,0 young per pair per year (Sutherland & Allport, 1991) gives an indication that not only the presence of these predators is a factor, since they have about the same animals as the Netherlands. These factors will be discussed further in the penultimate paragraph.

Intervention

On both research areas different methods have been used in an attempt to decrease the number of Egyptian Geese. Shimmering objects did not seem to have any effect on the birds. How and where these objects had been placed is unknown and it could be possible that this was not sufficient. On the other side, geese are known to get used to these kinds of objects and many shimmering objects are likely to have a negative effect on residents and other animals as well. The effect on other animals and residents is also a problem when using the method McKay & Parrott (2002) found to diminish the number of Mute Swans (*Cygnus olor*). A combination of tape and twine significantly lowered the number of droppings on the oil-seed fields, but strands were placed closely to each other. Aguilera et al. (1991) evaluated two hazing methods for urban Canada Geese (*Branta canadensis*). The use of screamer shells during a 10-minute period resulted in a significant decrease in geese for several days. In 3 of the 5 replications there were no geese present up to 15 days after the treatment.

There has been a falconer on the property of PLR to scare the geese with a bird of prey. It seems that the geese know that they are large birds and not an easy target for predators because no reaction was seen (Staff PLR, pers. comm. August 2013). If predatory birds have an effect on the number of pairs that nest in the area and number of young that survive is not known.

Otters have been put in the water of the Longmere dam, but what the effect is on the number of young is unknown.

Chasing the geese with dogs did help to decrease the number of geese at SR. Several years ago there were 300 – 400 geese on the property, whereas during this research there counted 11 – 49 geese a day (Bastiaansen, unpublished data). Although it seemed that the number of geese was increasing towards spring, it seems unlikely that there will be as many geese in the summer as there were three

years ago. Chasing the birds with dogs that need guidance is a time consuming solution, but does decrease the geese in the area up to a certain point.

The use of wires on the roofs of the chalets at SR does not help to diminish the number of Egyptian Geese, but prevents the geese from sitting on the roofs and chimneys. To reduce the noise harassment, this intervention could also be used at PLR.

Egyptian Geese are often found in the area where they have nested (Van der Jeugd & Majoor, 2010; Van Dijk & Majoor, 2011). Lensink (1998) found that young that have made pairs also tend to make a nest within a small distance of existing breeding places. Approximately 88% of the new couples make a nest within 10 km of a breeding place, 11% between 11 – 30 km and 1% in 31 – 50 km. Decreasing the number of pairs that are breeding by taking the breeding geese of the property will probably not result in a decrease of nests because new pairs can occupy the free space. Besides that, intervention in the number of pairs breeding could possibly not result in a decrease of geese. Lensink (1999) discovered that the number of young that survives per brood increased when the number of pairs decreased, resulting in approximately the same number of young that become an adult goose.

There are different methods that can be used to diminish the number of eggs and/or young that will fledge. If these methods will decrease the population of Egyptian Geese can be calculated in a Leslie-matrix (Caswell, 2001) if adequate data is collected. A Leslie-matrix could be made with the data that is currently known from scientific research, but most of these numbers are from different parts of the world. As can be seen with the average number of young per breeding pair per year in Britain, Uganda and the Netherlands (respectively 1,0, <2,0 and 2,0 (Sutherland & Allport, 1991; Eltringham, 1973; Van der Jeugd & Majoor, 2010)), these numbers are not all alike.

Finding nests to manually intervene with the number of hatched eggs, will be a time consuming task and might even be impossible in some areas. Animals that eat the eggs and/or young (e.g. otters, iguanidae, cats) can enter the most areas and might be sufficient to decrease these numbers when put in the area. The downside of this solution is the possibility that all eggs/young will be consumed and couples will make a new nest.

Decreasing the number of pairs might not lead to a solution considering the growth of the population, as outlined above. What a solution might be, is decreasing the average number of young per pair. One could think of using contraception like deslorelin-acetate. In most Japanese quails (*Coturnix coturnix japonica*) this implant causes a decrease in production of eggs for approximately 70 days. It should be tested how many days such implant has effect in an Egyptian Goose. Because the breeding season is widely spread through the year, the implant might need to be inserted multiple times if the number of days that the implant works is around the same as in the quails. Another possibility is Nicarbazin (NCZ) capsules, which might reduce hatchability in domestic mallards (*Anas platyrhynchos*) (Yoder et al., 2006). With this medicine, it should also be tested how many times the geese should be fed with the capsules to give a reduction throughout the breeding season. Thoughts should be given to the method to catch the geese in order to give them a ring and implant/capsule. In the Netherlands geese are quite easily to catch because they are used to people feeding them (F. Majoor, pers. comm., June 16, 2013), whereas Egyptian Geese in South Africa are more withdrawn. A study on the effects of contraception is best done at SR, because there are more couples of geese staying at the same spot.

Another method that can be used is to manually diminish the number of young that fledge. Young are not able to fly before they are approximately 10 weeks old. In this period they will eat on the grass and can be caught when driven in a corner. At SR this is possible in for example a porch of a chalet, whereas in the Longmere dam area the corners should mostly be made manually. Care should be taken to prevent the young for entering the water. In the water, young will dive under the surface to avoid being caught and they are hard to catch. An eye should also be kept on the adult geese because they will attack when a young is threatened (F. Majoor, pers. comm., June 16, 2013).

