OPTICAL BIRD DETERRENT DEVICES USAGE IN RESIDENTIAL AREA IN THE WESTERN CAPE – HEALTH EFFECTS IMPLICATIONS.

A REVIEW OF AVAILABLE LITTERATURE

PUBLIC HEALTH PRACTICUM REPORT

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Acronyms and abbreviations

CAE:	Childhood Absent Epilepsy
EGG:	Electroencephalogram
GTCS:	Generalised Tonic-Clonic Seizure
GGE:	Genetic Generalised Epilepsy
Hz:	Hertz: flashes per second
IPS:	Intermittent Rhythmic Photic Stimulation
JAE:	Juvenile Absence Epilepsy
JME:	Juvenile Myoclonic Epilepsy
PSE:	Photosensitive Epilepsy
PPR:	Photoparoxysmal Response

Introduction (Timeline, deliverables, activities, source of information, change in focus) – main topic health and ecology

This project was prompted by concerns raised by community members from residential areas in Fish Hoek suburb, City of Cape Town, about the use of optical bird deterrent devices placed on the roofs of houses and other building to keep birds away from them in the area. Those raising this issue find these devices (which reflect sunlight and flash as they rotate in the wind) to be an irritating disturbance that affects their quality of life. Secondly, there is concern that at certain flicker frequencies, they may trigger seizures in persons who have a condition known as Photosensitive Epilepsy (PSE).

The client (representing the community members) approached the School of Public Health at the University of Cape Town on the issue and a second-year master's degree student in Public Health/Environmental Health track was contracted to conduct a literature review with the initial aim to gather evidence on the use of bird deterrent devices in residential areas and the health effects that could arise from exposure to flashes from those devices, especially for individuals suffering from PSE. The search diverted from the initial plan after consultation with experts in Epilepsy (Appendix 1); therefore, the final search focused on incorporating the whole aspects of health nuisance that could arise because of exposure to flickering light from optical bird deterrent devices including the ecological benefits that birds bring to a residential area.

The project timeline was a maximum of 120 hours spread over 16 weeks. It was conducted remotely with a single visit on the site, Clovelly area, Fish Hoek suburb on the 6th of August 2021.

This report seeks to:

- *Describe the various Optical bird deterrent devices used,*
- *Provide evidence on the impacts of optical bird deterrent devices on the quality of life and risks to persons with PSE and*
- *Report on the local and international regulations relating to the use of bird deterrent devices, light exposure, and health nuisance.*
- *Other project outputs: A presentation will be presented to the client, members of the Clovelly community and local authorities to outline the main findings of this study and the recommendation to amend this issue.*

1.1 Information source

1.1.1 Desktop literature review

The initial research questions were:

- *What is the specificity of visual bird deterrent used in residential areas and are there any existing regulations around their usage?*

- *What are the health risks associated with exposures from flashers of Bird deterrent devices, with PSE syndrome?*

The source to inform the report were collected by conducting a literature review, this was based upon the guide to writing a dissertation literature review by Randolph (2009), a similar search strategy was used to assess risks of light flashes to cause Photosensitive Epilepsy.

The search strategy followed three steps:

Table 1 Search strategy

1. Electronic search	A search conducted on Google Scholar/PubMed and UCT online library using key words as: ("Optical Bird repellent" OR "Bird scarer") AND ("Utilisation" OR "Use") AND ("South Africa"), ("bird deterrent") AND ("Utilisation") AND ("South Africa") and ("Visual deterrent" OR "Eagle eye bird deterrent") AND ("properties" or "Specification") AND ("Usage" OR "Utility") AND ("South Africa"). Key words for PSE: ("Light exposure" OR "glare" OR "Light beam" OR "glare" OR "Flahers") AND ("Frequency" OR "Speed") AND ("Epilepsi" OR "photosensitive epilepsy") AND ("Adults"), ("Photosensitive epilepsi" OR "photoparoxysmal response" OR "Photosensitivity" or "EEG response") AND ("Light exposure" OR "Flashes" OR "Light Flickers") AND ("Frequency")
2. Reference search	Search using cited literature in an article.
3. Consultation with experts	Consultation with experts in Epilepsy and bird ecology.
4. Electronic Search from potential article title	Review of visual bird deterrent, commonly used optical bird deterrent devices, Physiology in the developing visual bird deterrents and review of visual bird deterrent in residential areas.

1.1.2 Consultation with experts

An expert in epilepsy working at the epilepsy foundation in the city of Cape Town, South Africa, was consulted after the first draft of the literature was developed and submitted to

the client. The aim was to get insight on the conclusion drawn on the possible relationship between epilepsy and reflective bird deterrent devices from the document. From this consultation, it was concluded that there was a need to examine all the health outcome that could arise from exposure to light and not only Photosensitive Epilepsy. Additionally, journal articles were provided by the expert to support the student in the search.

A second consultation was held with an expert in conservation biology from the FitzPatrick Institute of African Ornithology at the University of Cape Town (Appendix 2). The student conducting the practicum was provided with three literature sources on bird ecological value in residential areas to add on the literature for that topic and inform the literature review.

The literature review has-two main aims with additional sub-focus points. It focuses firstly on bird deterrent devices used worldwide and in South Africa and possible health nuisance that could arise from exposure to such devices. Another main point of the study was to look out for any existing relation between exposure to artificial light from any output device and its possible health effects; it also looks at the ecological importance of birds in communities as well as any regulation relating to bird deterrent devices or health nuisance from light exposure. Articles on these subjects were selected at a minimum period of 10 years from now, 2012 – 2021. Articles that were not reporting on any sort of bird deterrents devices weren't selected for this review. Articles not referring to optical bird deterrent devices but touched on other types of bird deterrent devices as audible bird deterrent devices were used in the literature.

