10 APRIL 2001

Environmental Impact Assessment Ordinance, Cap. 499
Application for Permission to Apply Directly for Environmental Permit
Application No. DIR-048/2001

Temporary Wind Monitoring Station on Lamma Island

Local Opinion

Discussions with representatives of the Hong Kong Bird Watching Society and Asia Ecological Consultants have identified the following main issues related to birds and the proposed wind monitoring station.

1. The impact of a tower structure is considered to be of most concern to White Bellied Sea Eagles and to a lesser extent Black Kites.
2. Sea Eagles build large visible nests in trees on exposed headlands; the proposed monitoring station on Ngai Tau is also in an area of exposed headlands.
3. Sea Eagles have been seen on both Lamma and Po Toi Islands, but they are not known to be nesting on either island.
4. Black Kites are scavengers that soar on wind currents to look for food, but they do not dive on land for hunting purposes.
5. Regarding measures for mitigating bird strikes on the tower structure, it was suggested:
   a. Avoid bright lights so that birds are not disoriented during bad weather.
   b. Visual contrast seems to be effective for warning birds.
   c. Guy wires can be painted with alternating light and dark colours.
   d. Flapping plastic strips have been used elsewhere to make wires obvious.

Literature Review

There are several bibliographies which provide literature reviews of bird interaction with man made structures. One site on the Internet where some of these bibliographies are linked is at www.towerkill.com/issues/links.html. One of the most detailed literature reviews of bird mortality from tower structures is Avian Collision and Electrocution: an Annotated Bibliography published by the California Energy Commission in October 1995 (Publication number P700-95-001). From this review which spans over 100 years of observations, we have extracted some key issues related to the wind monitoring station on Lamma Island.

1. Some studies have suggested that mass bird kills associated with towers and building structures typically occur during rare weather patterns such as during the passage of a cold front. Bird mortality from these short episodes is typically much greater than all of the rest of the year combined.
2. Many studies have documented that the greatest danger to eagles from power lines is from electrocution rather than from collision. Electrocution is primarily due to eagles standing on closely spaced conductors and from lightning strikes on nests located in tall metal structures (like towers) which are lightning hazards.
3. Birds collide more frequently with the smaller diameter grounding wires on the top of overhead power lines compared to the larger current carrying cables.
4. Higher mortality from wire collisions is observed during conditions of panic-caused flight when birds are flushed out of their habitat by disturbance.
5. Some studies found that plastic strips or spirals attached to wires did not reduce the number of bird collisions, whereas plastic silhouettes of raptors that were visible in poor light were successful in deterring other birds from wires. *(Heijnis R. 1980. Bird Mortality from Collisions with Conductors for Maximum Tension. Okol. Vogel (Ecology of Birds) 2, Sonderheft 1980; p111-129.)*
6. Some studies have indicated that attempts to make power lines more visible with luminous orange tape have been inconclusive regarding reduced bird collisions.
7. In one study an attempt to make power lines more visible to swans by attaching large staggered wooded blocks to the wires failed.
8. Other studies have estimated that bird strikes on the grounding wire of overhead power lines can be reduced by almost 50% when marker balls or air flow spoilers are attached to the grounding wire.
9. It is hypothesised that bird collisions with lighted structures under overcast conditions is due to spatial disorientation of birds when bright light causes a loss of visual clues to the horizontal. This effect may be produced by bright light sources like airport ceilometers or less bright lights like aircraft warning lamps when refracted by mist or rain. Some studies assert that these effects do not cause birds to migrate towards lighted structures, but only those birds on a path close to the lighted object will be affected.
10. Some studies have not found a definitive correlation between poor weather conditions and increased collision mortality.
11. The US Forest Service General Technical Report RM65 suggests the following mitigation measures to reduce bird strikes on man made structures:
    a. Better siting of overhead wires (away from wetlands, for instance).
    b. Alter the reflectivity of glass surfaces.
    c. Eliminate unnecessary illumination of structures.
    d. Convert warning lamps for tall structures to an On - Off cycle.
12. Studies from power plants have shown more bird kills from unpainted chimneys marked with bright white strobe lights and less bird mortality at towers painted with red and white bands that are marked with flashing red lights.

Conclusion

Based on the local and international experience cited above, we would conclude that the following is a reasonable assessment of the bird strike risk and the best mitigation measures for the proposed wind monitoring station at Ngai Tau on Lamma Island.

