HOW GOOD DESIGN CAN PROTECT THE KĀREAREA (NEW ZEALAND FALCON) AND IMPROVE NETWORK SAFETY

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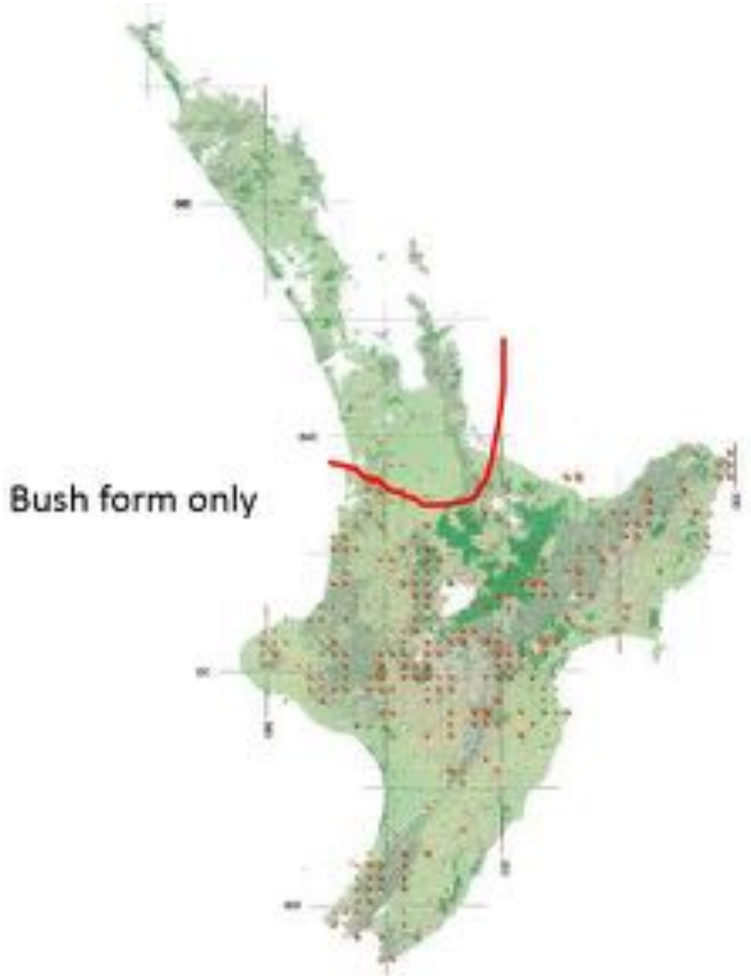
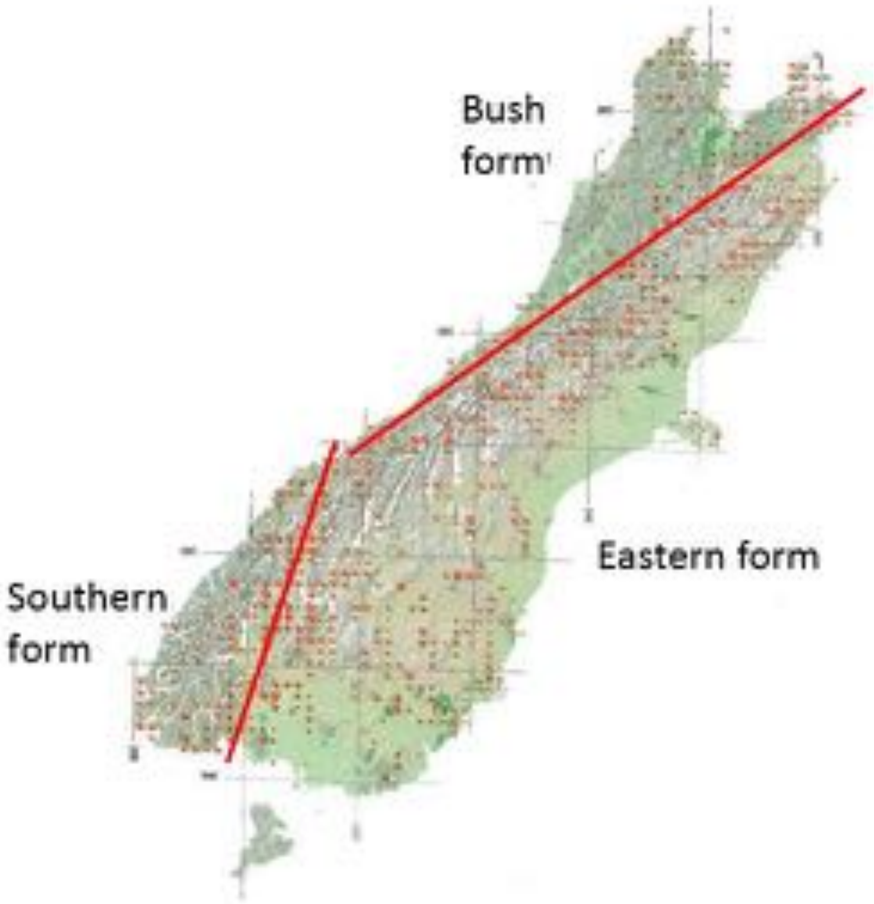
BACKGROUND – THE KĀREAREA