1.1.3 Study subject

It was reported by the client that the first incidence of an optical bird deterrent device being placed on a premises was in 2018, since then the practice has grown. As of 06/11/2021, it was observed that more than 5 houses (Appendix 3) had those devices placed on their roofs and some had 2 devices on one house (Appendix 3). The observed frequency of the light on the "eagle eye bird deterrent" was 1 in 1 seconds. As visualised in figure 1, The most common birds that sit on the roofs are the following indigenous species:

Cape Turtle dove (Streptopelia capicola)

Common starling (Sturnus vulgaris)

Egyptian goose (Alopochen aegyptiaca)

Hadeda ibis (Bostrychia hagedash)

Redwing starling (Onychognathus morio)

Speckled pigeon (Columba guinea)

Figure 1 Most common birds found in Fish Hoek: (eBird, 2021)

2. Study Area and Context

This figure below (figure 2) taken from Google earth maps represents Clovelly Area, in the small suburb of Fish Hoek in the Cape Peninsula area of Cape Town, is considered a safe space to live and have tourism activities (Wikitravel, 2021) which contribute 10% of the provincial GDP (Bird Life, 2018).

South Africa is renowned for having a great consideration of biodiversity being among the few countries in the world having a Biodiversity Act and a National Biodiversity institute. This shows that South African value birds and they contribution to the country biodiversity (Bird Life, 2018).

Figure 2 Google earth picture of Clovelly area, Fish Hoek,

The presence of these birds in residential areas can have negative health impacts for the residents, for instance, Feral Pigeons soil buildings with their droppings, they destroy and contaminate foodstuffs (particularly grains) and are source of zoonotic diseases (Rivadeneira *et al.*, 2018). The European starlings are a source of Salmonella enterica at concentrated animal feeding operation (Rivadeneira et al., 2018), they can be source of other bacteria like *Salmonella spp, Escherichia coli O157*, and other shiga toxin–producing *E-Coli*. The pathogens are transmitted in the environment via bird droppings, secretion, bird feathers (Rivadeneira et al., 2018).

Despite these adverse health effects, birds can play a crucial role in maintaining the ecosystem of residential areas.

Ecosystem refers to natural processes that benefits humans (Whelan, Wenny and Marquis, 2008). Birds contribute to the environment and help humans not to witness the 'extinction experience' which refers to an increasing separation between humans and nature over time creating biological impoverishment leading to lower expectations of environmental quality

followed by a great loss of biodiversity (Belaire *et al.*, 2015). Researchers argue that the ecosystem services provided by birds do not fully explain the extinct of benefits, experience, and value that people may perceive in the environment and because of urbanisation, people and birds will overlap in spaces more and more frequently and only the way we interact will shape the future for our co-existence (Belaire *et al.*, 2015)

The study by Whelan et al (2008)states that birds provide us with many cervices, they serve as link between city dwellers and the natural environment. Birds offer cultural services by providing a beautiful scenery to watch in the morning and is associated with mental health benefits which enhances human–quality of life (Whelan, Wenny and Marquis, 2008). Neighbourhood satisfaction is also another added factor, as there is a perceived association between the presence of birds in an area and the wealth of that area (Belaire *et al.*, 2015)

It is reported that residents treat birds according to their personal perception, the more they perceived birds in their neighbourhood, the more they said positive things about birds which affects the decision they make about the presence of birds in their areas (Belaire *et al.*, 2015).

2.Background information on bird deterrent devices

2.1 Bird deterrents

Bird deterrents, also called birds scarers, are a non-lethal anthropogenic control solution to the problem posed by birds both in agricultural settings and residential areas. They are used in residential areas and cities, to prevent birds from settling on or living on the roofs of buildings where they deposit droppings and can cause other problems (Harris *et al.*, 2016) . A wide range of bird deterrents is used to control birds in urban environments, especially on tall buildings. The effectiveness of a particular bird deterrent is related to the type of bird it is meant to deter, hence the difference in their physiology (Adams *et al.*, 2019).

Bird deterrent devices are found in various forms and are used in various settings as described in figure 1 (Rivadeneira *et al.*, 2018). Visual and auditory bird deterrents are the most utilized types of devices, they are affordable and keep birds away from the designated areas, however, here are reservations on the use of these devices. Concerns about the noise pollution of auditory bird deterrent devices were raised, and birds are getting used to them making them inefficient in a short period (Adams *et al.*, 2019). Chemical bird deterrents are more costly, not easy to apply, and not as effective as the previous methods mentioned and require a license in the United States before being used on birds used in the field (Rivadeneira *et al.*, 2018). The latest technologies in agricultural settings used in deterrent and scaring strategies are unmanned aerial vehicles (UAVs) or drones (Wan Mohamed, Mohd Naim, and Abdullah, 2020).

Category	Specific Type
Visual	Lasers, Dogs, Humans, Scarecrows, Predator models, Corpses or effigies, Balloons with eyespots, Kites, Kite hawks, Falconry, Drones, Lights (flashing, rotating, strobe, searchlights), Mirrors, Reflectors, Reflective tapes, Flags, Rags, Streamers, Dyes or colorants, Air dancers
Auditory	Propane sound cannons, Bangers, Screamers, Squawkers, Whistlers, Gunfire, Distress calls, Ultrasonic sounds, High intensity sounds, Sonic net
Tactile	Spikes, Sticky substances
Habitat modification	Bait stations, Lure crops, Sacrificial crops, Removal of roost structures, food, and shelter
Exclusion	Nets, Electric fencing, Overhead wires, Anti-perching devices
Chemical	Methyl anthranilate, Anthraquinone, DRC-1339, Keyplex-350, Measurol
Reproductive	Chemo-sterilants, Contraceptives, Immune contraceptive vaccines
Lethal	Avicide, Shooting, Egg destruction, Nest destruction
Multi-faceted	Pyrotechnics, Optical gel, Falconry, Drones

2.2 Optical bird deterrent devices

2.2.1 The “Eagle eye bird deterrent”

Optical bird deterrents help to represent danger by having multiple colours because pigeons can see in colour and ultraviolet spectrum. According to company literature, this device must be "installed above the incoming flight trajectory of birds, it reflects sunlight at a large variety of angles". It also helps to reflect light from its different ranges, even infra-red and ultraviolet" (Eagle Eye Bird Control, 2021a).

