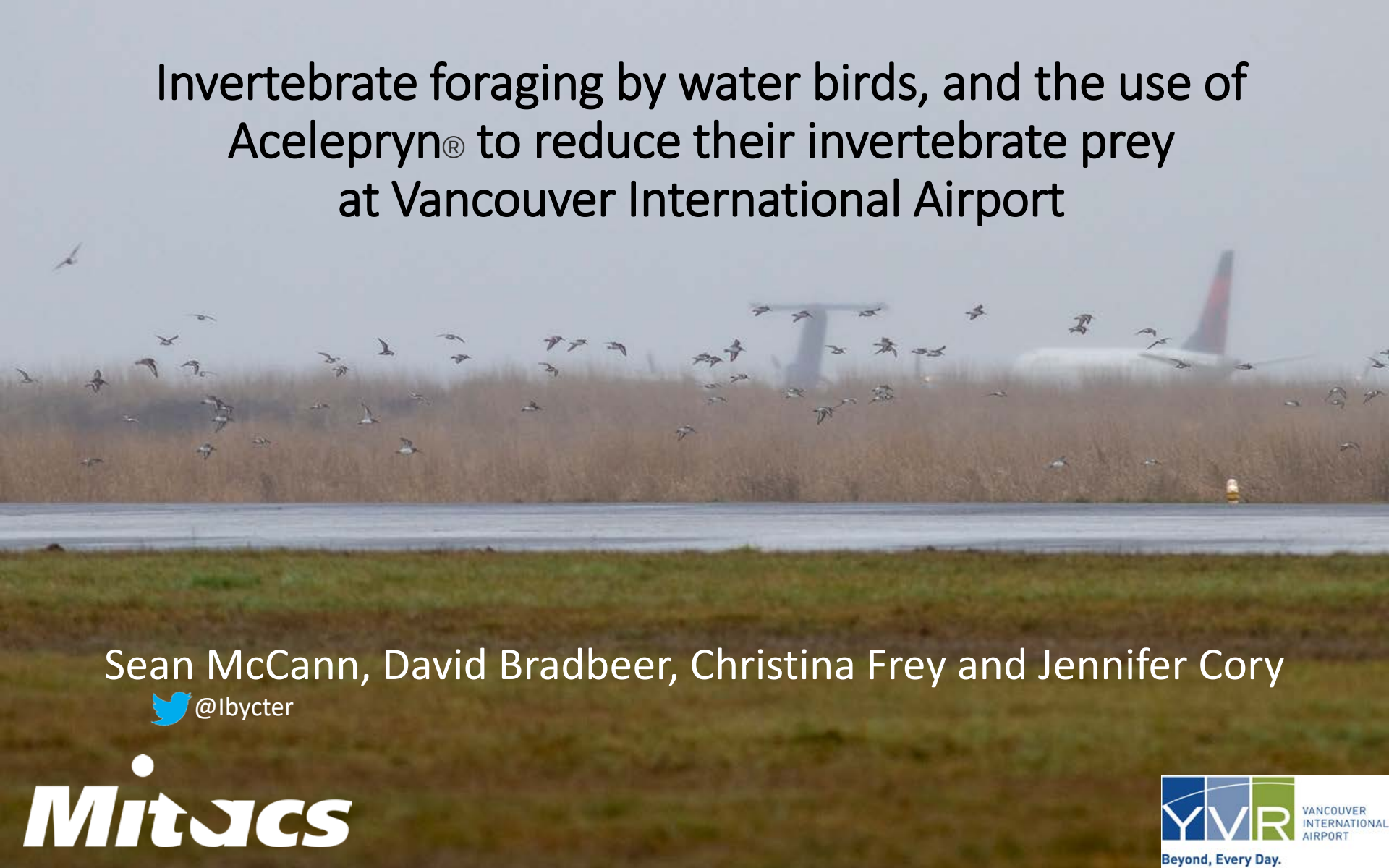
Invertebrate foraging by water birds, and the use of Acelepryn® to reduce their invertebrate prey at Vancouver International Airport