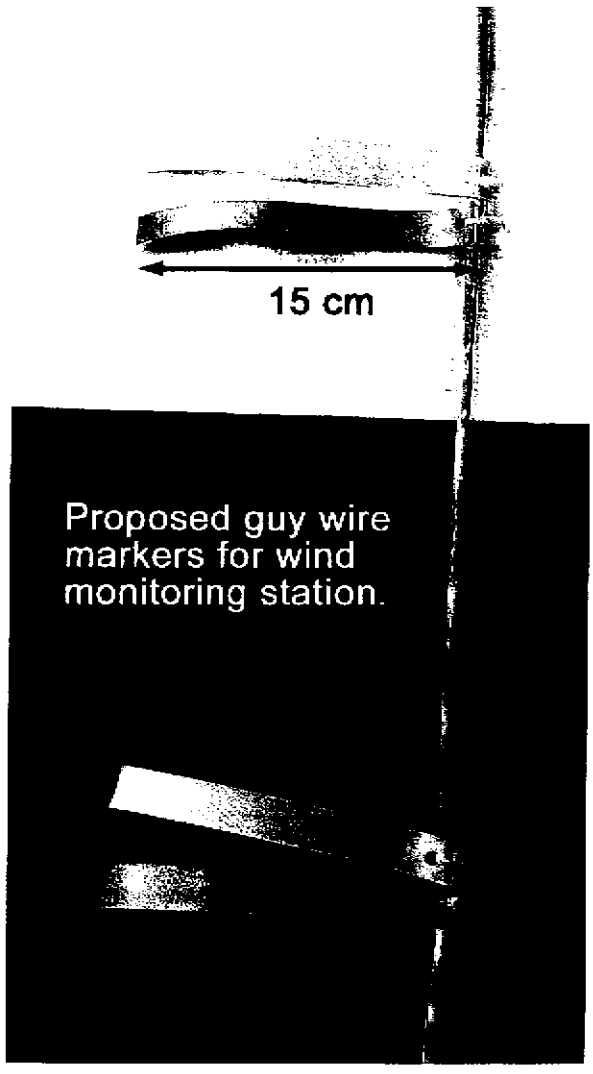
1. The threat to the species of greatest concern, the White Bellied Sea Eagle, is probably low. This is not a type of bird that is associated frequently with wire or tower collisions.
2. Migratory birds may be more susceptible to impact with tower and wire structures depending on the species, individual health, season, and weather pattern.
3. While there is some disagreement among studies, the best mitigation measures to reduce bird strikes on tower and wire structures seem to be:

a. Reduce night time illumination or make warning lamps intermittent to avoid disorienting birds in bad weather. However we are unable to achieve this goal as the Civil Aviation Department requires a steady red warning lamp at the top of the tower on Lamma (one in the middle and one on top for the Po Toi site).

b. Mark the tower structure with contrasting stripes of colour. The proposed tower at Ngai Tau on Lamma Island will have alternating bands of orange and white to provide visual contrast. The wind monitoring station on Po Toi Island already has this type of feature.

c. Mark the guy wires with plastic strips of light and dark colour to provide movement and contrast that will make birds more aware of the presence of the wires. The plastic strips will be placed together in pairs of light and dark with spacing between each pair of 2.5 m (about 8 ft.) The wind monitoring station on Po Toi Island already has this type of feature.

A photograph of this mitigation measure is shown on the right with a white and black background for reference.



Proposed guy wire markers for wind monitoring station.

(41)

25 May 2001

Planning Department

Paragraph 2.
We agree with the conclusion of the Planning Department. However, it should be clarified that Hong Kong lies on the general migratory flight path of several bird species. There is presently no certainty that the possible impacts on migratory birds would be less if the proposed wind monitoring station was moved to another location in the area. We shall co-operate with relevant organisations like the Hong Kong Bird Watching Society in the coming months to improve the understanding of coastal and offshore use by migratory species. This more detailed information will be essential for further planning on wind power issues in Hong Kong.

Paragraph 3.
For the further consideration of the Planning Department we have attached a series of photographs of the wind monitoring station installed at Heung Ngam on Po Toi Island (Annex A, pages 1 - 2). Please note that the tower on Po Toi is 50 m tall and the proposed tower on Lamma is 30 m. In addition to the notes included in Annex A, we would like to make the following summary comments based on our experience with the Po Toi tower installation.

1. The visual impact of the tower colour is highly dependent on the sun angle.
2. The orange colour of the tower is most obvious when the sun angle is low and when the sun is behind the viewer. When the sun angle is high and/or the sun is not behind the viewer, the orange tower sections appear grey even at distances less than 1 km.

3. For the proposed wind monitoring tower location on Lamma Island at Ngai Tau, the optimal conditions for the tower colours to be obvious to viewers would be the following:

   Stanley Peninsula (Distance from tower: 6 km)
   Very early morning

   Tung O and Mo Tat Old Village - Lamma (Distance from tower: 2 km)
   Late afternoon and evening

   Based on the criterion of sun angle, there are no other communities in line to see the most obvious impact of a tower colour scheme. Tower colours would appear grey to most viewers at most times, no matter what the chosen colour scheme.

4. The tower guy wires which are 3/16" stainless steel cables are not visible to the human eye before about 500 m under optimal conditions, and are only obvious at distances less than 250 m under normal conditions.

5. The effect of a cloudy or clear background sky is less important than sun angle in determining the visual impact of the tower. We note that Hong Kong's skies are predominantly cloudy (average 65% cloud) according to the Hong Kong Observatory.