Figure 3 Eagle bird deterrent placed on top of residential home displayed on the company product catalogue. Source: (Bird Deterrent Specialists, 2017a) – Text style is not consistent

2.2.2 The Pro-Peller unit:

"This device rotates using a double bearing system, designed to rotate in the presence of a slight wind and is 100% wind-driven" (Bird Deterrent Specialists, 2017b). It emits flashes and stroboscopic lights at low to high intensity in all directions, it has a low scale rate of 2.8/10 of being neighbour friendly and a high reflection intensity scale rate of 7.9/10 (Eagle Eye Bird Control, 2021b). It is estimated to be ideal for agricultural areas and homes and must be placed in areas where it does not "cause risk of irritation to the neighbours" (Eagle Eye Bird Control, 2021a).

Figure 4 Pro-Peller unit displayed on the company product catalog. Source: (Bird Deterrent Specialists, 2017b)

2.3 Reflection intensity and frequency

A reflection intensity test was conducted according to company literature to measure the amount of light emitted by a light source in a minutes (Lumens) per square meter (Lux) of Optical bird deterrent devices that are subject to this review – the Eagle eye device (Eagle Eye Bird Control, 2021b)

The reading was taken using an R-3809 light meter with silicon photodiode as a measuring instrument. To obtain the readings, the Lux reading was taken in absence of the Eagle Eye unit to provide the control measurement (Eagle Eye Bird Control, 2021b).

The stationary Eagle Eye unit was placed in an open field in direct sunlight. The readings were taken from a height of 1.2 meters in a horizontal direction and the sun behind the instruments. The measurements were taken at Stellenbosch University in South Africa on a sunny day: 27 degrees Celsius (Eagle Eye Bird Control, 2021b).

The table and graph below depict the results obtained from their measurements:

Table 2 Measurement results of the reflective intensity of Eagle Eye bird deterrent device

Distance (m):	Max reading (Lux):	Control (Lux):
5	67000	10050
10	35000	10050
15	27000	10050
20	19000	10050
30	13000	10050
40	12500	10050
50	12000	10050
60	11500	10050
70	10050	10050
80	10050	10050
90	10050	10050
100	10050	10050

Source: (Eagle Eye Bird Control, 2021b)

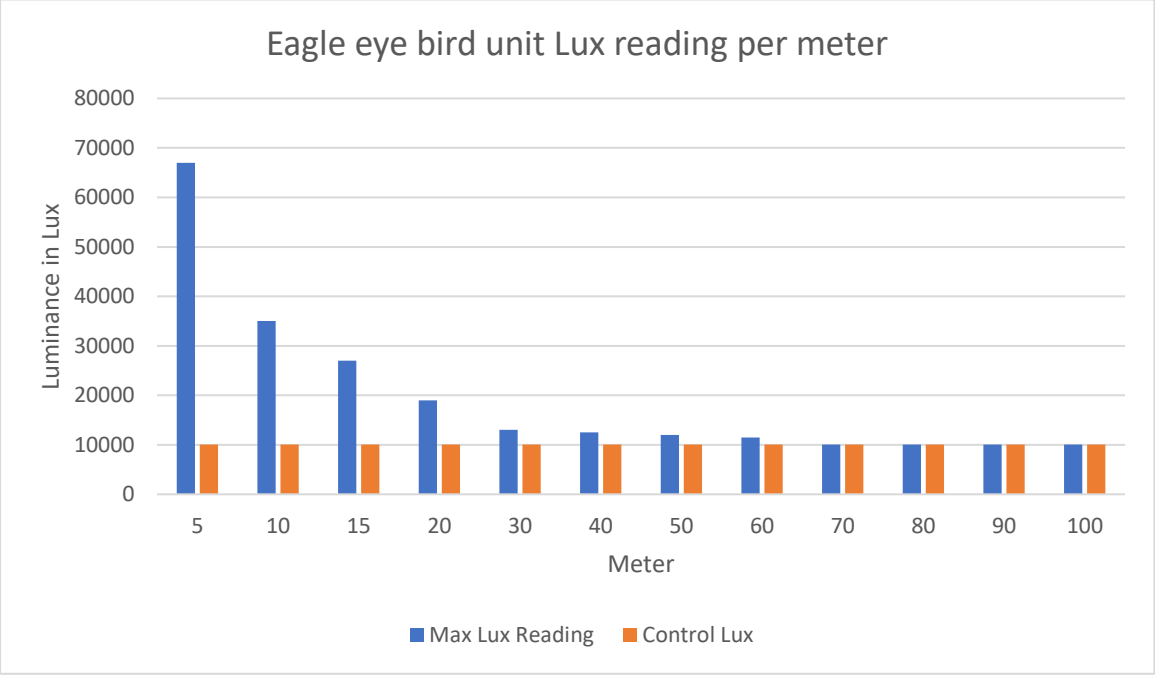

Figure 5 Lux reading per meter

The graph was redesigned and represented to best visually represent the two types of measurements taken. We can observe that the Max Lux readings reduces as the distance increases, it was deducted by the student that the control Lux measurements were taken to take into consideration light coming from the Sun.