- The kārearea or New Zealand Falcon is nationally at risk.
- Only around 3000-5000 breeding pairs remaining.
- Historical and ongoing habitat loss.
- Introduced predators at nest.
- Human interactions – shooting, collisions cars and windows.
- Electrocution.

NATIONAL DISTRIBUTION





THE PROBLEM - ELECTROCUTION

- Two studies have attributed nearly half of the bird deaths to electrocution.
- Marlborough: 47% (10 of 21) falcons electrocuted.
- Glenorchy: 54% (7 of 13) reported deaths electrocution.
- Falcons electrocuted at a range of electrical distribution structures.
- Marlborough: 9 of the 12 structures involved were distribution transformers.
- Glenorchy: most incidents involved transformer structures, including cable terminations, a recloser and two inline structures.

SOME OF THE EVIDENCE

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SOME OF THE EVIDENCE: CARPAL BURN

SOME OF THE EVIDENCE: FOOT BURN

SOME OF THE EVIDENCE

Photo: DoC

STRUCTURES INVOLVED: TRANSFORMERS

STRUCTURES INVOLVED: TRANSFORMERS

STRUCTURES INVOLVED: TRANSFORMERS

STRUCTURES INVOLVED: RECLOSER

STRUCTURES INVOLVED: CABLE TERMINATIONS

STRUCTURES INVOLVED: INLINE

RISK OF ELECTRIC SHOCK

In order to determine likely risk and mechanisms of an electric shock on a specific structure type we must first understand:

- Falcon geometry.
- Identify critical contact points.

and secondly:

- Behaviour – movement interactions.
- Identify injurious body currents.
- The geometry of the structure.

FALCON GEOMETRY

How does falcon geometry effect risk?