The question should be asked whether the problem needs to be solved on a larger scale or only locally, and which geese are considered most welcome on the property. Diminishing the number of (hatched) young will not reduce the number of adult Egyptian Geese which are causing the most nuisance, but might be able to result in a decrease of the total population. Reducing the number of

pairs that breed will possibly result in an increase of young that survive per pair Lensink (1999), but these young geese will not stay on the property and are considered more likable by residents. A combination of both could be the best solution. One of the methods to decrease the number of young could be combined with a change of the surrounding to diminish the places where pairs could have a nest. Watersides should be difficult to reach from the water and not have an open sight for the geese (Hockey et al., 7th edn) and most grass should be grass that is not sweet in taste (e.g. not kikuyu (*Pennisetum clandestinum*) or LM (*Dactyloctenium australe*) grass). Not sprinkling grass might make the grass less appealing for the geese to raise their young on. Changing the plants can also change the habitats of other birds. Some birds might leave the area as well, but other can come to the changed property (Fox & Hockey, 2007).

When intervention is done, several factors should be taken into account before concluding the effect. For example weather conditions could alter the results. Van der Jeugd & Majoor (2010) found that the Egyptian Geese are sensitive to drought. A positive relationship between the rainfall during the Dutch summers and the survival of young and old geese was apparent. Also, in the Netherlands there are more successful pairs Egyptians Geese after a severe winter which all raise significantly more young than after an average winter (Lensink, 1999). Because the geese can compensate the decrease of the population from the severe winter in that way, intervention in the breeding success is not likely to be a solution that can be done once, but needs to be done every year.

Because the manager of PLR and the deputy general manager of SR stated that the peak of the number of Egyptian Geese is around December-January with a doubling of the number of geese compared to the summer and the breeding season is at the end then, it would be interesting to do another study that period. Lessons of how such study could be done better can be learned from this paper. When geese could be ringed, more correct data could be collected and follow up of the individuals for further research is possible. With more data collected a more accurate Leslie matrix could be produced to calculate the possibilities to decrease the population of Egyptian Geese.

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Supplement 1

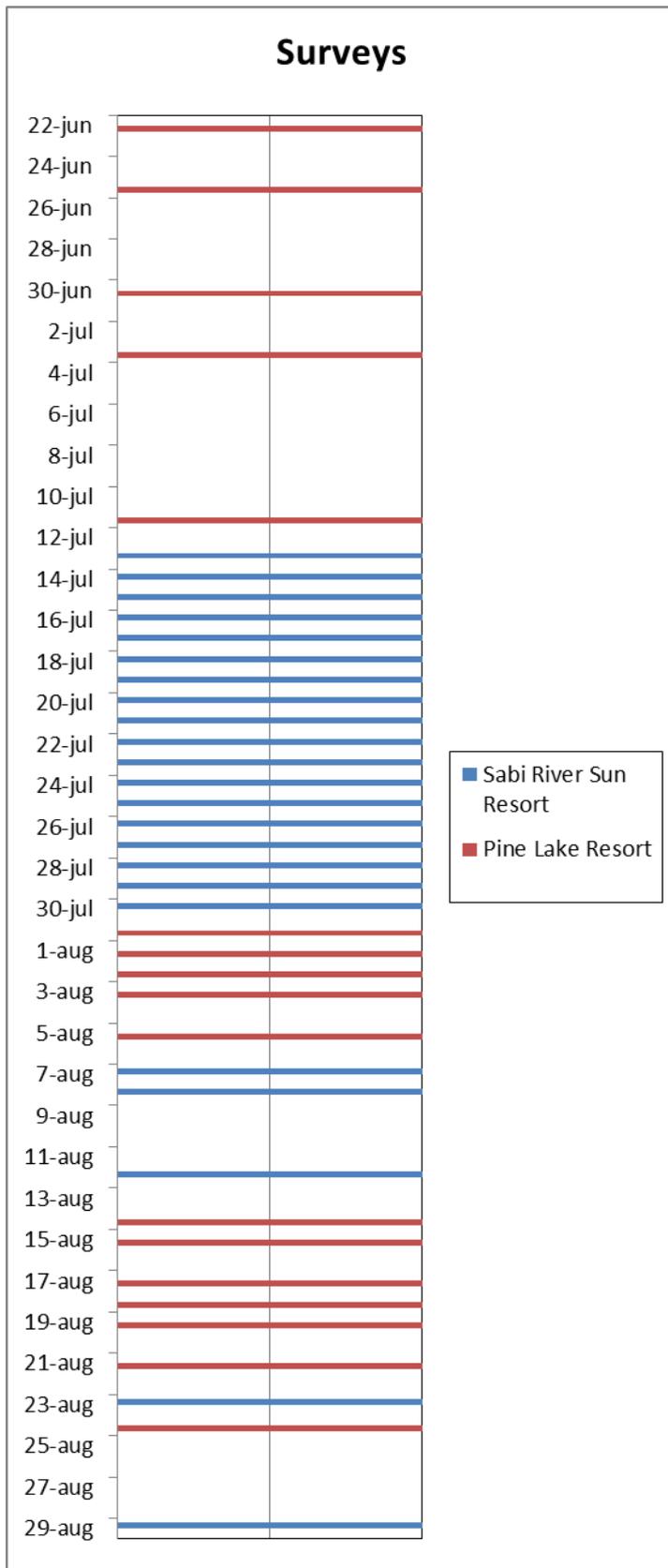


Table 5 . Dates when surveys were conducted.