Sean McCann, David Bradbeer, Christina Frey and Jennifer Cory

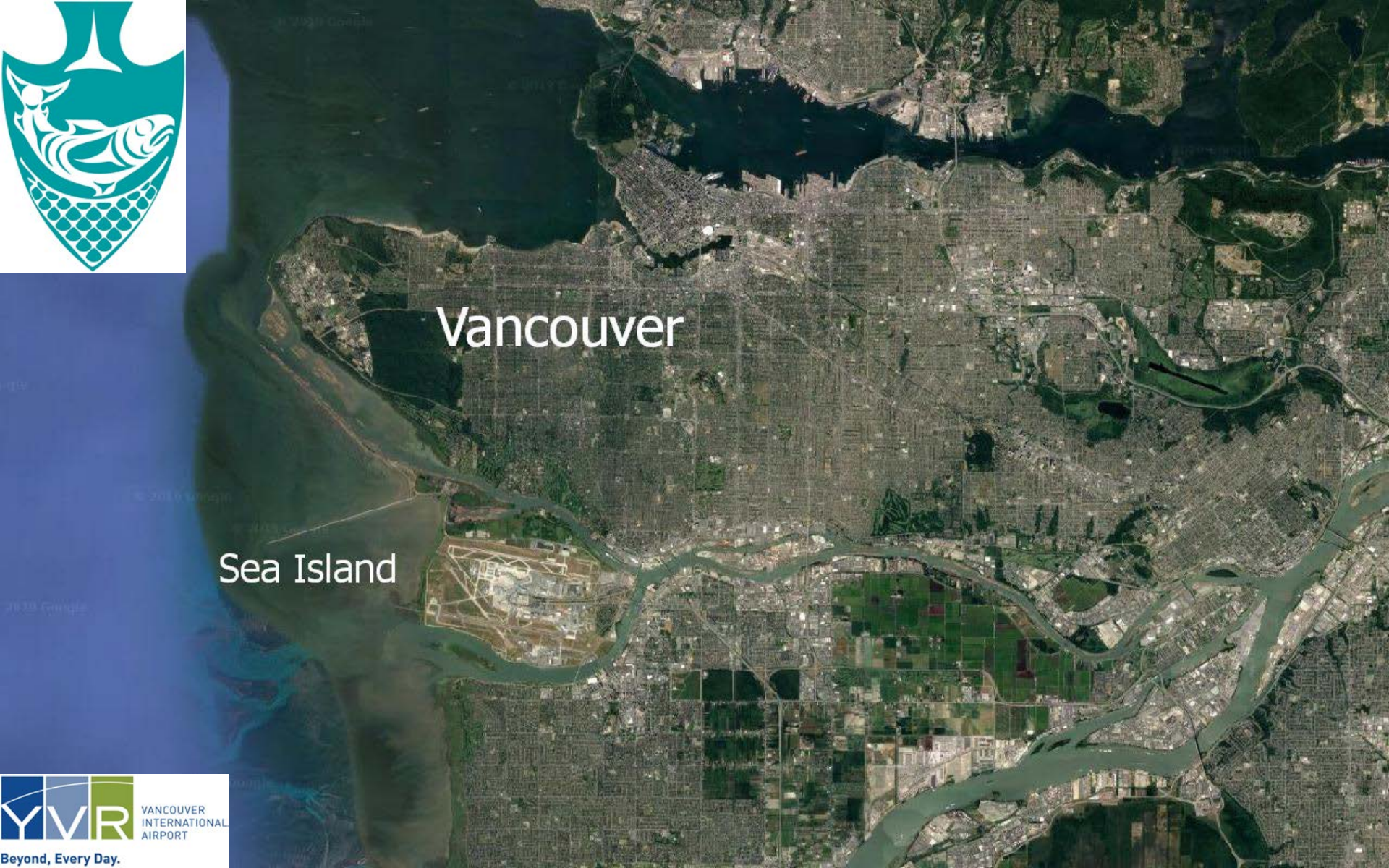
@Ibycter

Mitacs

YVR VANCOUVER INTERNATIONAL AIRPORT

Beyond, Every Day.


Vancouver
Sea Island



YVR VANCOUVER INTERNATIONAL AIRPORT
Beyond, Every Day.