Photo: Sara Kross

CRITICAL CONTACT POINTS - SOFT TISSUE

Photo: Andy Frost

CRITICAL CONTACT POINTS - SOFT TISSUE

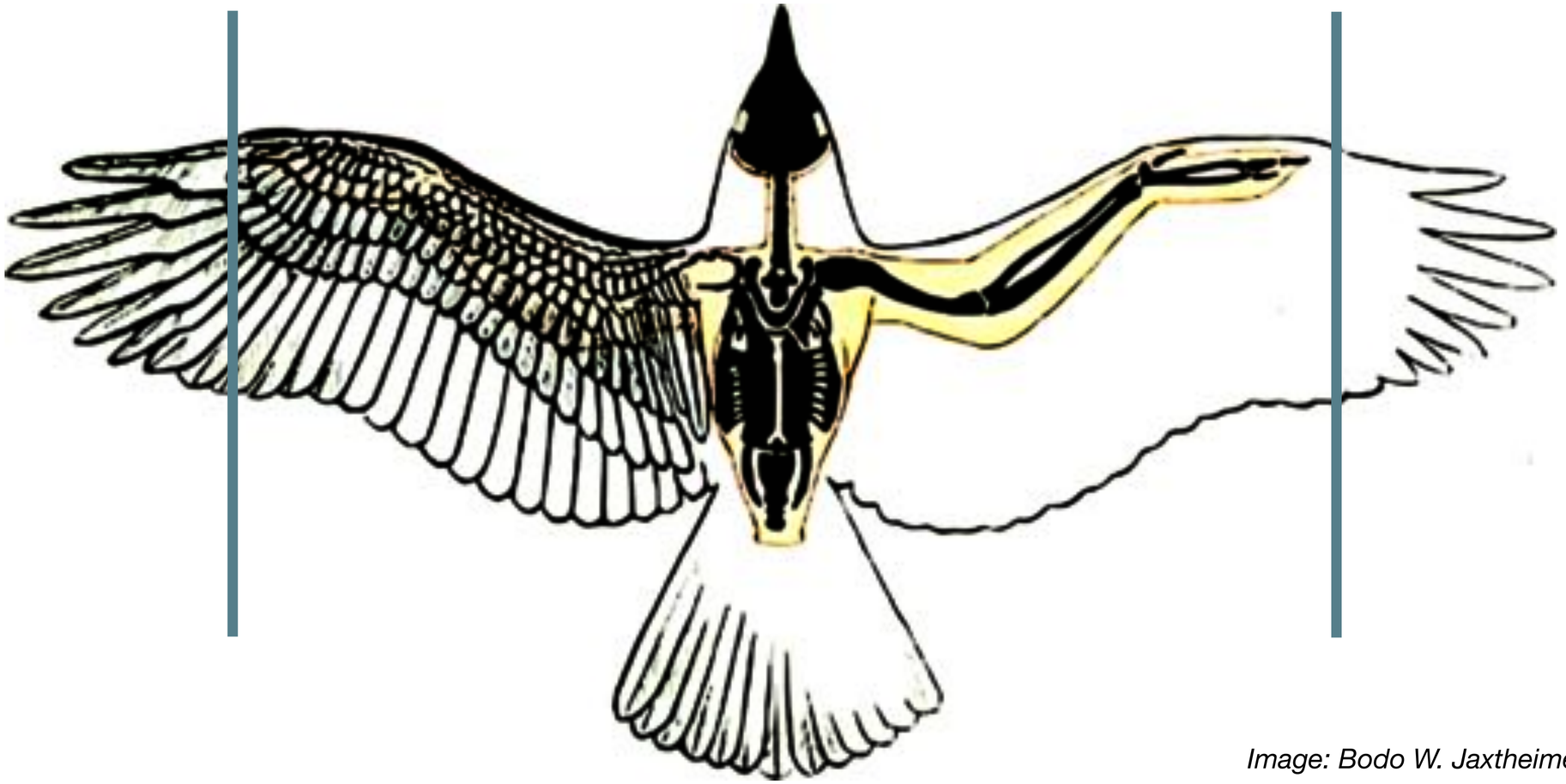


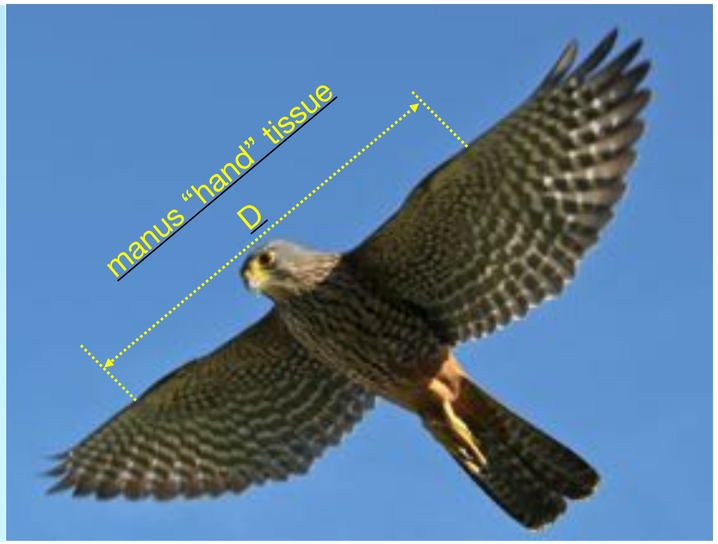
Image: Bodo W. Jaxtheimer

FALCON MORPHOMETRIC DATA

- Dead falcons handed into the Department of Conservation's Glenorchy field office between 2005 and 2015.
- Female falcons significantly larger than males (~20% - sexual dimorphism).
- Females considered at elevated risk of being electrocuted.
- Females are therefore used as the basis for defining critical geometries.
- The 95 percentile on the normally distributed population provides statistical basis for design parameters.

CRITICAL FALCON GEOMETRY

Measurement:	*μ+2σ (> 95th Percentile)*
Foot to Head (Perching) (A, n=8)	296 mm
Outer “Hand to Hand” (Manus Tissue) (D, n=7)	539 mm
Centre Body to Outer “Hand” (Manus Tissue) (D/2)	269 mm
Foot to Chest (Perching) (2/3*A)	197 mm



