



IMPROVED SCIENCE AND TECHNOLOGY COMMUNICATIONS: BARN OWL ACT AS SOCIAL VACCINE AGAINST COVID-19

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Received : 25, June 2020; Accepted :29, June 2020 ; Published :30, June 2020

Abstract : Currently, scientists has been an urgency to develop vaccines against novel coronavirus, the COVID19 pandemic, coming from animals, effecting on the; global economy, education, civilization, professional and social life, and communities-health, travel and clinical-research. So, to tackle and overcome the situations, the “Barn Owl Breeding Project of Kanchannagar D.N. Das High School (HS)” where prevails an ecosystem complex with landscaping by trees, garden, play area, pond and river with agriculture; keeping and caring of Barn owl apparently acts as a keystone species in the food-chain-relationships. Rats that happen to spoil food items of mid-day meals, rooms, and documents are controlled by Barn owl. Bats of the banyan tree, make the school building dirty by their excreta are also controlled by this owl. Different pests and mongoose, which are found to significantly reduce food production in agriculture and pisciculture, are also appreciably kept in control. It is worth mentioning that the Barn owl plays the role of the top carnivore, predated on mongoose juveniles and bats, the carrier of coronavirus, showing the “Barn-Owl Act as a Social-Vaccine Against COVID-19 Improving Science and Technology-Communication-Environments-Agriculture-Biodiversity- Conservation-Socioeconomic-Applications with Joyful-Learning-School-Environment”. And, improves midday meal, arouses interest of students and communities on ecology-food-chain-relationships-issues, and contribute to sustainable-pisciculture-pond, agriculture, and kitchen-garden-management, micro- and macro-climate issues, and also community as well as students’ health and awareness development. They are also opening a path of more future research and communication, for the betterment of societal conditions benefitting global humanity by advancing innovations in the fields of scientific research.

Keywords- Improved-Science-Technology-Communications, Barn-Owl, Social-Vaccine, COVID-19, Control.

INTRODUCTION

The recent ongoing spread of the COVID19 pandemic, effects on the human civilization, our private and professional and social life, and the communities, affecting global health, travel and economy as well as the educations and the clinical research, with scientists, has been an urgency to develop vaccines against novel coronavirus, which comes from animals [1-2]. The Barn Owl is respected as the acolyte of the Goddess Chamunda in Karnataka. In Bengal, it is revered as the carrier of Lakshmi, the deity of wealth. But barn owls are getting reduced gradually due to the rapid urbanization, poaching, superstition, use of insecticides, and the fatal cord of kites [3-4]. Having been surrounded by green plantation, ponds, rivers, and rivulets Kanchannagar D.N.Das High School location-wise an ideal place for domestic and migratory birds. The diversity provides good habitat conditions for all animal groups [3-4]. Barn owls belong to the top of the food chain and are attracted to the plenty of

food availability [3-6]. Midday meal in a school depends on the quality and supply of healthy foods which depend on the habitats in the school environment [7-8]. The rats, moles, and mice were spoiling the foods for midday meals, rooms, important documents, and materials in the school [1-6]. Once the bats in the banyan tree (*Ficus bengalensis* L.) began to make the school building dirty by their stools and urinals making our white walls dirty [1-6]. Different pests significantly reduce food production in the nutritious kitchen garden in school [7-8]. The pesticides are the most effective means of control, but they are expensive and not environment friendly [8-15]. To move forward, it will require new and more efficient solutions, technologies, products and it has to fulfill all requirements by improving Science and Technology Communication. In 2015 it took the initiative to protect and preserve the birds those are the frequenters to the banyan tree within the school campus³. For safe nesting, various types of boxes (including a wooden box for the owl also), pitchers, and swings are provided along with water for drinking and bathing, food particles, and sandpits. Birds, squirrels, bats, monkeys, owls are the regular frequenters of this tree. They use these means to procreate³. In the last four years (2015-

2019) number of barred owls increase noticeably [3-6]. In these four years, a pair of owls lay eggs twice and give birth to 32 owlets, on an average 3. Eggs are generally laid in the months of May-June and October-November, in the same nest [3-6].