Vancouver
Sea Island


1
0
1
2
3
4 km


Image: Alejandro Erickson 2007

Reproductive physiology of *Culex* mosquitoes


Ibycter americanus
Red-throated Caracara

Apoica pallens


Myrmica rubra


Latrodectus hesperus

YVR Airport Work

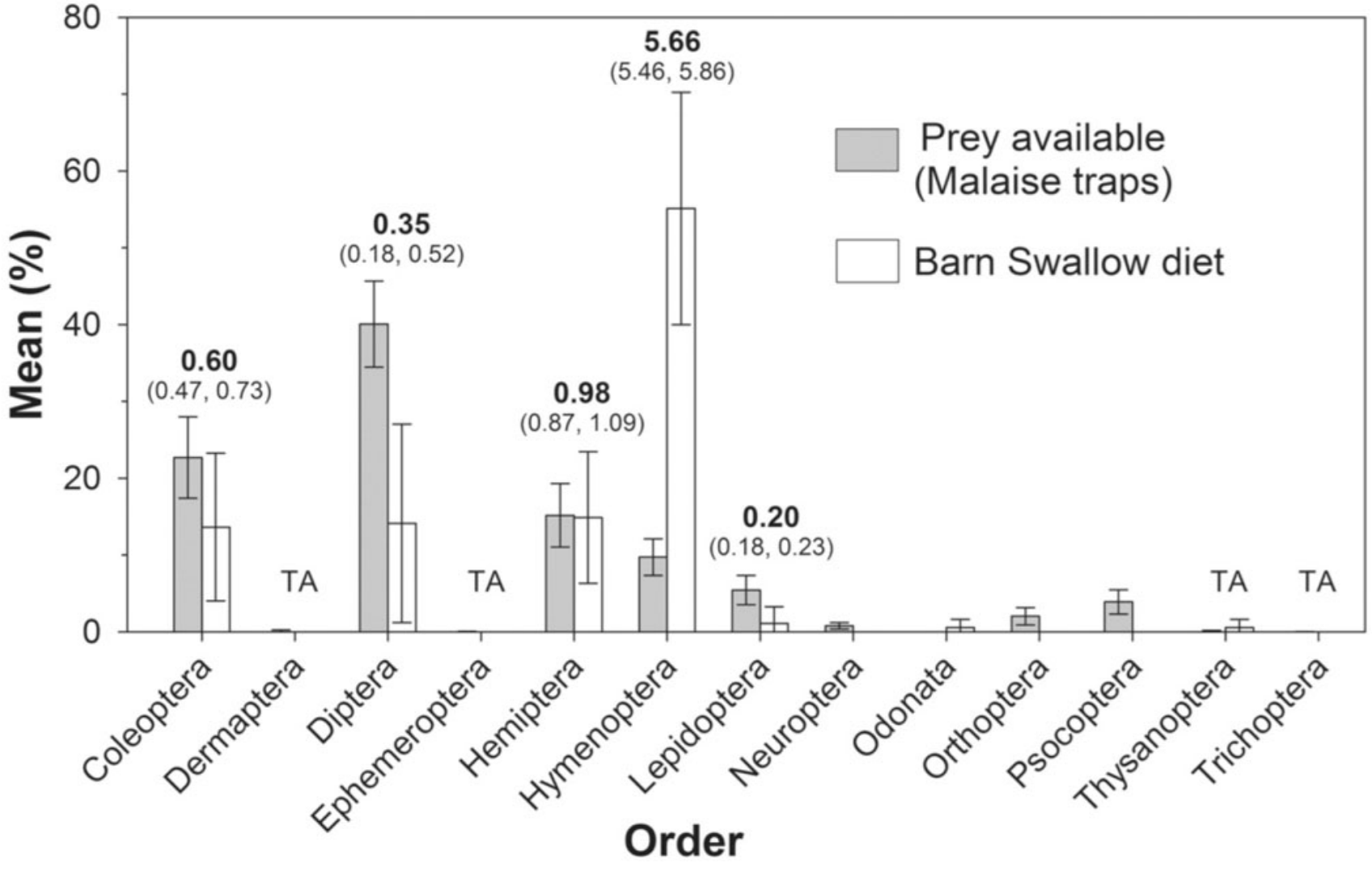
Barn Swallows: 607+ strikes since 2000

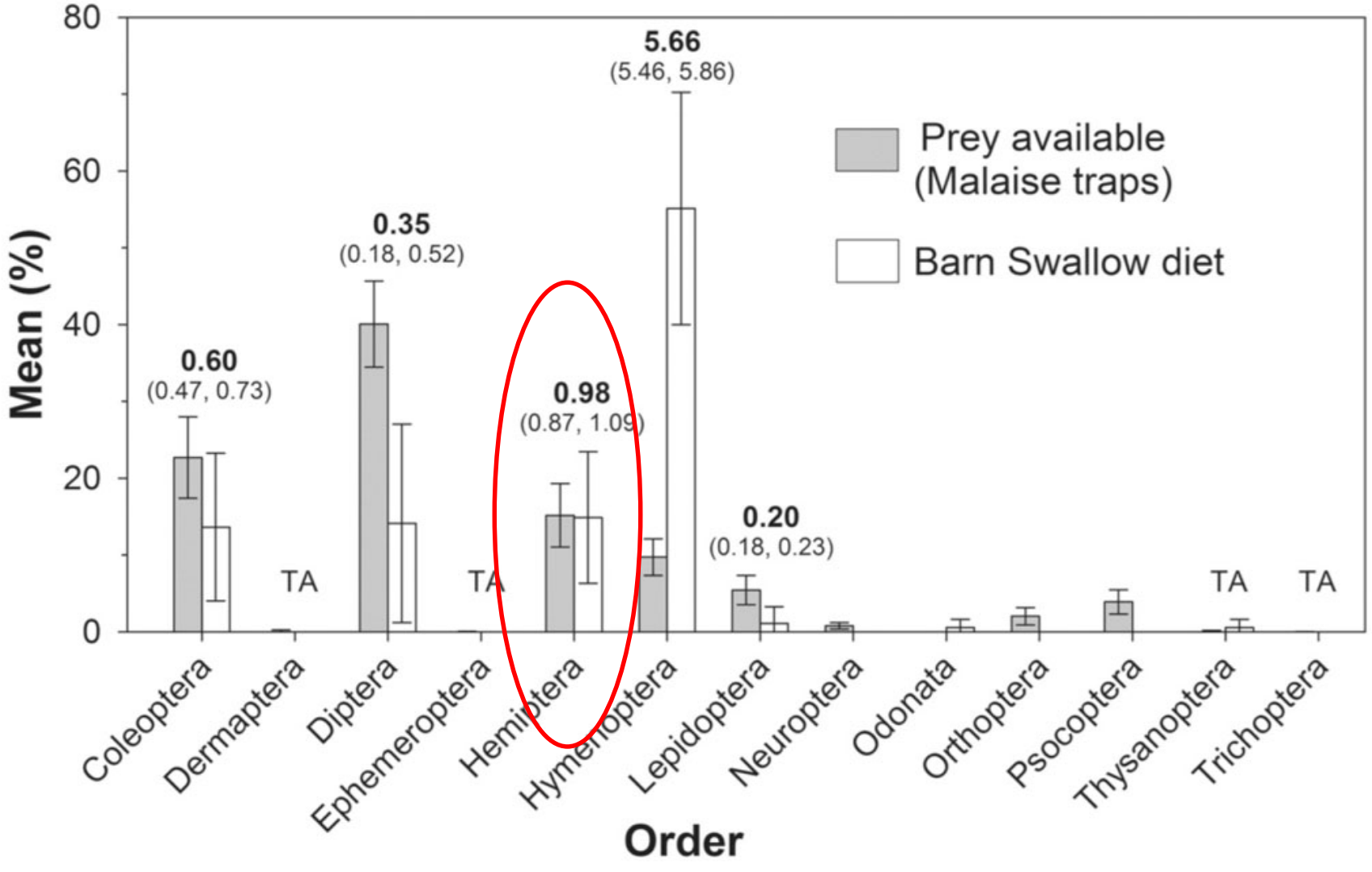
YVR2017AUG14_1217PDT_BNSW

YVR 2017 SEPT 10 _ 1023 PDT _ BNSW X 2


YVR2017 AUG14_1250PDT_BNSW x4

- We dissected and examined 31 Barn Swallows that had been killed in birdstrike incidents in the summer of 2013
- We identified insect prey and compared it to available flying prey caught in Malaise traps
- Calculated selection ratios for orders