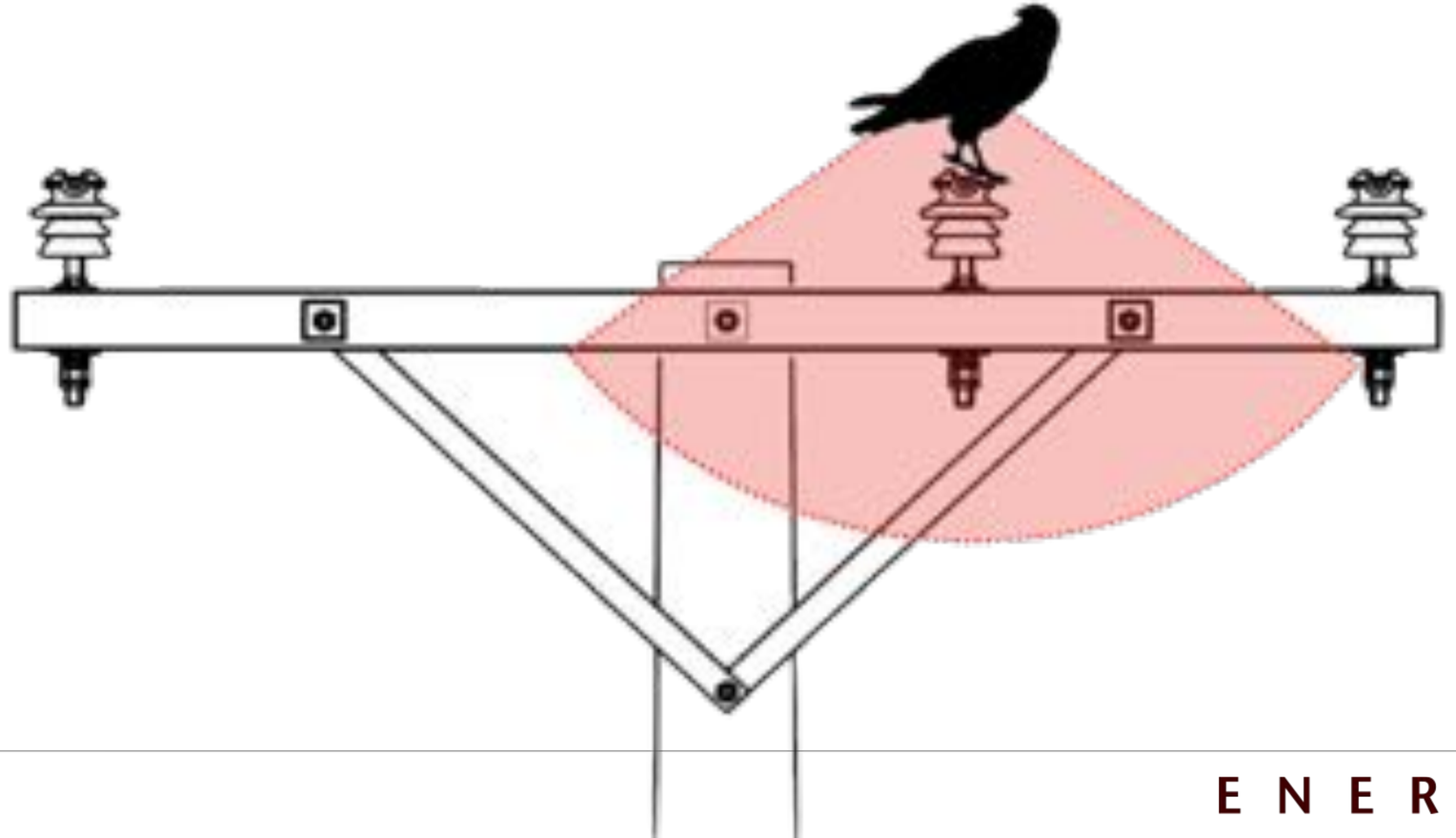
FALCON BEHAVIOUR

- Falcons appear to prefer perching on crossarms and the heads of poles rather than on insulators.
- They prefer perches with good height and visibility when looking for prey and a good flat platform for eating it.
- Perching on cable terminations, reclosers or fuses is unclear.
- They may be merely victims of the extra live parts, droppers, crossarms and reduced clearances that exist on such structures.
- Fine scale interaction unclear: requires research.

FALCON ‘STREAMERS’ (EXCREMENT STREAMS, LIQUID FAECAL STREAMS)

STREAMER GUIDELINE

As a guideline for discussion we proposed a maximum ‘streamer’ length of 500mm at an angle of 40º to vertical.



INJURIOUS BODY CURRENTS

- A safe threshold of body current for a ‘typical’ falcon is difficult to define.
- Information used from the poultry industry.
- Electrically shocking of an animal is an unreliable method of euthanasia.
- Highly variable nature of the resistance and current path
- Documented examples of falcons receiving a shock and then fully recovering.
- Guidelines from the poultry industry indicates that minimum currents of 100mA (50Hz) be achieved for the stunning of chickens using a water bath prior to slaughter (European Regulations).