As the box was damaged by the rainy season in June 2018, the mother barn owl took shelter in the pigeons nest. Recently (1st session; from September 2018 to February 2019 and 2nd session; October 2019 to March 2020) in a tilted bench that has been hanged from the ceiling of the veranda, a pair of barn owl (*Tyto alba*) has nested along with a pair of rock pigeon (*Columba livia*) just beside the three classrooms [1-6]. One fine morning in both sessions we find both of them have laid eggs and engaged themselves in incubation. And there are about 1000 students attending the school and about 50 to 70 students/class are attending the three classrooms where the owl had laid eggs [1-6].

For the present studies, our best endeavor is to focus on the observations on the dietary habits, especially bats and mongoose, and behaviors of the barn owls (*Tyto alba*) which may have important, for improves the Science and Technology Communications by joyful school environment and economic implications for agriculture by better crop quality and production for a midday meal in future. The results would be more realistic in terms of the potentiality of the barn owls, use as potential Science and Technology Communication Social Vaccine-Bio-Indicator, or -Bio-Monitor or -Environment-Friendly Predator Birds, in controlling various pests, unknown threaten microorganism like novel coronavirus, the COVID-19, as well as ecosystem. Our main aim to investigate new and more efficient solutions, technologies, products and it has to improve "Science and Technology Communication Social Vaccine against COVID-19" forming joyful school as well as community environment, and fulfill its food and nutrition requirement which indirectly -influence or -indicate any kinds of thresholds or natural calamities for the climate change and resource productive economies enriching quality of midday meal as well as a joyful educational environment.

MATERIALS AND METHODS

Location and Weather of the Study Area

The experiment was carried out at the Kanchannagar D.N.Das High School (HS), Kanchannagar, Purba Bardhaman-713102, West Bengal, India, where the temperature was 17□5oC, relative humidity was 67□5%, was situated beside the Damodar river and is surrounded by ponds- and agriculture- fields. Bardhaman is extending from 22o56' to 23o53' North latitude and from 86o48' to 88o25' East longitudes. And the average rainfall was 150 millimeters. The school campus, prevails the main old- and tall- tree of the banyan tree (*Ficus bengalensis*) with other trees, nutritional garden with a midday meal, exhibited an enriched faunal diversity comprising small mammals, small birds, reptiles, toads and insects [7-10].

Time of Experiments and Type of Nest

The experiment was conducted from September 2018-February 2019 and October 2019 to March 2020 in the big wooden nest (dimensions: Length - 180.78cm; width -

50.5cm; depth - 15.0cm) which is a tilted bench that has been hanged from the ceiling of the veranda. The nest was observed every day thrice by the students at 10 am, 1 pm and 5 pm. All the data were counted for statistical analysis by the analysis of variance (ANOVA) [5-6].

Group Formation and Distribution of Works

First Group includes Class-V and -VI, will observe and report regarding the number of owls sitting on the nest and surroundings. Second Group includes Class-VII and -VIII, observe and report regarding the number of pellets on the nest and surroundings. Third Group includes Class-IX and -X, observe, collect, and report regarding color, size, and number of pellets on the nest and surroundings. Fourth Group includes Class-XI and -XII, observe and report regarding number prey consumed from pellets on the nest and surroundings. The fifth one includes all staff and community, will observe everything with the guidance of Headmaster (Principal). All the data were submitted to Headmaster and were counted for statistical analysis by the analysis of variance (ANOVA) [1-3, 5-6].

Collection of Pellets

The diet composition of the barn owls were studied by the analysis of the materials found in the pellets and the prey remains collected from the demarked floor-bade underneath the tilted bench nest of owls, nest box and its vicinity, in variable numbers throughout the studies (1st session; September 2018 to February 2019 and 2nd session; October 2019 to March 2020), surveyed and analyzed [4-6]. Solid pellets collection was done on a daily basis in the morning (at 10 am), afternoon (at 1 pm) and in the evening (at 5 pm). All the pellets were not included in the samples [4-6,16-18]. They were carefully, numerically numbered and measured with the date and time, placed in polyethylene bags, and brought to the laboratory for further analyses [4-6, 16-18]. All the data were counted for statistical analysis by the analysis of variance (ANOVA).