6. Localised fog that occurs on ridges and hilltops due to the topographic influence on moving air masses can be a significant factor that reduces tower visibility. The Po Toi wind monitoring site regularly exhibits such a localised fog effect that makes the tower almost invisible even from Tai Wan (distance 750 m). We have not observed the proposed Lamma site for a sufficient period of time to conclude whether a local fog effect would reduce the tower visibility significantly.

7. We do not have any preference about the tower colour scheme. Standard painting options from the manufacturer are either orange and white bands as installed on Po Toi, or solid grey.

Paragraph 4.
The Civil Aviation Department has previously stated that a colour scheme is not required for either the Po Toi or Lamma wind monitoring towers. CAD stipulated that red warning lamps must be installed to illuminate the structures at night and at low visibility. We have noted regular helicopter traffic during the day very near to the Po Toi site (Annex A, page 3). This may warrant some consideration about tower colouring. We are not certain of the helicopter traffic pattern close to the proposed Lamma wind monitoring site.

Agriculture, Fisheries and Conservation Department

For the consideration of the AFCD we have included some photographs of the Po Toi wind monitoring site (Annex A, page 3). Please note that the tower on Po Toi is 50 m tall while the proposed tower on Lamma is 30 m.

Width of tower colour bands

The orange and white bands on the Po Toi Tower have the following configuration:

Band	Colour	Width
Lowest	Orange	6 m
2	White	6 m
3	Orange	9 m
4	White	9 m
5	Orange	9 m
6	White	7.5 m
Top	Orange	6 m

Colour of plastic strips

The plastic strips are dark blue and white. As shown on page 3 of Annex A, one strip of each colour is installed every 2.5 m on the top and middle guy wires.

Evidence of avoiding bird collision

Our experience with the Po Toi wind monitoring tower after its set-up on 20 April is that local birds use the tower frequently as a perch. Smaller birds have been observed perching on the lower guy wires, particularly during the evening. Bird droppings on the guy wires indicate preferred locations for perching. Larger birds have been observed circling the tower, flying between the guy wires, and subsequently landing on the sensor supports. To date we have only managed to photograph an example of the latter behaviour.

These observations support the idea that local birds quickly become familiar with a new structure in their territory. However, it does not prove that our guy wire plastic markers and the tower colour scheme are effective at avoiding all possible bird collisions under all conditions. We have not found any evidence in the literature to suggest that there is a 100% sure method to avoid bird collisions with man-made structures. In fact, as indicated in our last submission, some international studies are contradictory in their evaluation of measures which reduce bird collisions.

In the absence of guidelines for protecting birds from urban structures we have adopted a bird marker spacing of 2.5 m on the guy wires based on common sense. To date we have not observed any bird mortality and we shall continue to monitor the site to provide better information on bird interaction with these structures so that a more scientific basis for bird protection can be developed in the future.

Width of plastic strips

The plastic strips are 1.8 cm wide.

Enclosures:

Annex A. Annotated photographs of the Po Toi wind monitoring station. 3 pages A3.

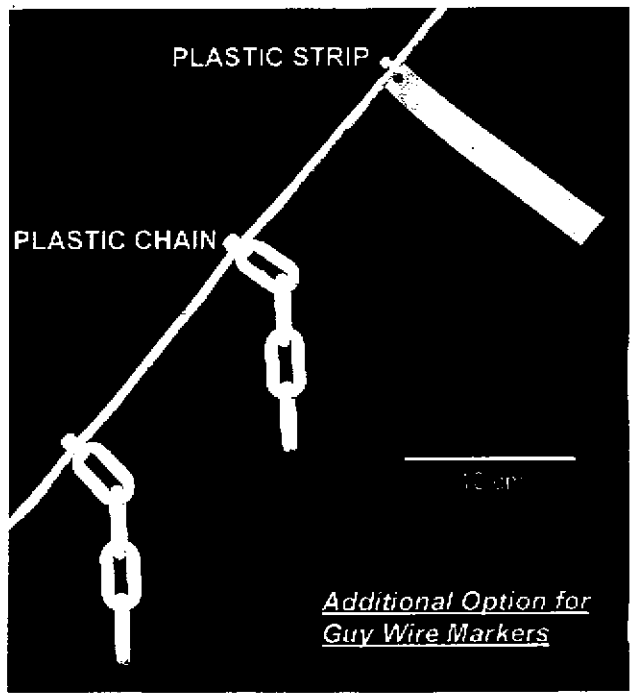
8 June 2001

Tower Colour Scheme

The choice of colour does not affect the objective of data collection at the site in any way. The tower can be painted grey if so requested. It should be clarified that our submission of photos from Po Toi Island is not intended to promote any particular colour scheme. However, we do feel it is relevant to show that under real conditions the colour of the tower is usually not clear.

Guy Wire Markers

We continue to investigate other options for making the guy wires more obvious to birds. It should be clarified that the plastic strips used at Po Toi are not the only choice. A more durable marker for high winds and long weather exposure would be the use of plastic chain as shown on the right. We would value the feedback from the AFCD about the use of such a marker type.



Additional Option for Guy Wire Markers