HIGH VOLTAGE RESISTANCE TESTING

HIGH VOLTAGE RESISTANCE TESTING

RESULTS

From	To	Voltage [Volts] V	Body Current [µA] I	Condition	Resistance [MΩ] R=V/I
Wingtip	Wingtip	6350	7.9	Dry	804
Wingtip	Foot	6350	180.0	Wet - Sprayed	35
Wingtip	Foot	6350	190.0	Wet - Sprayed	33
Carpal Tissue	Foot	400	7000.0	Wet - Sprayed	0.057
Wingtip	Foot	6350	11.0	Dry	577
Wingtip	Foot	6350	12.0	Dry	527

Table 4: Summarised result of HV testing of testing of kāhu or harrier hawk (Circus approximans)

RESULTS

Species	Sample	Soak time [minutes]	Feather Length [mm]	kV	Leakage Current [µA]	Additional Test Length [seconds]
Harrier	1	Dry	280	6.6	10	
Harrier	5	30	270	6.6	350	
Harrier	5	30	270	6.6	320	30
Harrier	5	30	270	6.6	280	45
Harrier	5	30	270	6.6	250	60
Harrier	5	30	270	6.6	190	75
Falcon	1	Dry	230	6.6	7.6	
Falcon	6	30	220	6.6	80.2	
Falcon	6	30	220	6.6	9.4	30
Falcon	6	30	220	6.6	9.2	45
Falcon	6	30	220	6.6	9.3	60
Falcon	6	30	220	6.6	9.3	75

Table 5: Sample of results of HV testing of testing of Hawk and falcon flight feathers

RESULTS

The results suggest that:

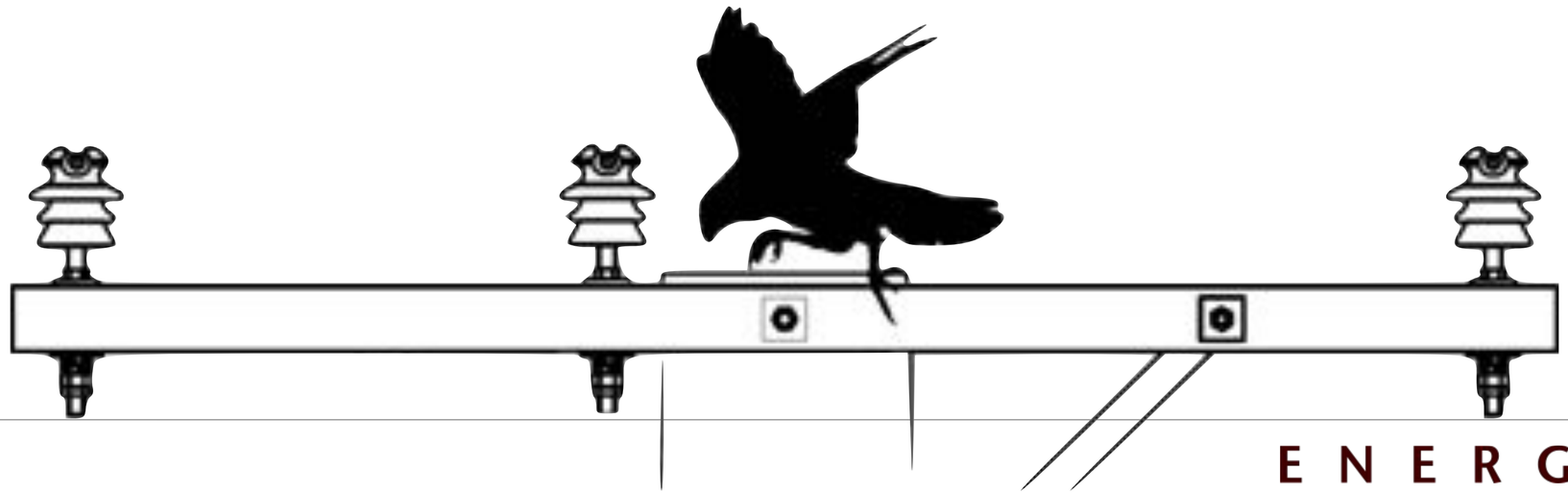
- Contact between a bird's flight feathers away from any tissue is less likely lead to an injurious or fatal electric shock.
- Tissue contact between an exposed live part and earth or another phase should be considered potentially injurious or fatal.
- Dimensions that include primary flight feathers are not as critical as those that involve tissue.
- The critical contact points are considered to be the feet, chest/body, manus "hand" and carpal tissue areas.

ELECTRICAL STRUCTURAL GEOMETRIES

The following items on structures are considered critical:

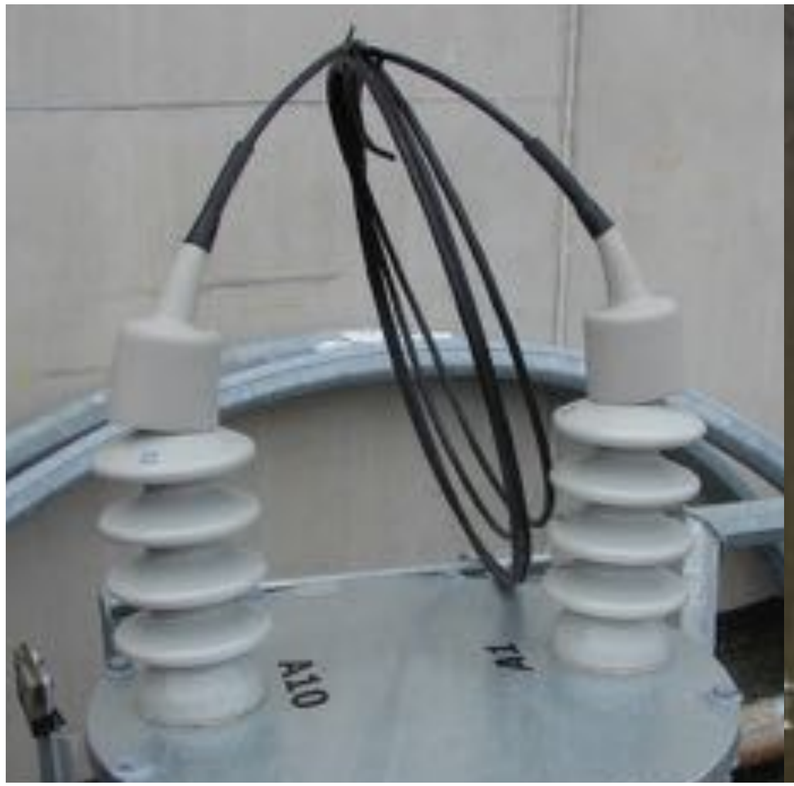
- Distribution Transformers.
- High Voltage Droppers.
- Crossarms, conductive poles and insulators.

We will look at each of them in turn and show critical points and mitigation measures.