Analysis the Pellets

For analysis, the pellets were immersed in water in Petri boxes for 10 min[4-6,16-18]. Bones and sclerosis fragments recovered from the pellets were separated by morphological categories. Each pellet before being dissected was photographed and length was measured [4-6, 16-18]. Pellets were cut loose with sharp forceps and contents were checked for small mammals, birds, and insects. The dissected barn owl pellets were critically examined and materials identified were designated as small mammals, birds and insects, as predominant prey items. All the identified food items were compared and contrasted with available reference materials for various rodent species, mainly on the basis of their dentition and skull patterns, etc and the other prey were identified using any recognizable remains [4-6,16-22]. Analysis was done regularly for the six months each [4-6]. All the data were counted for statistical analysis by the analysis of variance (ANOVA).

Maintenance of Records

Records were maintained for all the pellets sampling and all the data were counted for statistical analysis by the analysis of variance (ANOVA) to ascertain the variations of

barn owl pellets in the study site and their predilection for specific food items, as determined from their pellet analysis [4-6, 16-22]. Species richness estimation regarding the relative population abundance of prey items were calculated [16-22] to explain the results meaningfully.

Observation on Different Behaviors

Nesting and hunting behavior, egg-laying, incubation and hatching behaviors, breeding behavior, sound-producing behaviors, cleanliness behavior, and social behaviors, as well as bio-indicator behaviors or social distance maintaining behaviors, has been observed [1-6, 16-28]. Relationship or interaction or attitude among the parent's owls, among the hatchlings of owls, pigeons, other birds, dogs, cats, students, teachers, closely related staff, community, photographers, visitors, and media personnel, etc., has also been studied for four years. The position of nest boxes provide direct physical access to observe all [5-6].

Science and Technology Communication

The activity of students, teachers, staffs, community, photographers, visitors and media personnel, -campaign or -aware or -make the news or -publication regarding importance in Science and Technology Communication of the barn owl in different audiovisual media (TV channels), social media, newspaper and journals is recorded [1-3, 5-6, 28].

RESULTS AND DISCUSSION

Diet spectrum and frequency of ingested barn owl preys

Table 1 shows that during three years of observations from September 2018 to February 2019 and October 2019 to March 2020, 1279 -totally consumed prey animals of the barn owl, are analyzed from the 1172-regurgitated pellets; rats/mice, bats and moles remained the highest as owls dietary proportions (71.53%), squirrels (13.60%), mongoose (7.03%), small birds specially babbler (4.92%), coleopteran insects (2.34%) and others animals like toads (0.5%) (P<0.1 by ANOVA).

Regarding the rodent composition in its diet, rats/mice, bats, and moles, were found to be the most comprehensively depredated food item, while squirrels, were the next consumed food item. Of the others, mammals mongoose and birds were moderately preferred in the diet but the amphibians toads and coleopteran insects were the least preferred in the school and surrounding environment. These observations suggest that the barn owl is an opportunistic predator taking whatever prey is available [1-6, 28]. It is interesting that barn owls are capable of switching to alternative prey when mammals become rare, but that they return to preferred prey as soon as it becomes available [3-6, 16-28]. Highest numbers of pellets and consumed prey animals are found in the month of January 2019 and February 2020 due to the presence of a total of 10- young owlets (6- offspring in 2019 and 4- offspring in 2020) and total 4- parents (P<0.1 by ANOVA). But the highest numbers of owls/owlets are found in the month of December 2019 and January 2020 for the quick demand food supply to the 10- growing nestlings owlets (P<0.1 by ANOVA). In the year 2018-2019 highest numbers are consumed by; rats/mice in November, moles, and bats and squirrels in January, small babbler birds in February, insects in November, other animals like toads in December, and mongoose in November-December. But the highest numbers are consumed by; rats/mice, bats, moles, squirrels, and mongoose throughout the last session i.e. October 2019- March 2020. It is also observed that -bat and -squirrel consumption percentage is more than -three and -two-fold increase in the last October 2019- March 2020 session in comparison to the 1st session - September 2018 to February 2019 (P<0.1 by ANOVA)[3-6, 16-17]. It may be due availability of food or balance of the ecosystem or maybe due bio-indicator for any thresholds forming 'Social Vaccine'! [3-6, 16-29]. The researchers proposed bats (or mongooses) as the most likely reservoir for SARS-CoV-2 as it is very similar to a bat coronavirus [29-31].

