Study Committee C3

Power System Environmental Performance

10531_2022

Challenges in solving conflicts between power line management and bird conservation in Japan

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1-1. Background

Bird collisions with power lines are a global concern within conservation. Transmission system operators (TSOs) installed bird flight diverters to warn birds of overhead ground wires and to prevent collisions. **These devices, however, can make the transmission wires difficult to maintain and can even cause electrical faults because of the increase in wind and ice loading potential** (Fig. 1).

The Japanese archipelago, which extends from north to south, has various climate zones ranging from subarctic to subtropical. Therefore, transmission facilities have experienced several accidents, such as the collapse of towers and vibration of power lines, because of natural disasters, such as typhoons and heavy snowfall.

In the northern Japan, there are concerns about the risk of snow accretion and associated galloping in winter. The southern part of the country is exposed to typhoons with wind speeds of >20 m/s during summer and autumn. Therefore, power lines and towers are designed to withstand disasters. On the other hand, **these environments make it difficult to install bird flight diverters and other devices for birds.**

1-2. Objective

Because TSOs face the conflicts between the management of bird conservation and a reliable electric power supply, it is necessary to solve the various constraints of each power transmission facility. This study aims to review the background of bird collision and mitigation measures adopted by TSOs (i.e., bird flight diverters) in Japan and to discuss the effective management of both birds and transmission power facilities.

2-1. Questionnaire survey for TSOs

We distributed a questionnaire surveying bird flight diverters to Japanese TSOs in 2021 and received responses from 13 sites. The questions focused on the details of bird flight diverters, such as shape, size, and interval of installation. In addition, each site was asked for their motives (external requests or internal activities) and matters of concern (increasing wind and ice loading and falling diverters) regarding the installation of bird flight diverters.

2-2. Bird flight diverters in Japan

Ground wires and/or electrical conductors in the TSOs were marked using four types of bird flight diverters (Fig. 2). Of the 13 sites surveyed, one site had three types of diverters (i.e., ring, tag, and spiral) and two sites had two types of diverters (i.e., ring and tag).

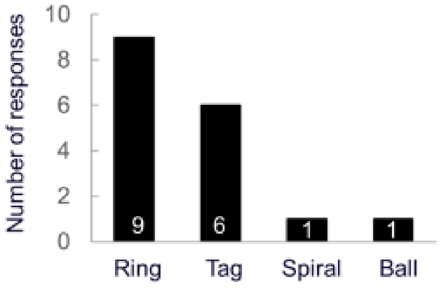

Fig. 2. Four types of bird flight diverters used by transmission system operators in Japan

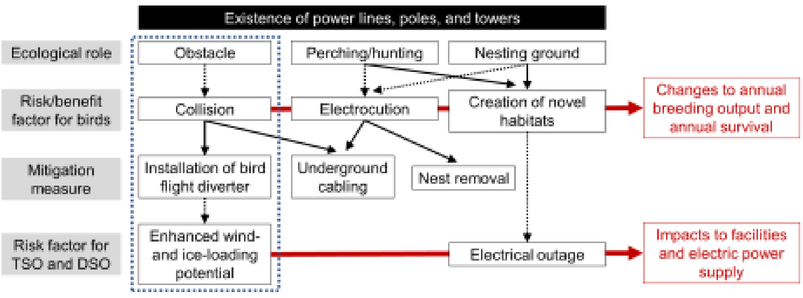

Fig. 1. Schematic of positive (solid arrow) and negative (dotted arrow) interactions between transmission facilities, ecological characteristics, and outputs (red arrow)

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2-2. Bird flight diverters in Japan (continued)

"Ring-type" diverters are red- or yellow-colored snow-resistance rings that are attached to overhead ground wires and electrical conductors to improve visibility for birds.

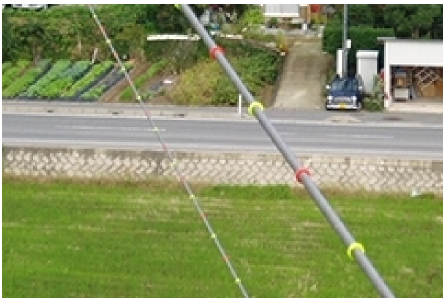

Fig. 3. Example of the Ring-type diverters (Image courtesy of Kansai Transmission and Distribution, Inc.)

"Tag-type" diverters consist of a plastic ring and a common plastic plate 10 cm long and approximately 4.5 cm wide. These hang from a cable using snow-resistance rings and can swing back and forth.

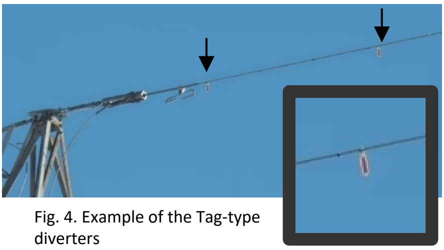

Fig. 4. Example of the Tag-type diverters

Of the BFDs in Japan, the ring and tag types were fixed to ground wires or electrical conductors every 0.3–1.0 and 1.0–1.5 m, respectively. General BFDs are designed to make the appearance of the line approximately 20 cm thicker over a length of 10–20 cm. The interval between diverters is often 5–20 m outside of Japan, which tends to be longer than that in Japan. Therefore**, it can be noted that smaller BFDs are installed at relatively short intervals in Japanese transmission facilities.**