80
60
40
20
0
Mean (%)
Prey available
(Malaise traps)
Barn Swallow diet
0.60
(0.47, 0.73)
TA
0.35
(0.18, 0.52)
TA
0.98
(0.87, 1.09)
5.66
(5.46, 5.86)
0.20
(0.18, 0.23)
TA
TA
Coleoptera
Dermaptera
Diptera
Ephemeroptera
Hemiptera
Hymenoptera
Lepidoptera
Neuroptera
Odonata
Orthoptera
Psocoptera
Thysanoptera
Trichoptera
Order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(Malaise traps)
Barn Swallow diet
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Coleoptera
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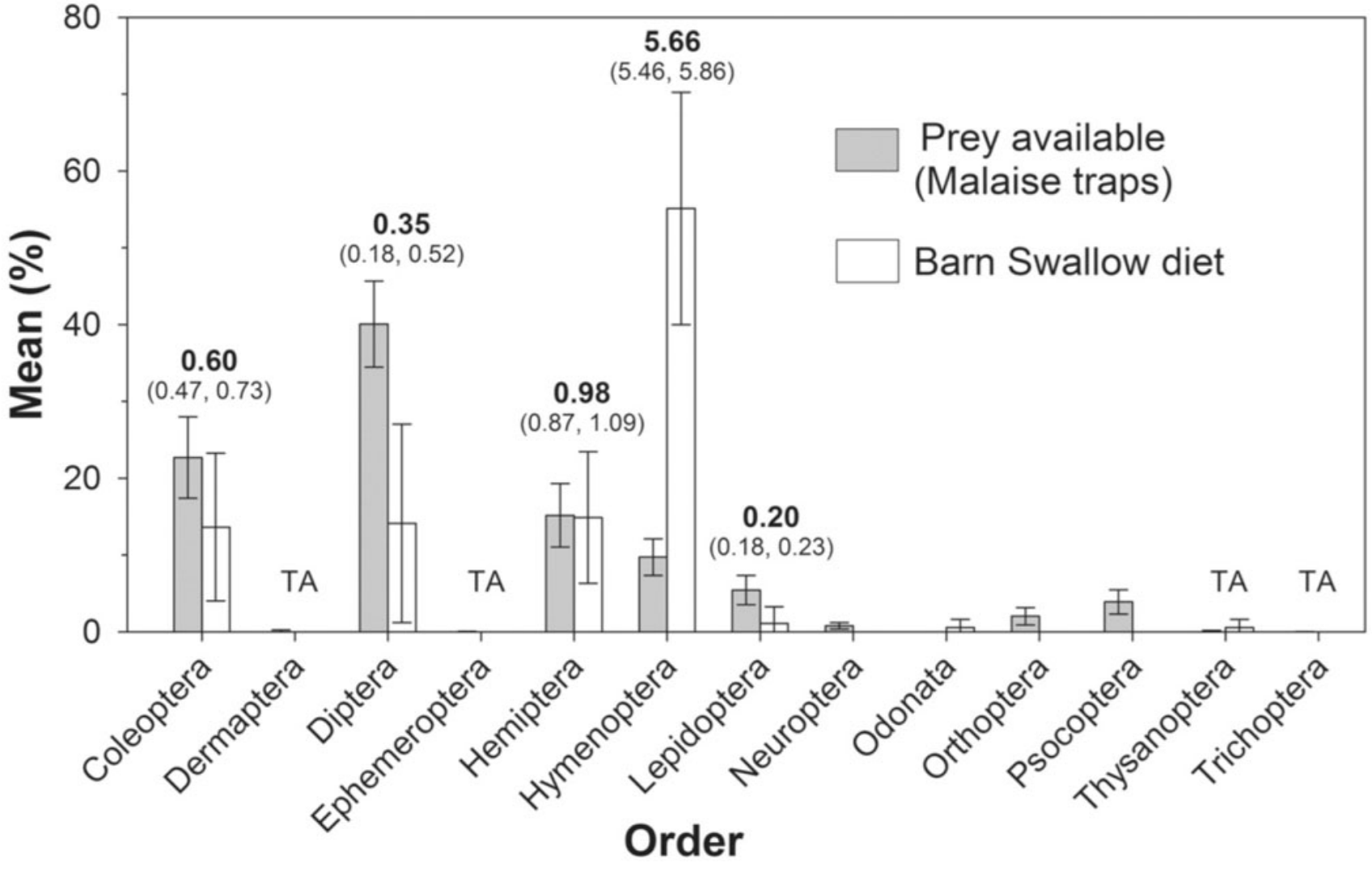
Diptera
Ephemeroptera
Hemiptera
Hymenoptera
Lepidoptera
Neuroptera
Odonata
Orthoptera
Psocoptera
Thysanoptera
Trichoptera
Order