TABLE 1. DISTRIBUTION OF ANIMALS IN THE OWL'S PALLETS COLLECTED FROM STUDY AREA OF KANCHANNAGAR D.N.DAS HIGH SCHOOL (HS)

Years	No. of Pallets in Nest	No. of Owl / Owlets found in the Nest	Rats / Mice	Moles	Bats	Squirrels	Small Birds (Babbler)	Insects	Other s Animals (Toad s etc.)	Mongoos e (whole Cranium with Skeleton)	No. of Total Prey Animal s Consume
Sept.-2018 to Feb.-2019	767a ±0.02	974a ±0.13	262a ±0.08 (30.64%)	235a ±0.03 (27.49%)	116a ±0.02 (13.57%)	76a ±0.04 (8.89%)	54a ±0.04 (6.32%)	19a ±0.03 (2.22%)	4a ±0.02 (0.47%)	89a ±0.03 (10.41%)	855
Oct.-2019 to Mar.-2020	405b ±0.01	453b ±0.05	62b ±0.02 (14.62%)	42b ±0.01 (9.90%)	198b ±0.04 (46.69%)	98b ±0.04 (23.11%)	9b ±0.01 (2.12%)	11b ±0.01 (2.59%)	3a ±0.02 (0.70%)	1b ±0.01 (2.59%)	424
Total	1172	1427	324 (25.33%)	277 (21.65%)	314 (24.55%)	174 (13.60%)	63 (4.92%)	30 (2.34%)	7 (0.5%)	90 (7.03%)	1279

a,b- different small letters in a column show significant difference by 'ANOVA' (P<0.01).

The scientists found that the SARS-CoV-2 backbone differed substantially from those of already known coronaviruses and mostly resembled related viruses found in bats and pangolins. The researchers proposed bats as the most likely reservoir for SARS-CoV-2 as it is very similar to a bat coronavirus [29-31]. There are no documented cases of direct bat-human transmission, however, suggesting that an intermediate host was likely involved between bats and humans [29-31]. An analysis of public genome sequence data from SARS-CoV-2 and related viruses found no evidence that the virus was made in a laboratory or otherwise engineered [30-31].

Significantly, the size and color of the Barn Owl pellets were also variable (average length 5 to 9 cm, diameter 12 to 18 cm and color blackish to deep brown), but sufficiently large to include the scats of variable small mammals, insects and small-sized birds [3-6, 16-22]. Pellet analysis also indicated a relatively high richness of the dietary habit in each sample for the barn owl, therefore, rendering it to be the cosmopolitan bird of prey [3-6, 16-22, 26].

Nevertheless, the percentage composition of small mammals was largest which showed its affinity for them throughout the present studies, lasting from fall through winter, relatively cold and dry weather, which had no impacts from rainfall, as there are incidences of the rain to affect the barn owl populations, and during the rainy days, resource availability certainly increases to affect the barn owl populations [3-6, 16-19]. Perhaps, the species richness for Barn Owl (rodents) would be considerably higher during the November to March, with more availability of food to them, than in the fall and winter seasons populations [3-6, 16-19]. As the majority of the rodents have proved to be destructive to important cash crops causing substantial economic losses, the efficiency of barn owls among the woodlands might trigger the reverse trend to control their populations through an efficient control, and augmented global trend for management of pests using non-chemical methods to protect the already dwindled agricultural systems, as well manifested in oil-palm plantations in Malaysia using the Barn Owl populations against rodent pests populations [20].

Of the mongoose, toads and insects present in the Barn Owl pellets can also be regarded as an alternative diet of the owl due to the diminishing of their preferential foods, the rodents, in any habitat populations [3-6, 16-21] and finally, the incidence of avian fauna was found in small proportions in the barn owl pellets, with babbler in relative abundance, whereas, some traces were also found for other birds. Impacts of rodent pests have been unparalleled on sustainable agro-ecosystems in the school, causing considerable depredations to mid-day meal stored grains and the materials [7-15]. The requirements of the modern-day agriculture in wake of alarming increase in population, demand better crop quality and yield [7-15]. Cropping systems throughout India are plagued with various vertebrate pests, mainly rodents, insects, and mammals, disrupting the stability and sustainability of the rich diversity of food crops [7-15]. It, therefore, augments that, propagation of the barn owl in the cultivations would be beneficial to do away with the rodent menace largely, inhibit the damage and economic losses, without putting any serious implications of the sustainability

of agro-ecosystems of school and surroundings [3-13, 22, 28-29].