To obtain the non-adjusted lux measurements Lux capacity, we must deduct the control lux measurements from the maximum lux measurement. This was done because there are various times and temperatures during the day and people do not only get exposed to light from optical bird deterrent devices during daytime:

Table 3 Adjusted lux reading

Max Lux Reading	Control Lux	Lux Reading
67000	10050	56950
35000	10050	24950
27000	10050	16950
19000	10050	8950
13000	10050	2950
12500	10050	2450
12000	10050	1950
11500	10050	1450
10050	10050	0
10050	10050	0
10050	10050	0
10050	10050	0

The table above (table 3) used data from table 2 and figure 5: the last column of table 3 is the difference between (Max Lux Reading – Control Lux) to obtain the real lux reading. It provides us with the adjusted Lux reading, showing a maximum of 56 950 Lux reading when the optical device is placed 5 min away from the subject and a reading of 10 000 Lux when the device is placed at 100 meters away from the Lux without considering sunlight.

This information is important because it will help the researcher in identifying the visual field affected by the light and the hazard of the light output.

3. Case study: Optical bird deterrent and bird population reduction

Diverting from the Cape Town region, other parts of South Africa use the same strategy for the bird population. This next case study will be looking at Pretoria – a central part in another province of South Africa.

This paper was selected as a case study to show that bird deterrent devices are being used in South Africa as a strategy to keep birds away from buildings. Moreover, by also showing how effective these devices were in achieving the wanted results to reduce the bird population on the Muckleneuk campus in Pretoria.

This study by Harris et al. 2016) investigated the use of non-lethal pigeon control strategies with a particular focus on visual deterrent and physical barriers to reduce the pigeon's population on the premises of the University of South Africa's Muckleneuk campus in Pretoria. This study was conducted over two years with a baseline study (March 2013 –

February 2014) establishment of the pigeon population Counts and in the management year (August 2014 – August 2015) once the bird deterrent devices were implemented on the buildings. For the two years of observation, the pigeons were observed and counted once a week during the mornings and evenings for 52 weeks

The placement of the bird scaring devices on the building was chosen by the pest control company to ensure that they were suitable for the pigeon control purpose. The bird deterrent devices (Eagle eye bird deterrent, bird spikes, and Fire flags) were placed on the roofs of each balcony at regular intervals. The fire flags were placed on the tallest building such as the OR Tambo building because these devices are 100% wind-driven, and the building is exposed to high air current at such heights.

The pigeon population index was determined by calculating the percentage change in the number counts of pigeons between the baseline year and management year in which the control structure was implemented to indicate the reduction ~~the reduction~~ in percentage of each control structure on the pigeon population index.

After two years of monitoring and observation, it was noted that 50% of the bird population was reduced on campus. Fire flags were the least effective with a bird reduction of (33%), Eagle Eye was also limited in bird reduction on the campus, and bird spikes were proven to be the most effective (Harris *et al.*, 2016). It was reported that:

- the pigeon population declined by 50% between the baseline study and the management year after the control structures were installed
- The fire Flags reduced the pigeon population index by an average of 33 %
- The Eagle Eyes™ indicated reduced the pigeon population index by nearly 40 %
- The combination of control structures resulted in a mean reduction of 45 %
- while bird spikes reduced the pigeon population index the most by a mean of nearly 70 %

In summary, bird spikes were significantly more effective in reducing the bird population on campus than the fire flags and eagle eye bird deterrent devices.

4. Exposure to light flashes and possible health effects

It is stated on the manufacturing company website: "Consider neighbours and tenants when placing the Eagle Eye system as the flashes may cause irritation".(Eagle Eye, 2022).

This statement adds to the body of knowledge gathered around the aspect of health effects caused by flashing light. Evidence from literature shows that there is a close relation between exposure to flashing lights and a feeling of discomfort, and nuisance on the receptors. Light can have both a positive and negative impact on human health and interchangeably human health can be affected by other several aspects other than light (Boyce, 2021).

Additionally, ‘Light affects human health via the visual and non-visual systems originating in the retina of the eye or as optical radiation falling on eye or skin (Boyce, 2021).’ Concurrent exposure to light can be a source of skin cancer, blindness, immune depression, or skin rash.

Health is defined by the World Health Organisation (WHO) as a “complete state of physical, mental and social well-being and not merely the absence of disease and infirmity”. Light can have a negative impact on health hence it is considered a health nuisance. The same way air and light are useful for human survival, but air pollution has adverse effects on health, this is the case with extensive light exposure (Boyce, 2021).

Any individual can have susceptibility to unstable light output however lighting is not the only issue, the characteristics of the environment where light is originating as colours, patterns and the presence of shadows are of concern (Boyce, 2021).

Adverse health effects from exposure to light arise when there is inconsistency in the light output and this is usually flickers, stroboscopic effect, patterns, night club lights, etc. The light frequency, percentage modulation of the luminance fluctuation and the visual field are the most important factors in determining whether a fluctuation in light output will be visible by the subject (Boyce, 2021).

The higher the luminance is, the larger the percentage of modulation and the area of the retina affected, the more likely a given frequency will be seen as flicker. However even when flicker is not visible, an instable light will still disturb the operation of the visual system (Boyce, 2021).

People with pre-existing conditions can be affected by having an instable light output as people suffering with Photosensitive Epilepsy, migraine and people experiencing falls. Another reported condition that rises when exposed to flash-like light of a short duration is photopsia; this term refers to visual hallucinations where a person sees something that is not related to the real object (Boyce, 2021).

4.1 Photosensitive Epilepsy

"Human health can be impacted by light via visual and non-visuals systems originating in the retina of the eye or as optical radiation falling on eye or skin" (Boyce, 2021); this statement aligns with the concepts discussed in the second part of this literature review.

People diagnosed with photosynthesis epilepsy have a high risk of experiencing visual discomfort while exposed to flashing light or unstable light output (Fisher *et al.*, 2005).

Photosensitivity, which is the attribute of Photosensitive Epilepsy (PSE), is described as an abnormal Electroencephalogram (EEG) response to a visual stimulus known as a photoparoxysmal response (PPR), this response is characterised by changes in waves in response to certain visual stimulation (Poleon and Szaflarski, 2017).