2-3. Reason and concern of installation

The reason for the installation of bird flight diverters at each site was more due to external requests from local nongovernmental and citizen organizations than voluntary activities of the TSOs (Fig. 5). The installation of bird flight diverters involves close consultation with stakeholders in each region. Therefore, **the installation of bird flight diverter is considered to contribute to the improvement of public acceptance of transmission facilities in important bird habitat areas.**

Although more than one-third of 13 sites were concerned about the installed diverters falling, none of these sites mentioned the influence of wind or ice damage (Fig. 6). **Since snow-residence rings are small and commonly used device, it is assumed that TSOs do not need to be concerned about damage caused by wind and snow.**

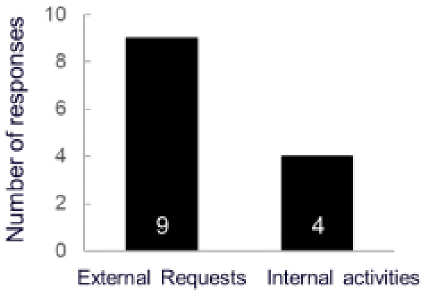

Fig. 5. Main driver to install bird flight diverters in Japan

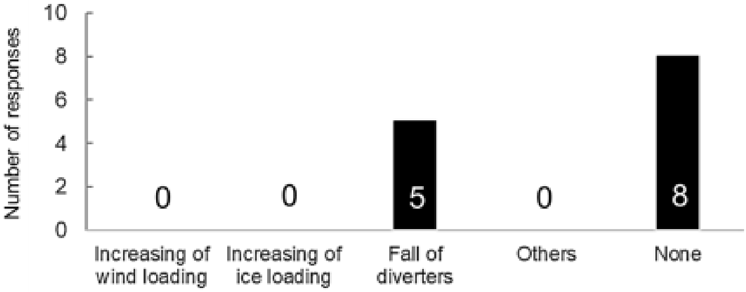

Fig. 6. Areas of concern over newly installed bird flight diverters

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3. Change of public perception

In recent years, efforts to conserve endangered bird species have accelerated in Japan. A typical example is the reintroduction project for the oriental white storks (*Ciconia boyciana*), which became extinct in the 1980s. The reintroduction project of the storks began in 2005, and the wild stork population exceeded 200 by 2020.

The storks are a bird species that are sensitive to collisions with and electrocution from power lines, so it is necessary to carefully monitor the project's progress to avoid conflicts. We focused on newspaper articles to understand how the Japanese media portrayed conflicts between electric power facilities and white storks in Japan. Articles relating to electric power facilities and white storks were analyzed from national, local, and community newspapers (49 newspapers in total) that were published between January 2001 and December 2020.

Using an electronic search engine, 1,304 articles were identified. The number of articles involving both electric power facilities and white storks increased following the reintroduction of storks in 2005 (Fig. 7). From 2016 to 2020, >600 articles were published, potentially related to the increase in the number of wild storks (reaching 100 in 2016 and 200 in 2020).

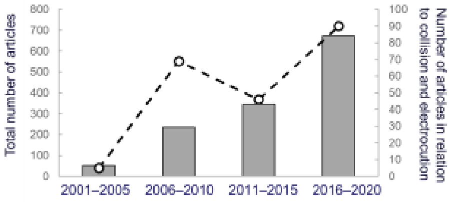

Fig. 7. Number of newspaper articles addressing power facilities and an endangered species (white storks) (bars) and articles in relation to collision and electrocution (dashed lines)

When articles containing the keywords "collision" and "electrocution" were assessed, the number of publications also increased significantly from 2001 to 2020 (Fig. 7). Recently, >40 articles containing these keywords are being produced annually. These trends indicate that the increase in the population of storks due to the reintroduction has resulted in an increase in news reports concerned about collision and electrocution with power lines. Because social concern about collision and electrocution of birds is expected to increase in the future, **it may be necessary to introduce more reliable conservation measures (e.g. larger-sized diverter).**

4. Consideration of larger-sized bird flight diverters

Installing larger BFDs at shorter intervals improves the visual effect for birds but also increases the negative impact on the respective facility. The optimal size and spacing of BFDs should be evaluated with consideration for both collision mitigation and structural integrity.

As novel challenges, there is an ongoing attempt to quantify the increase in wind load caused by various installations of BFDs via finite element method (FEM) model of power lines.

How to simulate

1. Make FEM model based on actual structural condition
2. Add cylindrical diverters and wind load on the FEM model
3. Solve motion equation of each element
4. Output the tension of the edge point
5. Calculate how much the tension increases due to wind load on diverters

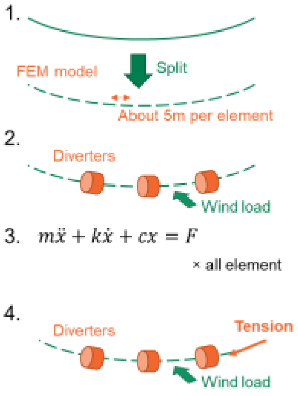

Fig. 8. Schematic image of finite element method (FEM) model of power lines with bird flight diverters

5. Conclusion

Our research found that TSOs in Japan installed smaller diverters at relatively short intervals. Although the smaller diverter is considered to contribute to the reduce of negative impacts from wind and ice loading, the effectiveness on birds remains vague. In order to respond to requests for more reliable conservation measures, it will be necessary to evaluate the impact of larger-sized diverter with modern approaches, such as simulation analyses.