“**Barn Owl Breeding Project**” in the school premises not only helps to escalate the vegetation profile of the school as well as the surrounding area but also keeps the pond ecosystem viable. It is worth mentioning that the Barn owl in this school environment plays the role of the top carnivore, predated on mongoose juveniles and bats which are mainly dependent on fishes and aquatic animals in the ponds. And, as such, an improved midday meal is possible conserving aquatic biodiversity also. In fact, it is observed that Barn owl keeping help improve the school environment, arouse the interest of students as well as communities on ecology and food chain relationships as well as biodiversity and improving Science and Technology Communication issues. And, this ultimately contributes to sustainable pond and kitchen garden management, macro- and micro- climate issues [3-13, 22, 28-29].

Nesting and hunting behaviors

In 2015 it took the initiative to protect and preserve the birds those are the frequenters to the banyan tree within the school campus [1-3]. For safe nesting, various types of boxes, pitchers, and swings are provided along with water for drinking and bathing, food particles, and sandpits [1-3]. Birds, squirrels, bats, monkeys, owls are the regular frequenters of this tree [1-3]. They use these means to procreate. In the last four years, the number of barred owls increase noticeably in the wooden owl-box of the banyan tree [1-3]. In four years, a pair of owls lay eggs twice and give birth to 32 owlets, on an average. Eggs are generally laid in the months of May-June and October-November, in the same nest [3, 5-6].

As the owl-box was damaged by the rainy season in the banyan tree, the mother owl recently took shelter in the pigeon's nest, which is a tilted bench that has been hanged from the ceiling of the veranda, a pair of barn owl (*T. alba* L.) has nestled along with a pair of rock pigeon (*Columba livia* L.) just beside the three classrooms, without hesitation the pigeon family welcomed her and this resulted in a good relationship between them [1-3,5-6]. The female owl hunted rat, mice, bat, squirrel in order to attract the male one, and the effort results in a relationship between them and began to stay together. When hunting they are very swift and will catch their prey unawares with their long and slim feet [1-3,5-6, 23].

Egg-laying, incubation and hatching behaviors

Every year, one fine morning we find both of them (owls and pigeons) have laid eggs and engaged them in incubation. The owl has laid ten (1st year 6 eggs and 2nd year 4 eggs) white colored eggs within 12-days. The average measurements of egg were: length 4.8cm, width 3.4cm, weight 20.9g. We got dumbfounded to find this amicable juxtaposition of predator and prey without hesitation the pigeon family welcomed her and this resulted in a good relationship between them [1-6, 23].

After one month of incubation, the ten nestling (four males and six females) comes to the earth. It is observed that in both seasons the sequence of egg-laying; 1st hatchling is a female owl, 2nd one is also a female owl, 3rd one is the male owl,

4th one is female, 5th one female and last one is again male owl [1-3,5-6]. Sex determination has done by morphological characters. Nesting barn owls store prey items at the nest site while they are incubating to feed the young once they hatch. The adult male counterpart has taken responsibility of supplying food. The length of the adult female is 33 cm and 93 cm when it spans its wings. And the parent owls always feed and care for the newborns. Within 10-12 days from hatching, the owlets grow and learn to eat and hunt from their parents [1-6, 17-24]. Initially, these make a "chittering" sound but this soon changes into a food.

Food supply behaviors

The female tears up the food brought by the male and distributes it to the chicks, demanding "snore". The bird was conscious about the surrounding environment. On some disturbance, parents flew away from the nest giving an alert call and perched on a palm tree nearer the building. Sometimes two owlets were observed sitting on the nest. The male is the main provider of food until all the chicks are at least four weeks old at which time the female begins to leave the nest and starts to roost in the palm tree. By the sixth week, the chicks are as big as the adults but have slimmed down somewhat by the ninth week when they are fully-fledged and start leaving the nest briefly themselves. They are still dependent on the parent birds until about thirteen weeks and receive training from the female in finding, and eventually catching prey [1-6, 17-26].