Studies in the early 2000s revealed that there were uncertainties on the prevalence of photosensitivity in the population because of lack of clarity on the reported condition and bias in the sample population. Many individuals experiencing photosensitivity did not have

an abnormal electroencephalogram (EGG) response to a visual stimulus, implying that an unknown number of individuals with no evidence of epilepsy were experiencing seizure from exposure to flashing lights (Fisher *et al.*, 2005).

4.1.1 The visual stimuli

For a flickering light to induce seizure in the person exposed, it is important to consider the duration of exposure, distance from the source of flickering light, background illumination, contrast (stimuli with high contrast are more likely to cause seizures than seizures with low contrast), colour (seizure is more likely to happen with bright colours), open versus closed eyes, one- versus two-eye viewing, and stage of sleep–wakefulness cycle (Fisher et al., 2005).

There are three important features to consider when looking at the visual stimuli shown to cause seizure ("photosensitive seizures"):

- The brightness of the stimulus: “a flash is considered to be a significant hazard for a photosensitive individual when a pair of opposing changes in luminance exists (i.e., an increase in luminance, followed by a decrease) of more than 20 cd/square meter”(Harding *et al.*, 2005)
- The frequency of the flashing lights: the International Telecommunications Union (ITU, a United Nations body) has given guidelines in 2005 that greater than 3 Hz should be regarded as a potential hazard.(Meng *et al.*, 2016)
- The size of the visual field involved in the viewer: Guidelines say a hazard exists when more than 25% of the central 10 degrees of vision are involved (Fisher et al., 2005).

4.1.2 People with Epilepsy can experience “Photosensitive Epilepsy”

People diagnosed with epilepsy are susceptible to experience Photosensitive Epilepsy, additionally people not diagnosed with epilepsy can also have the same experience when they are exposed to visual stimuli like flashing lights, patterns that trigger the Photoparoxysmal Response (PPR) (Kasteleijn and Trenite, 2021). People with epilepsy experience epileptic seizures induced by sensory stimuli as reflex epilepsy. Sensory epilepsy can be triggered by anything (food, lights, pattern, fireworks, television) and each reflex epilepsy is usually named after its trigger (Kasteleijn and Trenite, 2021). Of all sensory epilepsy, Photosensitive Epilepsy is considered the most important because of strong flickering lights, patterns, and devices reflecting lights. These are readily available in the environment and the visual cortex is relatively big to receive and integrate with visual information (Martins Da Silva and Leal, 2017).

Visual sensitive epilepsy is the most common form of epilepsy, this phenomenon has been investigated since 1970 but gained more research interest after the “Pokemon incidence” (Kasteleijn and Trenite, 2021). A significant number of 685 children were hospitalized after watching episode 38 (currently banned) of Pokemon and since then international television bans were implemented to display that episode. This event played an integral part in research on Photosensitive Epilepsy (PSE). The episode featured “high-contrast, high-flicker, and high-

luminance imagery" that led to children and adults experiencing symptoms as "blurred vision, nausea, headaches, and seizures" (Martins Da Silva and Leal, 2017).

It is reported that PPR occurs in 2 out of 14 patients with epilepsy but there are still some existing dark areas in research around the nature and causes of this response (Poleon and Szaflarski, 2017). It is known however that The PPR is provoked by certain types of visual stimuli: patterns, light, luminance patterns which are produced while watching TV, fireworks, nightclub, video games (Poleon and Szaflarski, 2017).

4.1.3 Symptoms and affected population.

It is impossible to detect whether an individual has a high susceptibility to experiencing photosensitivity by their physical appearance because it is neurologically detected (Specchio *et al.*, 2011).

It has also been reported that PPR response is higher in females than males undifferentiated of whether they suffer from epilepsy or not. The reason for this sex distribution is unclear but could be attributed to hormonal levels and genetics in different sex. It is also reported in 7 – 19 years group of people rather than the general population (Poleon and Szaflarski, 2017).

Studies on epileptic patients found that IPS reactions are more prevalent in patients with epilepsy (10%) than in healthy people (Kasteleijn and Trenite, 2021).

4.1.4 Photosensitive epilepsy is also associated with the classical genetic generalized epilepsies (GGE)

GGE constitutes 20% of all epilepsies of which Photosynthesis epilepsy is reported in 30-40% in people with Juvenile Myoclonic Epilepsy (JME), 20% of children with childhood absence epilepsy (CAE), and 13% in patients with Generalized tonic-clonic seizure (GTCS) on awakening, and in 8% of patients with juvenile absence epilepsy.

The study by (Kasteleijn and Trenite, 2021)additionally pointed out that people having the following medical conditions: ADHD, Depression and Mania, Alzheimer Disease, Other Neurodegenerative Conditions, Post-traumatic Conditions, Chronic Pain Patients, Parkinson Disease Epilepsy, Panic Disorders, Brain Tumors, Schizophrenia and Autism; are at risk of experiencing photosensitivity epilepsy as these conditions predispose them to it.

The clinical test for suspected PSE is to record brain electrical activity by electroencephalography (EEG) in the presence of intermittent photic stimulation (IPS).