Ceraleptus pacificus (Hemiptera: Coreidae)


Ceraleptus pacificus (Hemiptera: Coreidae)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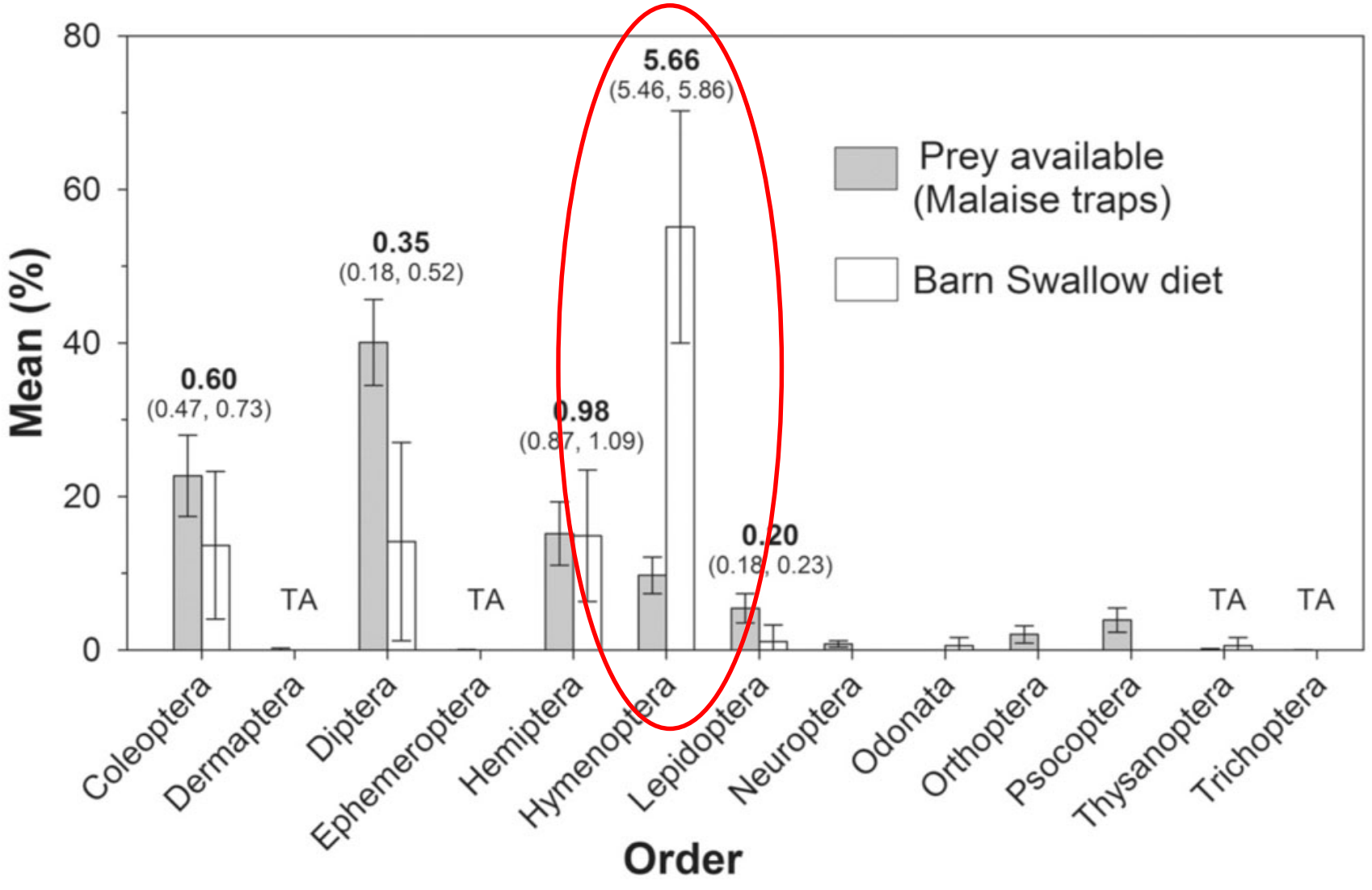
Diptera
Ephemeroptera
Hemiptera
Hymenoptera
Lepidoptera
Neuroptera
Odonata
Orthoptera
Psocoptera
Thysanoptera
Trichoptera
Order


Mean (%)
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Diptera
Ephemeroptera
Hemiptera
Hymenoptera
Lepidoptera
Neuroptera
Odonata
Orthoptera
Psocoptera
Thysanoptera
Trichoptera
Order


Myrmica specioides (Hymenoptera: Formicidae)
AKA “impressive fire ant”


Myrmica specioides (Hymenoptera: Formicidae)
AKA “impressive fire ant”


Lessons from the swallows


Ceraleptus pacificus is abundant
and a prime prey item

Mating flights attract swallows, possibly drifting over runways, where birds are struck

Diet and Prey Selection of Barn Swallows (*Hirundo rustica*) at Vancouver International Airport

Audrey A. Law[1, 6], Miranda E. Threlfall[1, 2], Brendon A. Tijman[1, 3], Eric M. Anderson[1], Sean McCann[4], Gary Searing[5], and David Bradbeer[5]