Sitting behaviors

The young 10-owlets always sit side by side in 180 degree angle and two male owlets sit in the middle surrounded by female owlets due to maintaining body temperature as well as a defense mechanism. About 65-70 days after hatching, they leave the nest for their first flight. However, they return to the nest to roost. About 3-5 weeks after they began flying, they then become independent. Eventually, after 90-116 days of full maturity, they are looking for their new nest. At the end of March, all the owls flew away and take safe-shelter behind the dry leaves of a palm tree where difficult to see or find out the owls due to the same background color of the owl and dry leaves [5-6,17-24].

Cleanliness behavior

Parents owls and 10- nestling owlets always clean the nest and never make dirty by their excreta. We do not get any decomposed materials from the nest except some little bones after all the adult owls flew away from the nest. It is noted that owls form a thin ash-colored solid layer in the platform of the wooden nest by cementing substance [1-6, 17-24, 28].

Sound produce during breeding behaviors

During incubation, the male will feed the female and both parents take care of the nestlings. When disturbed at its roosting site, an angry Barn Owl lowers its head and sways it from side to side, or the head may be lowered and stretched forward and the wings drooped while the bird emits hisses and makes snapping noises with its beak. A defensive attitude involves lying flat on the ground or crouching with wings spread out. They also 'twitter' when quarreling with nest mates. Nest boxes provide direct physical access to the breeding location [1-6, 16-28].

Singing Behavior

It is observed that barn owls do have various types of calls. There are five main categories of calls: screams, snores, hisses, chirrups and twitters, and other calls. The scream category consists of the advertising call (a drawn-out gargling scream), the distress call (a series of drawn-out harsh screams), the warning call (high-pitched scream), and the purring call (quiet scream used by the male to attract the female to a nest site). Snores are self-advertising calls given mostly by females and nestlings. Hisses are long and loud; they are given repeatedly to intimidate predators. Chirrups and twitters are given by males when delivering food and by females when feeding young. Nestlings will often twitter when uncomfortable or quarreling with a nestmate. Other calls include the mobbing call (an explosive yell), copulation call (staccato squeal), and greeting call (used during courtship and food deliveries) [1-6, 16-28].

Barn owl Anti-predator Behaviors

In the ecological food web, the Barn Owl is predated by large carnivorous mammals, red kites, hawks, eagles, some snakes, dogs, humans, and their pets, particularly house cats and feral cats. Barn owls are also predated by other owls, for example, the great horned owl [1-6, 16-28]. In 1st session, at the age of 65 days, a female owlet is theft by man for the pet in the house but the owl produces a large alarming sound when the tide in a big bag. Students hear the owlet voice and inform the Headmaster. Then, it is rescued by day-guard and frighten owlet don't come out from the bag when open the mouth of the bag by the Headmaster. But, when Headmaster enters and holds the owlet by the hand with repeated calling "Barn and Barnol", the owlet comes out and produces pleasure sound with the movement of the head [1-6, 27-28].

Barn owl Social Behavior

Barn Owl always gives positive responses for the relationship or interaction or attitude among the parent's owls, among the hatchlings of owls, pigeons, students, teachers, communities, and closely related staff specially Headmaster and two guards. Owls give negative responses to other birds, cats, dogs, photographers, visitors, and media personnel. But they behave good positive responses when very close related staff like Headmaster or guards accompany with them. Nest boxes provide direct physical access to observe all. Other sounds produced include a purring chirrup denoting pleasure [1-6, 16-28].

Barn owl Communication Behavior

Barn owls are mainly acoustic, that is, they communicate using sounds [1-6, 16-28]. The advertising call is the drawn-out gargling scream which is used often. A series of drawn-out gargling scream indicates that the owl is distressed. Some other vocalizations are a twitter when feeding and during courtship, an explosive yell in response to a mammalian predator and a defensive hissing sound. When they are not breeding they are less vocal [1-6, 23-28]. The young one also uses several distinct vocalizations which include a twitter during discomfort, attention-seeking and a snoring food call. The Barn Owl also shows visual communication to its predator and when attacked it squints its eyes, spread its wings, jerks its head back and forth, falls on its back, and

strikes at the intruder with its feet [1-6, 16-29]. But interaction with loveable students resulted in improved mental health and development forming joyful learning experiences with “Improving Science and Technology Communication by Joyful Learning School Environment”.