4.1.5 Provocative Frequency (flash per second) triggering PSE:

It is reported in the studies that PPR response is provoked by stimuli with frequencies between the range of 15 – 65 HZ however, the frequency at which this occurs differs from one study to another, here are the reported ranges:

Table 4 Frequency triggering Photosensitive Epilepsy

Study name	Frequency range	Description	Clinical significance
(Martins Da Silva and Leal, 2017) (Kasteleijn and Trenite, 2021)	(15 – 20) HZ	Frequency range commonly elicit PPR if IPS are binocular. The provocative range for patients and non-patients.	The IPS (Intermittent photic stimulation) is a procedure performed during EGG recording to detect the sensitivity of epileptic patients to different frequencies (Wilkins, 2016). Specific response on the EGG recording can be triggered by IPS at different frequencies of flickering in normal individual too. The frequency range of (15 – 20) is considered provocative (it will trigger IPS) for epileptic and non-epileptic patients when performed on both eyes of the patient (binocular).
(Poleon and Szaflarski, 2017)	(16 – 25) HZ	PPR is readily elicited by stimuli containing high-frequency flicker.	
(Kasteleijn and Trenite, 2021)	(50 – 65) HZ	50% of patients have IPS if a pattern is present in the stimulus.	A pattern could be "Flashing lights or rapidly changing or alternating images (as in clubs, around emergency vehicles, near overhead fans, in action movies or television programs, etc.) Static spatial patterns such as stripes and squares." (Wikipedia, 2016)

Figures from table 4 tell us that lower frequencies are susceptible to affect all populations whether they suffer from PSE or not, however higher frequencies can affect people who have previously been admitted because of PSE; "this is because the more of the visual field (and thus occipital cortex) that is involved, the more likely the stimulus is to induce a seizure". Almost all the studies attempting to estimate the precise frequency of photosensitivity in the general population are limited by subject- selection bias (Kasteleijn and Trenite, 2021).

According to our communication with the manufacturing company, the motorised Eagle Eye Bird deterrent devices have a lower frequency than the frequency level that is required to trigger Photosynthesis Epilepsy. It rotates at a speed of 30 rpm, it completes 1 flash every 1 seconds which gives a frequency of 1 Herts (John Kotzé (Jnr), 2021). Comparing this to the lowest frequency range to cause trigger, 15HZ, the motorised bird deterrent device has a frequency lower than the provocative range to trigger PSE.

The devices manufacturing company did not provide any information on the rotating speed of the wind driven eagle eye bird deterrent as it is dependent on the wind conditions, building orientation and installation location. However, they stated that the wind driven eagle eye bird deterrent devices, during moderate strong wind, turn faster than the motorized units. This will cause a reduction in the considerable reflection intensity of the unit, and it becomes more like a flicker rather than a flash. This could become a potential health nuisance as the company representative stated himself “if we suspect that a unit may pose any sort of irritation to people, we either put a shield on them or we replace the reflector with another version where the angles flashing into their direction are not reflective” (John Kotzé (Jnr), 2021).

6 Applicable Policies and regulation

6.1 Regulation regulating Optical Bird deterrent:

Key South African Policy finding

No regulation pertaining to optical bird deterrents in other countries were found. **After searching on online sources on regulations in South Africa that regulates the use of bird deterrent in residential areas:**

there was no record of such legislation available at national level in South Africa and different local municipalities, most regulations relate to the use of pesticides as a pest-control tool and not optical devices.

6.2 Health nuisance and lighting

The following legislations provide a framework for definition of key terms as health, environment, biodiversity, health nuisance, etc that are key in unpacking the issue being discussed.

City of Cape Town Bylaw, (Cape Town City Council, 2007)	Defines public nuisance as any act, omission or condition in the city's opinion is offensive, injurious or dangerous to health, materially interferes with the ordinary comfort, convenience, peace or quiet of the public, or which adversely affects the safety of the public, having regard to: (a) the reasonableness of the activities in question in the area concerned, and the impacts which result from these activities; and (b) the ambient noise level of the area concerned. With regards to placing lights on rooftops, it reported that 'No roof lights, non-masonry chimneys, solar water heaters, satellite dishes or any other features shall be in, on or above the roof of any building or anywhere else on any site except with the approval of the City'.
City of cape Town Bylaw, (City of Cape Town, 2015)	States in the specific provision for Victoria Road, Clifton local area that "No roof lights, non-masonry chimneys, solar water heaters, satellite dishes or any other features shall be in, on or above the roof of any building or anywhere else on any site except with the approval of the City".
Constitutional Act of South Africa, (Bird Life, 2018)	The constitutional act of South Africa states that everyone has the right to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that prevent pollution and ecological degradation; promote conservation; and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development'. This section supports the argument of possible degradation that could originate from keeping birds away from residential areas.
National Environmental health policy, (Government, 2013)	Environment means the surroundings within which humans exist and that are made up of: a) The land, water, and atmosphere of the earth, b) Micro-organisms, plant, and animal life,

	c) Any part or combination of (a) and (b) and the interrelationships among and between them, d) The physical, chemical, aesthetic, and cultural properties and conditions of the foregoing that influence human health and well-being. Environmental Health encompasses those aspects of human health, including quality of life that is determined by physical, chemical, biological, social, and psychosocial factors in the environment. It also refers to the theory and practice of assessing, correcting, controlling, and preventing those factors in the environment that can potentially affect adversely the health of present and future generations.

8. Key findings and Conclusion

8.1 Key findings:

- The limited South African evidence suggests that optical bird deterrent devices are not effective in preventing birds from settling on roofs and causing mess and damage.
- Light of unstable output could be a source of health nuisance for its receptors
- People exposed to patterns (light flicker, squares, etc) experience seizures in the frequency range between 15 HZ to 65 HZ
- No evidence has been found on whether the wind driven eagle eye has a frequency in the same range as the eagle eye bird control device, but it is suspected that in the presence of strong wind, the reflection intensity of the unit will be reduced, and it becomes more like a flicker rather than a flash
- No regulation on bird deterrent devices has been found in the literature in South Africa

The evidence provided helped us to understand the linkages between the use of bird deterrent devices and the possible health nuisance to the population followed by a potential loss of biodiversity for the community of Fish Hoek. Our assumptions are that optical bird deterrent devises could be a nuisance to health for the surrounding population because of its patterns (flickers) that could create an unpleasant environment. A statement from the manufacturing company on the website explain it well stating:

"Consider neighbours and tenants when placing the Eagle Eye system as the flashes may cause irritation"

A case study proved that optical bird deterrent devices are not the most efficient in preventing birds from settling on buildings in a certain area, hence it does not make optical bird deterrent device the best option of bird deterrent to use. Considering the negative health impacts coming with the bird population, it is reported that the cohabitation of humans and birds is inevitable with the increase in urbanisation and that humans should find a more sustainable way of cohabitating with birds not to affects the ecosystem and other beneficial values of having birds in residential areas.