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[2]Current address: 5651 Chester Street, Vancouver, British Columbia V5W 3B3 Canada
[3]Current address: 8851 Ash Street, Richmond, British Columbia V6Y 3B4 Canada
[4]Simon Fraser University, 8888 University Drive, Burnaby, British Columbia V5A 1S6 Canada
[5]Vancouver International Airport, 3211 Grant McConachie Way, Richmond, British Columbia V7B 0A4 Canada
[6]Corresponding author: audreyalaw@hotmail.com

Law, Audrey A., Miranda E. Threlfall, Brendon A. Tijman, Eric M. Anderson, Sean McCann, Gary Searing, and David Bradbeer. 2017. Diet and prey selection of Barn Swallows (*Hirundo rustica*) at Vancouver International Airport. Canadian Field-Naturalist 131(1): 26–31. https://doi.org/10.22621/cfn.v13i1.1777

The Barn Swallow (*Hirundo rustica*) is the most widely distributed aerial insectivore in North America, but has declined appreciably in recent decades. Reasons for these declines are largely unknown, though presumably relate mainly to changes in prey availability. To help inform conservation priorities for this species, we assessed their diet and prey selection using birds lethally struck by aircraft at Vancouver International Airport (YVR). Esophagi and gizzards of 31 Barn Swallows collected from June 2013 to October 2013 contained insects mainly from the orders Hymenoptera (mean across birds = 40% of insect numbers), Diptera (31%), Hemiptera (15%), and Coleoptera (12%). To assess prey selection, we compared the esophagi and gizzard contents of 20 swallows collected from July 2013 to September 2013 to populations of aerial insects we sampled during the same period using Malaise traps. Barn Swallows selected strongly for insects in the order Hymenoptera (mainly Formicidae, which comprised 29% of diet), and selected against insects in the orders Coleoptera, Diptera, and Lepidoptera. For all prey taxa combined, Barn Swallows displayed strong selection for insects of length 4–8 mm (body length excluding appendages). Conversely, they selected against smaller and larger insects, despite the fact that smaller insects comprised about 80% of all insects sampled in Malaise traps. Combined with past studies, our results suggest that Barn Swallows select among available aerial insects within local feeding sites for taxa that (i) are of intermediate size, (ii) occur at relatively high density, and (iii) have poor flight performance.

Key Words: Barn Swallow; *Hirundo rustica*; aerial insectivore; diet; prey selection; Vancouver International Airport; British Columbia

Introduction

Populations of aerial insectivores in Canada have declined by 70% since 1970, constituting the most pronounced decline among all categories of Canadian birds (North American Bird Conservation Initiative Canada 2012). The Barn Swallow (*Hirundo rustica*) is the most widely distributed aerial insectivore in North America and has declined appreciably throughout Canada, with Breeding Bird Survey data for 1970–2011 showing a mean annual trend of −4.01% (Environment Canada 2013). Barn Swallows were assessed as *Threatened* in 2011 by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), but have yet to be listed under the *Species at Risk Act* (COSEWIC 2011; British Columbia Conservation Data Centre 2013; Government of Canada 2017). The causes of Barn Swallow declines are unknown, but likely include a combination of the following threats on breeding grounds: loss of nesting and foraging sites due to agricultural changes, decreased abundance of aerial insects, climate change, competition for nest sites with House Sparrows (*Passer domesticus*), ectoparasites, and nest removal by humans (COSEWIC 2011).

Very few detailed diet studies have been completed for Barn Swallows, particularly for the North American subspecies (*H. r. erythrogaster*) that differs in behaviour and morphology from the Eurasian subspecies (*H. r. rustica*; Brown and Brown 1999). Limited results for both subspecies suggest that prey size is an important factor affecting prey selection; although small prey items occurred in the diet, Barn Swallows fed mainly on relatively large prey (≥ 1.5 mg dry mass; Turner 1982; Holroyd 1983). Adult Barn Swallows also tend to feed larger prey to their young than they eat themselves (Waugh 1978). A sample of 467 Barn Swallows collected throughout the United States and Canada contained mainly Diptera (39.5%), Hymenoptera (22.7%), Coleoptera (15.6%), and Hemiptera (15.1%; method of analysis not specified; Beal 1918).

The purpose of this study was to assess the diet and prey selection of an at-risk aerial insectivore, the Barn Swallow. To study this sensitive species, we took advantage of birds lethally struck by aircraft at Vancouver International Airport (YVR) on Sea Island in Richmond, British Columbia, Canada (49.2°N, 123.2°W). Barn Swallows are a concern at YVR because since