Barn owl Social Distance Behavior for COVID-19

It is interesting that in the 2nd session from the end of December 2019 the parent's owl only comes for the distribution food item and flies away quickly to maintain social distance. And from the 15th March 2020 to till date, all the 4-owlets also maintain social distance by sitting at least average 12 ft. [5-6, 28-31]. It may be assumed that barn owls serve as Bio-Indicator by biologically recognized regarding the spread of threatened epidemic human invisible enemy, the novel coronavirus; the novel COVID-19, which is initially observed in the Wuhan province of China, now firstly spreading around the world [29-31]. It is reported that owls have proven to be sensitive to a wide variety of toxic compounds, including pesticides, PCBs, metals, and fluoride, and are highly susceptible to secondary poisoning from consuming pesticide-poisoned prey by Steven R. Sheffield [29]. He also reported that much more work in the hazardous waste sites, smelters, landfills, agricultural croplands, and other major sources of environmental contamination [29]. So it may be told that barn owls may provide as Bio-Indicator an “early warning system” for toxic contaminants or threatened epidemic COVID-19 virus in the environment [28-31]. And these barn owls are positioned at the top of food chains and are in a position to be negatively impacted by secondary poisoning and bioaccumulation of contaminants in the environment [23-29]. It is of importance to monitor wild populations of owls at such locations as hazardous waste sites, industrial areas, agricultural areas, landfills, mining areas, and other potentially contaminated sites [28-31]. The rationale for using Barn Owl as ‘Social Vaccine’ -bio-indicator of a wide variety of environmental contaminants and it can provide an early warning to potential environmental health hazards [5-6, 28-31]. Because a social vaccine can be defined as, ‘actions that address social determinants and social inequities in society, which act as a precursor to the public health problem being addressed’. While the social vaccine cannot be specific to any disease or problem, it can be adapted as an intervention for any public health response, education and research crisis, unhealthy social and economic pandemic situations.

The aim of the social vaccine is to promote equity and social justice that will inoculate the society through action social determinants of health [32-36].

It need to expand international efforts of monitoring bio-indicator behaviors in Barn Owl by continental monitoring, identifying areas of high probability of exposure, is important, and should be implemented [5-6, 28-31]. Barn owl easily saves our society by ecological balancing of animals, as well as “Social Distance Behavior for COVID-19” [5-6, 16-31]. And it may suggest future directions for research in these areas and ultimately, the question of whether or not owls as sensitive, non-target, predatory species needs to be answered.

Special Notable Responses

The parent's Barn Owl flew away from the nest when visitors come to the spot without closely acquainted staff for photography. It took shelter behind the leaves of a palm tree. The Headmaster stated that no problem and he shall call the bird back. And started shouting...Barnol. Barnol...come. Barnol (later he stated that he found the name Barnol to be appropriate for the Barn Owl). Barnol came out and perched on a beautiful perch of a neem tree. "What a beautiful relationship!" ... when Headmaster calls, "Barn, Barn... Look your brothers from Kolkata for photography here". The young owlets also get delighted with thousands of students, teaching and non-teaching staff. All the Barn Brothers are now students forming a joyful school environment. It is noted that male owl is more responsive than female owl [1-6, 16-29].

Observation on Biodiversity

Therefore, it is observed that the biodiversity of the campus of Kanchannagar D. N. Das High School [1-29], it is seen that the procreation of the barn owls are taking place in the same environment where students, staffs, communities, visitors and birds and animals like mynah, dove, magpie, drongo, oriole, bulbul, crow, cuckoo, babbler, kingfisher, woodpecker, migratory birds, squirrel, bats, tailor birds, snake, mongoose, mice, frogs, cats, stray dogs, different types of insects, monkeys, etc. are amicably co-existing. Four years ago, the droppings of the bats in the banyan tree used to make our white walls dirty, but surprisingly, it does not occur anymore due to the presence of the owls. Food grains of mid-day meal attracts rodents resulting in a rapid increase of rats and mice but the presence of owl compel them to run away from the premises [1-29].