No legislation is available in South Africa on the issue of Optical bird deterrent devices, the cited legislations show us that everyone has the right to be protected from anything that is harmful to themselves and their environment. These devices could potentially have an adverse impact on the health of the population and therefore would require regulation.

9. Recommendations

After carefully examining the issue of bird deterrent devices in Clovelly area, we would like to put forth the following recommendations:

- There is a recognition that optical bird deterrent devices can constitute a health nuisance to the population of Clovelly, we would recommend that a petition on this issue should be drafted by the client, signed by the community members who approve that is an issue that requires regulation. The petition must be filled in accordance with the Sections 56 (d) and 69 (d) of the Constitution of South Africa.
- Encourage the municipality to take in consideration the issue of bird deterrent devices as they can be a potential threat to the residents.
- Encourage the municipality to consider updating the “City of Cape Town municipal bylaw of 2015”. Section 188,3,8 stating that: “No roof lights, non-masonry chimneys, solar water heaters, satellite dishes or any other features shall be located in, on or above the roof of any building or anywhere else on any site except with the approval of the City” concerning the Bakoven, Clifton and Glen Beach Bungalow Area (LAO/5) can be applied in the case of Clovelly area concerning the usage of bird deterrent devices (City of Cape Town, 2015)
- Residents are concerned that the practice of installing bird deterrent devices on the roof of houses can increase in Clovelly therefore we encourage the municipality to take in consideration the issue of bird deterrent devices as a potential nuisance to the wellbeing of residents.

10. Limitations

This review of literature had various limitations that affected the outputs; the topic was not explored intensively in South Africa therefore lots of evidence collected was not related to this study topic but were selected as they relate to it. This affected the timing of the project and the research focus. Another limitation was the lack of resources to accurately measure the frequency of bird deterrent devices as well as the limited information regulations on health nuisance in South Africa.

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12. Appendices

Appendix 1

Re: Consultation date and time - About consultation with expert in Photosensitive Epilepsy

Eunice.T muya <muyaeunise4@gmail.com> Wed, Oct 20, 2021 at 8:00 AM
To: "eastman@mweb.co.za" <eastman@mweb.co.za>

Eunice Muya is inviting you to a scheduled Zoom meeting.

Topic: Photosensitive Epilepsy
Time: Oct 21, 2021 02:00 PM Harare, Pretoria

Join Zoom Meeting
https://us05web.zoom.us/j/4335942026?pwd=bU1ETnJ0QkFCWDU4Lzhuczl3a1lMZz09

Meeting ID: 433 594 2026
Passcode: dfGi3k

Hello Prof,

I hope u are doing well.

This is the invitation to the meeting. The meeting agenda goes as follow:

Attendees: Prof Eastman and Eunice.
Minute taker: Eunice.
-Presentation from both parties
-Brief description of the project by the student
-Go through the evidence collected by the student on PES with Prof.
-Prof to comment/give an expert opinion on the direction taken by the student and possible recommendations, fixes.
-Any additional comments from both parties.
-Eunice to share the meeting minutes.
-Meeting closing.

Please find attached the working document - the literature review I have written so far on this topic. It is still in the draft stage, hence the comments and other notes, you can ignore those I left them to give you a sense of where I am at as I am still gathering evidence.
Please let me know if you need more clarity.

Report on Consultation with expert on Epilepsy.

Expert: Prof Roland Eastman, Retired head of Neurology

Student: Eunice Tshilengu

Meeting subject: Photosensitive Epilepsy

On the Agenda:

- Project description by student
- Student to go through draft literature review submitted to client

- Prof Eastman share comments/expert opinion on the student approach to the matter.

Proceedings:

- The student needs to identify the audience; the people concerned/complaining about the bird deterrent devices
- The information provided on the bird deterrent devices are important but not useful in answering the question of whether the flashes of the devices can trigger photosensitive epilepsy.
- The lack of literature on optical bird deterrent devices affects the quality of information and its usefulness on this case.
- Photosensitive epilepsy is a broad subject and cannot be limited to one aspect (flashing devices and light frequency) to be diagnosed.
- PPR response can be caused in an individual due to genetic traits or due to brain response to light or any physical damage to the brain acquired during an accident or any diseases that damages the brain: Meningitis.
- The majority of epileptic seizure/fit does not come from exposure to flashes, it is very rare.
- PPR is more prominent in women and young people.
- There are other factors that need to be considered when talking about photosensitive epilepsy as the visual field, the colour of the background light, the colour of the light flickering and its frequency, these will give more indication on how it will affect the individual because many cases of fit were observed while subjects (children) were watching TV and international regulations were put in place to avoid such scene to repeat themselves.
- Other places like clubs were also on the frequency and brightness of their lights but we do not have any information on optical bird deterrent.
- The evidence provided are not complete enough to justify Photosynthesis epilepsy from exposure to optical bird deterrent, the student needs to explore other avenues and evidence of stresses (Consultant provided some literature on this) that come from exposure to such devices as the company manual states that it can cause inconvenience to the neighbours which is one of the strongest pieces of evidence.
- The company does not provide literature on the frequency of the devices; it is advisable for the student to do a quick text of the frequency and take record.

Appendix 2

Gmail **Eunice.T muya <muyaeunise4@gmail.com>**

Re: About bird ecological contribution in residential areas.