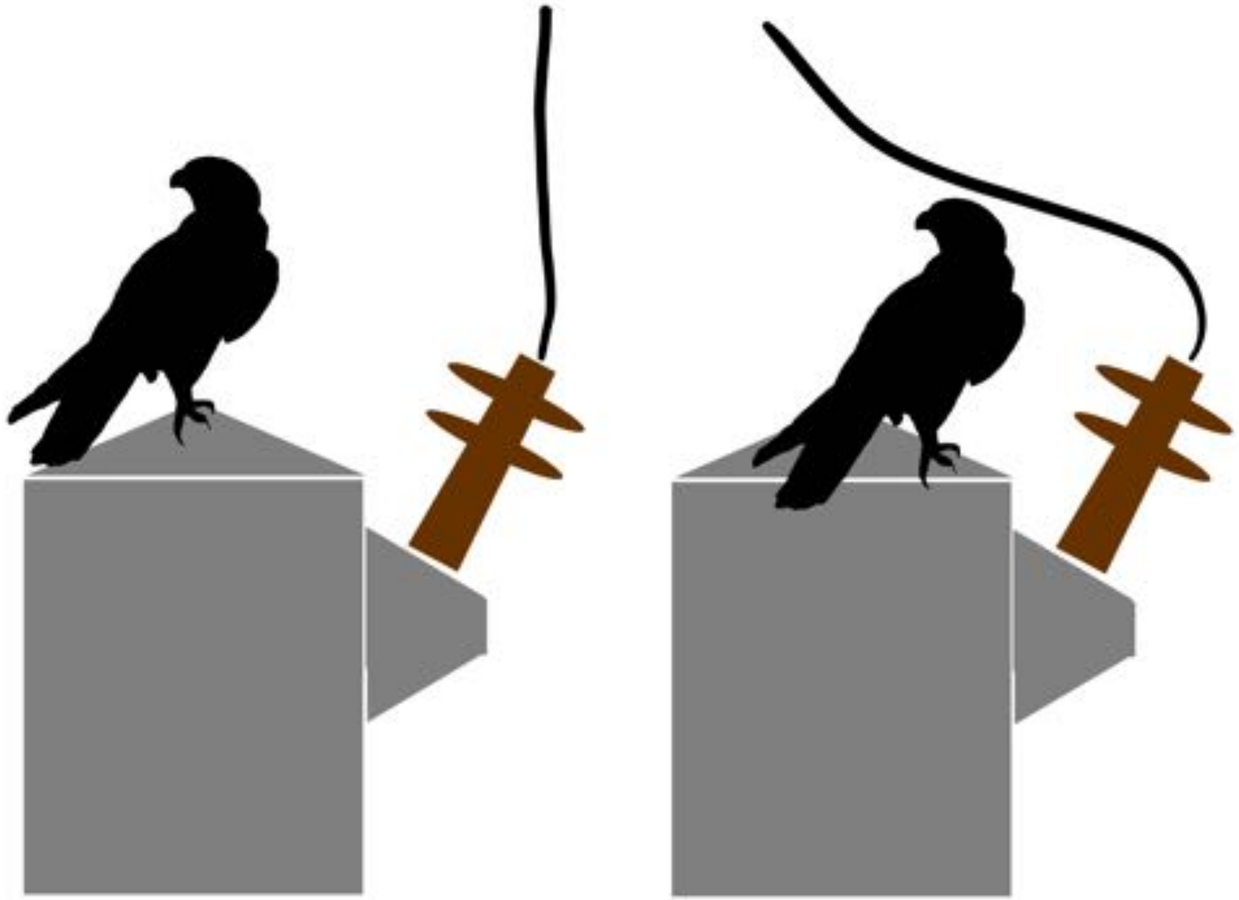


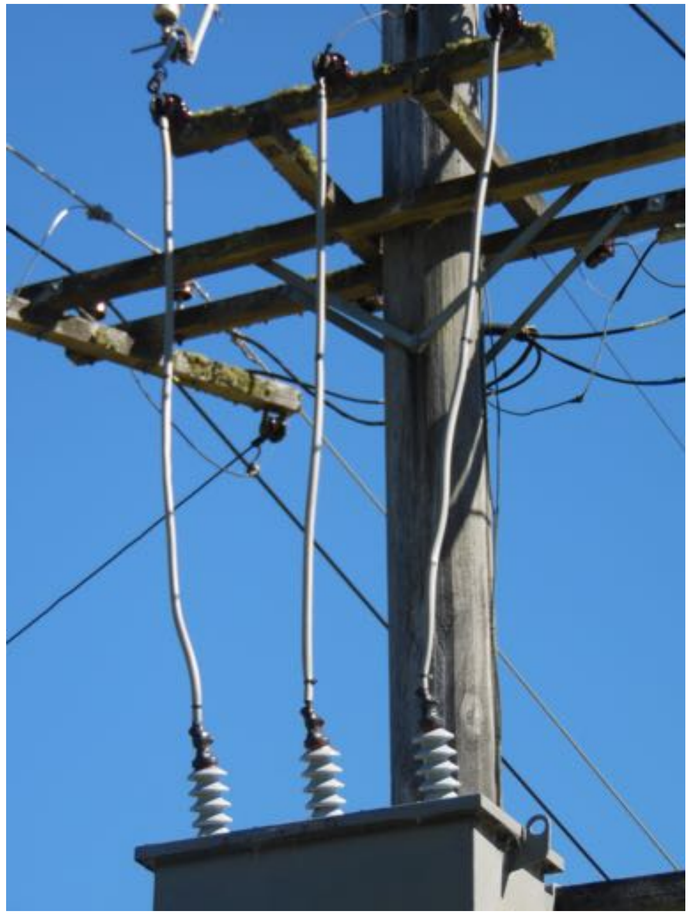
DISTRIBUTION TRANSFORMERS

DISTRIBUTION TRANSFORMERS - MITIGATION



HIGH VOLTAGE DROPPERS

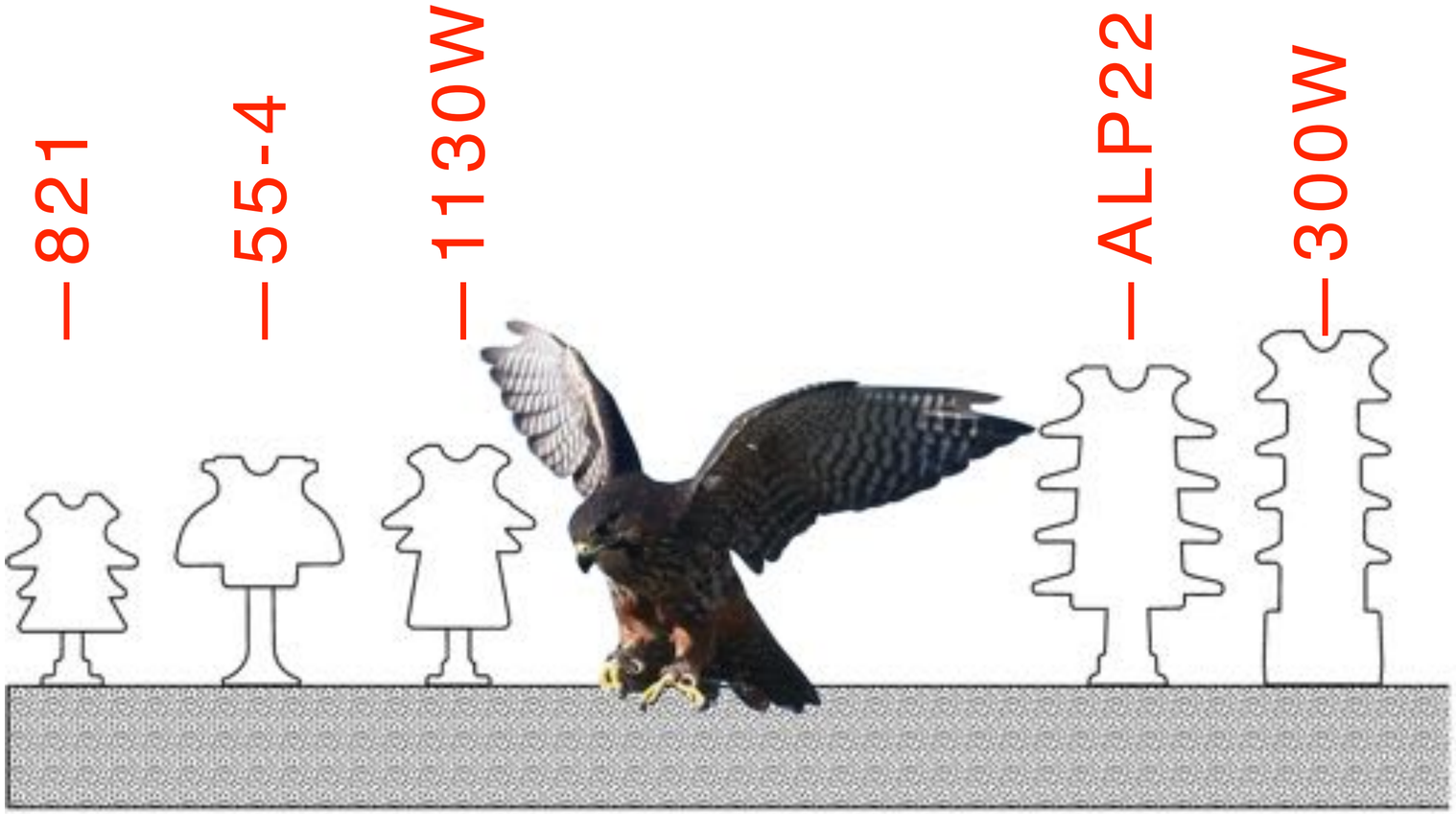




HIGH VOLTAGE DROPPERS - MITIGATION

- Increase separations
- Consider dropper route
- Cover conductor
  - PVC (AS/NZS 5000)
  - Split tubing

CROSSARMS, CONDUCTIVE POLES AND INSULATORS



older ——————> newer

CROSSARMS, CONDUCTIVE POLES AND INSULATORS - MITIGATION

- Newer designs of insulators are generally getting taller.
- Increase separations from conductive poles etc.
- Underslung ‘jumpers’ preferable.
- Careful placement of ancillary and supplementary equipment.

MARLBOROUGH LINES: FALCON FOR GRAPES

- Marlborough Lines started insulating the bushings of transformers in 2009
- Policy in place to tape the exposed bushings of new transformers in relevant areas with medium voltage fusion tape (MVFT) and to install split tubing onto the drop leads (“droppers”)

DELTA: KĀREAREASAFE

In 2015 Delta Utility Services Limited formed a conservation partnership (MOU) with the Department of Conservation to address the issue of falcon deaths.

- The retrofitting of four structures in Glenorchy.
- Incorporation of enhanced falcon friendly requirements into Network policy.
- Education material including information panels in Glenorchy and brochure.
- Ongoing development of KārearеaSafe certification/labelling scheme.
- New wildlife protection sections in both Overhead and Substation design and construction standards.

CROSSARM MOCK-UPS

Photo: Andy Frost

PROVISIONAL RECOMMENDATIONS

- Distribution transformer bushings connections should be taped or covered.
- Taller bushings and insulators should be considered.
- All HV droppers should use black PVC covered conductor with split-tubing used to supplement it where possible.
- The industry should move to the use of “hand to hand” (Manus Tissue) distances.
- Network drawings and designs should incorporate wildlife symbology.
- Animal contact and interactions should be recorded as part of inspections.
- Work undertaken should be documented in a networks AMP.
- Members of the public should be further encouraged to photograph and report falcons or other significant birds on electricity structures.

NEXT STEPS

- Further work using mock-up cross arms, sensors and cameras is planned by the Department of Conservation (DOC) at the MFCT aviaries in Marlborough to study the behaviour of falcons on such structures.

- From this work it is hope that risks can be quantified so that further funding can be sought for targeted initiatives.

CONCLUSION

Electrical structures typically have a design life of 50 years.

Sympathetically designed structures need not cost any more.

It is in no one's interest to harm threatened wildlife.

We must as an industry acknowledge the issue and work towards an industry wide solution.

ACKNOWLEDGEMENTS

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STREAMER CONSEQUENCES

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31st December 2015
Photo: Richard Healey