Importance in Science and Technology Communication

The activity of students, teachers, staffs, community, photographers, visitors, and media personnel campaign, aware, arrange workshop and seminars, make news and publish, the importance of Barn Owl for Science and Technology Communication, in different national- and local-audiovisual media (TV channels), different social media, different -national and -local newspaper, and different -national and -international journals [1-3, 5-6, 28-31].

We are amazed for Science and Technology Communication to find the coexistence of predator and prey on the same platform where owls and pigeons are found busy in incubation. It does not attack the pigeons. Owls do not cause any harm to the other resident birds within the campus also and directly or indirectly they are helping the society in various ways. They realize the meaning of Science and Technology Communication -relationship so they did not feel irritating when visitors, community, and school students went to meet them [1-3, 5-6, 28-31].

Barn owl Social Responsibility as a Bio-Indicator

Barn owl apparently acts as a keystone species in the food chain relationships [1-3, 5-6, 28-31]. We are amazed to find the coexistence of predator and prey on the same platform where owls and pigeons are found busy in incubation. It does not attack the pigeons. Owls do not cause any harm to the other resident birds and other cats within the campus. When the nestlings owlets are able to fly and their food habit

resulted in them as the “Social Guard” for the cleanliness of the school [1-3, 5-6, 28]. Their breeding helps to escalate the vegetation system of the school area and made the ponds clean; directly emphasized the ecosystem [1-3, 5-6, 28]. Directly or indirectly they are helping us in various ways. They are influencing the ecosystem as well as a joyful school environment and also working as “Science and Technology Communication Social Vaccine Bio-Indicator” and huge support to agriculture, horticulture, and viticulture [1-3, 5-36]. The Union Health Minister of India has recently asserted that lockdowns and social distancing are the most effective “social vaccines” available to fight the pandemic (Covid-19). They are also opening a path of research for the students of our school who are observing them closely.

Barn owl breeding project in the school premises helps to escalate the vegetation profile of the school area and even keeps the pond ecosystem viable. It preferred to consume a variety of rodents inhabiting the kitchen stored as well as the school campus. Foodgrains of mid-day meal attracts rodents resulting a rapid increase of rats and mice but the presence of owl compels them to run away from the premises and they become ‘guards for the cleanliness’ of the school. It is worth mentioning that the Barn owl in this school environment plays the role of the top carnivore, predated on mongoose juveniles and bats which are mainly dependent on fishes and aquatic animals in the ponds. And, as such, an improved midday meal is possible conserving aquatic biodiversity. Evidently, the Barn owl would ensure a substantial management of ecosystems for better growth of economically important crops and their management in agriculture, horticulture as well as pisciculture also. In fact, it is observed that Barn owl keeping help improve the school environment as well as surroundings, arouse the interest of students and communities on ecology and food chain relationships as well as biodiversity conservation issues. And, this ultimately contribute to sustainable pond and kitchen garden management, micro- and macro- climate issues, and also students’ health and awareness development including joyful learning experiences.

CONCLUSIONS

Barn owl breeding project in the school premises become the ‘Social Guards for the Cleanliness’ of the school and surroundings; improved midday meal, conserving biodiversity, and arouse the interest of students and communities on ecology and food chain relationships issues, and contribute to sustainable pisciculture-pond, agriculture, and kitchen garden management, micro- and macro- climate issues, and also community as well as students’ health and awareness with “Barn Owl Act as a Social Vaccine Against COVID-19 Improving Science and Technology Communication Environments Socioeconomic Applications with Joyful Learning School Environment”. They are also opening a path of more future research and communication and we strive towards the betterment of societal conditions benefitting global humanity by advancing innovations in the fields of scientific research.

ACKNOWLEDGMENTS

The work described here has been supported by all staff, students, guardians, community, photographers, visitors, and media personnel. I like to thanks Mr. Rakesh Khan, M.A., B.Ed., Secretary, and Mr. Subhendu Bose, Assist Lecturer, President, and all members of Burdwan Green Haunter and Students’ Goal for helping me for arranging several awareness programs regarding Science and Technology Communication Bio-diversity issue.

CONFLICT OF INTEREST- Nil

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