Arjun Amar <arjundevamar@gmail.com> Tue, Nov 30, 2021 at 11:37 AM
To: Eunice Tshilengu <TSHEUN003@myuct.ac.za>

Here are those papers we discussed.

Best wishes
Arjun

Associate Professor Arjun Amar
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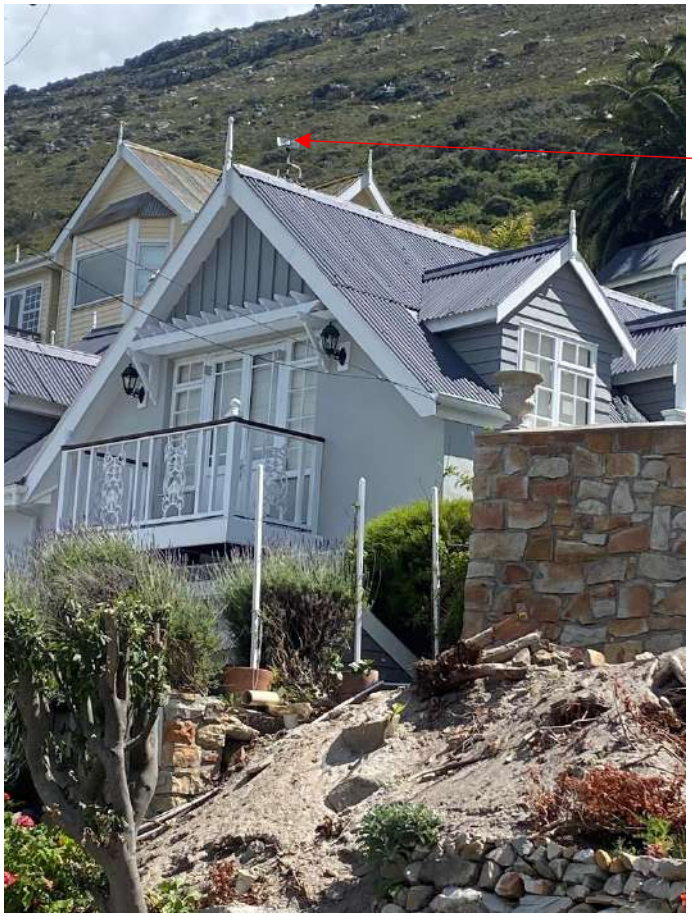
Appendix 3

Visit to Client, Clovelly area – 06/11/2021

Student: Eunice Muya Tshilengu

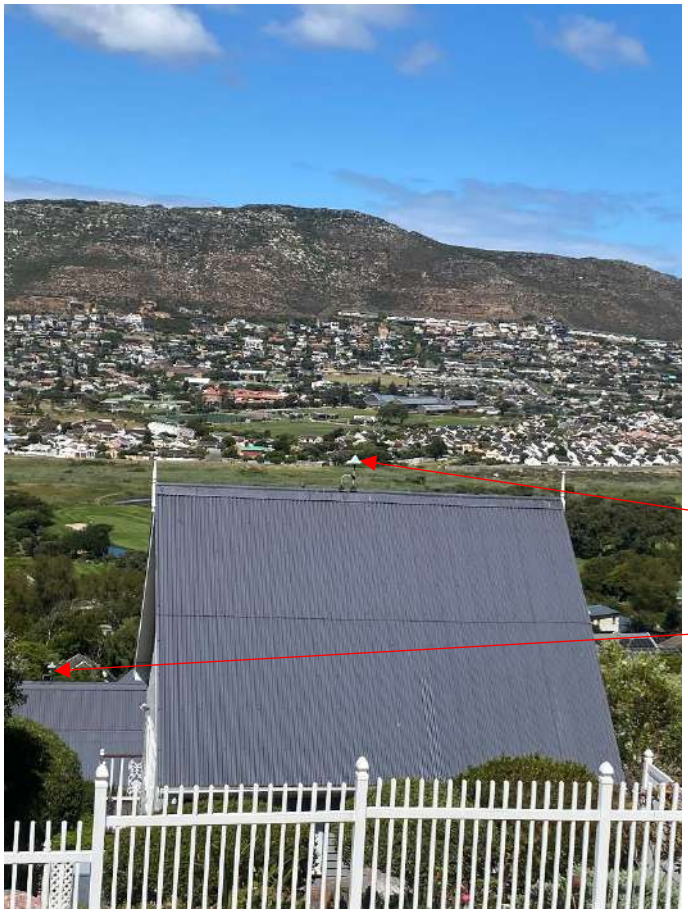
Client: Prof Andrew Dawes



Bird deterrent devices placed on top of roofs of houses in Clovellly neighborhood.

Photo by Eunice Tshilengu

Date: 06/11/2021



Bird deterrent devices placed on top of roofs of houses in Clovellly neighborhood.

Photo by Eunice Tshilengu

Date: 06/11/2021

Link to videos available here:

https://drive.google.com/drive/folders/1rlZEpin4dO2e091jFSnqlUlgE9JIOBlS?usp=sharing

13. Useful resources

Light pollution	**https://www.darksky.org/light-pollution/** **https://www.globeatnight.org/light-pollution.php** **https://cees.iupui.edu/blog/why-birds-matter**
Birds ecological contribution	https://www.environmentalscience.org/birds-ecosystem-services https://medium.com/@chaurasiarobin4/what-are-the-importance-of-birds-in-our-life-and-how-to-save-them-66d280e61c98
Epilepsy: Epilepsy foundation, Epilepsy SA was established in 1967 as the South African National Epilepsy League (SANEL). It is the only national organisation in South Africa offering specialised and comprehensive services to persons with and affected by epilepsy. Our aim is to enhance and improve the quality of life of our target group. Provides resources on what is epilepsy and educational materials as infographics.	https://epilepsy.org.za/