Current work: invertebrate foraging by water birds at YVR


Human–Wildlife Conflicts 1(1):97–105, Spring 2007
Comparison of 2 vegetation-height management practices for wildlife control at airports
Thomas W. Seamans, Scott C. Barras, Glen E. Bernhardt, Bradley F. Blackwell, Jonathon D. Cepek
INSECTS AND BIRDS ON TWO NEW ZEALAND AIRFIELDS
T. A. CAITHNESS,
Wildlife Service, Dept. of Internal Affairs, Wellington.
INTRODUCTION
Highly social birds—those which feed, roost and flock together on and around airfields—may be a serious hazard to aircraft. In New Zealand, birds have not caused any major accidents so far. However, bird strikes which occur regularly, often result in unscheduled and expensive overhauls of structures, engines or both.
That birds are more than a nuisance is illustrated by the Boston Bay tragedy in October, 1960, when, as the result of multiple strikes by starlings (Sturnus vulgaris) a turbo-prop "Electra" crashed with the loss of 62 lives. (Aircraft Accident Report, 1962).
Bird strikes cost one Canadian airline half a million dollars in 1959-60, and in the last five years Canada's major commercial airline operators have experienced more than 1,000 bird strikes, at a direct cost of more than two million dollars (Lewis, 1967).
Although the unpredictable flight and roosting habits of gulls and wading birds cause most concern in New Zealand, species which are mainly insectivorous such as starlings and, in some areas, magpies (Gymnorhina sp.) are also troublesome. At Wellington and Gisborne airfields, starlings are particularly numerous.
When surface water collects and their burrows are flooded Porina and earthworms are forced to the surface. Large concentrations of other birds not primarily insectivorous may then occur; for example, black-backed gulls (Larus dominicanus), red-billed gulls (Larus novaehollandiae scopulinus) and, in some areas, black-billed gulls (Larus bulleri), oyster-catchers (Haematopus spp.) and spur-winged plovers (Lobibyx novae-hollandiae). Such concentrations do not occur frequently but when they do they may be dispersed by using shotguns, distress calls or some other conventional method of scaring.
19
This article is a U.S. government work, and is not subject to copyright in the United States.
Human–Wildlife Conflicts 5(2):204–209, Fall 2011
Commentary
Using dietary analyses to reduce the risk of wildlife–aircraft collisions
Brian E. Washburn, Glen E. Bernhardt, Lisa A. Kutschbach-Brohl
Wildlife foraging on airfields
Wildlife Society Bulletin 39(2):434–442; 2015; DOI: 10.1002/wsb.545
Tools and Technology
Assessing Chemical Control of Earthworms at Airports
Thomas W. Seamans, Bradley F. Blackwell, Glen E. Bernhardt, Daniel A. Potter

Overview

1. Birds of concern
2. Invertebrate diet of winter birds
3. Chemical management of invertebrates
4. Future directions

Image: Colin McCann


Bird species of concern at YVR

Rough-legged Hawk Hawk: 40 confirmed strikes

Red-tailed Hawk: 66 confirmed strikes


Coyote: 6 confirmed strikes (though not a bird)
6℃
01/18/2019
04:06AM
CAMERA3

Short-eared Owl: 75 confirmed strikes

Bald Eagle: 29 confirmed strikes

Great Blue Heron: 51 confirmed strikes


Microtus townsendii

Snow Goose: 39 confirmed strikes high hazard species

American Wigeon: 77 confirmed strikes

My species of interest:

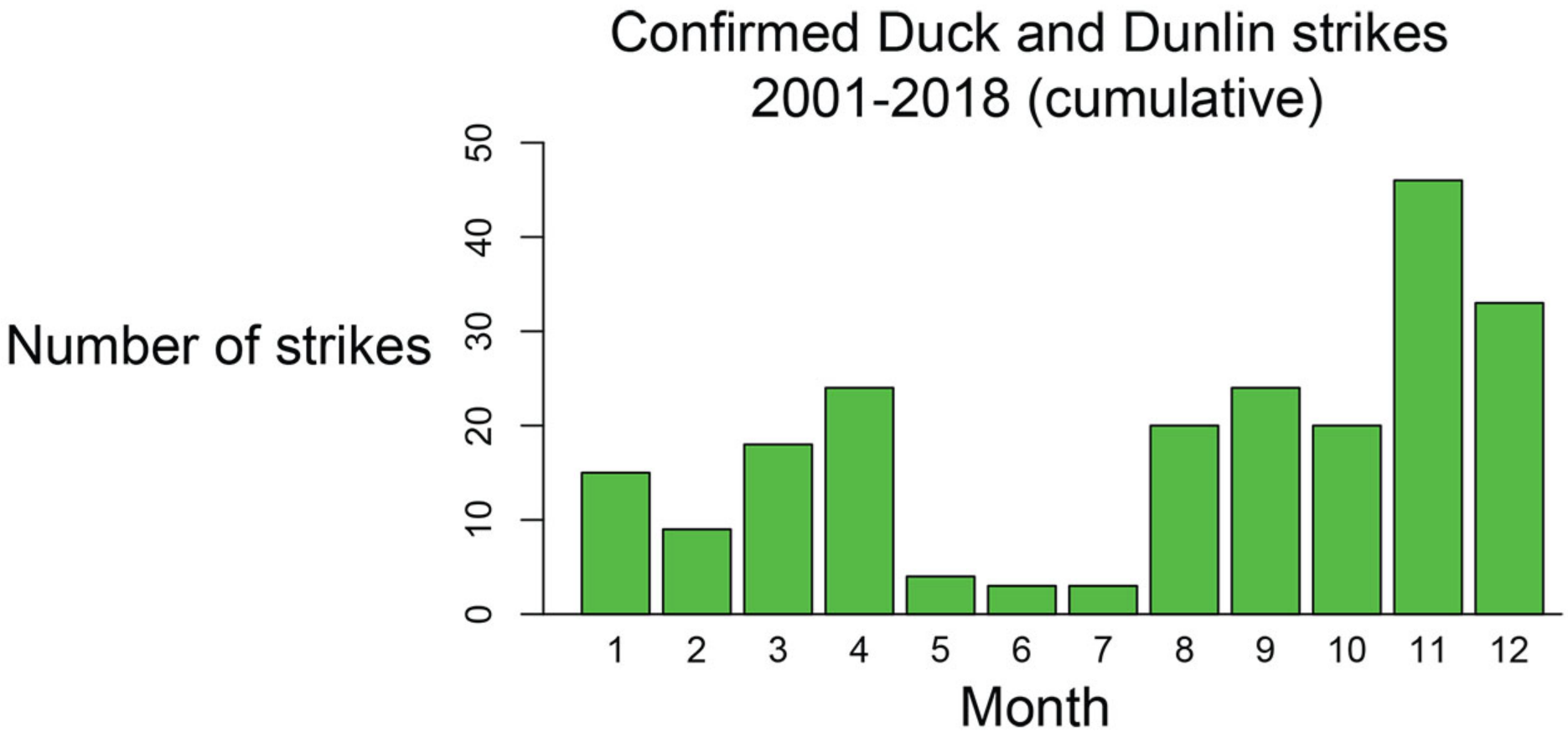
Mallard: 61 confirmed strikes

Northern Pintail
13 confirmed strikes

Green-winged Teal
30 confirmed strikes

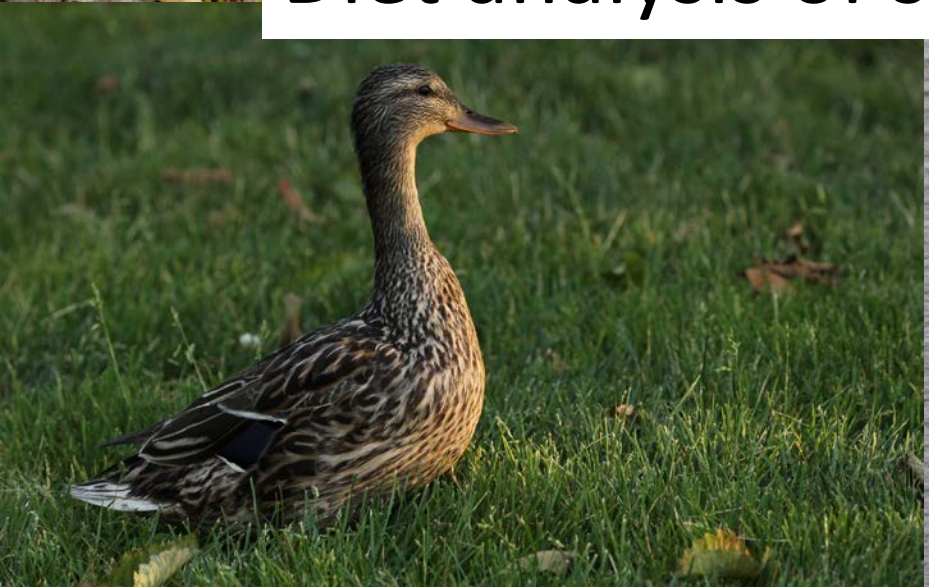
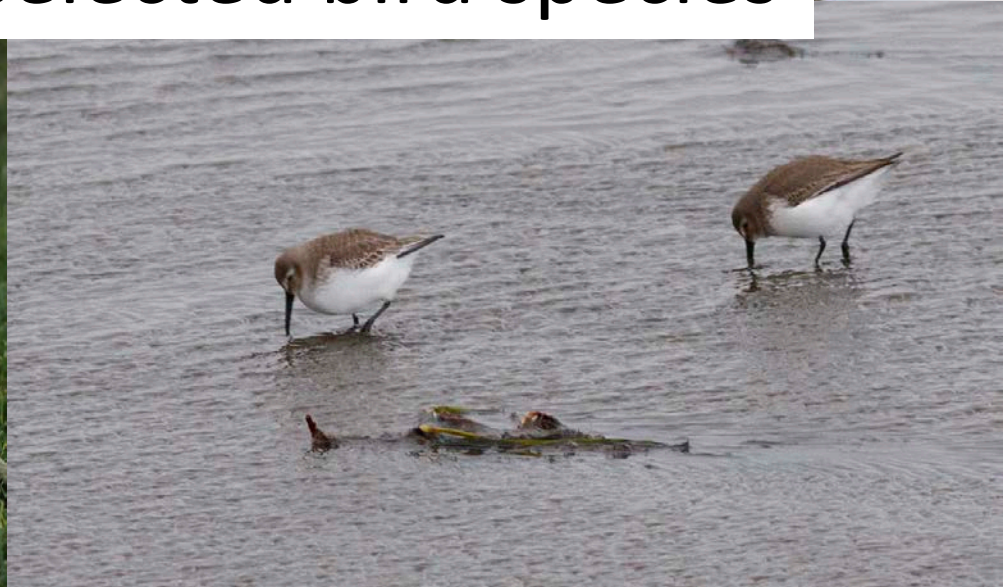
Dunlin: 106 confirmed strikes

Photo by David Bradbeer



Represents appx. 25% of total confirmed bird strikes!


Diet analysis of selected bird species

Diet analysis

187 birds examined, 141 of which had were suitable for diet analysis

Species	Number of birds examined
Mallard	123
Green-winged Teal	33
Northern Pintail	23
Dunlin	8

71 birds had identifiable invertebrate prey items


uchNTu
ANCED PRODUCT & WORKER PROTECTION
Ansell


MALL CULL ♀ ASH
16 OCT 2017 1514
CULL MALL ♀ ASH
19 DEC 2017
1516
CULL MALL ♀ ASH
2017 OCT 10 2145

Local flavour


NOFI
Cull ♂
13/III/2018 2212/pst

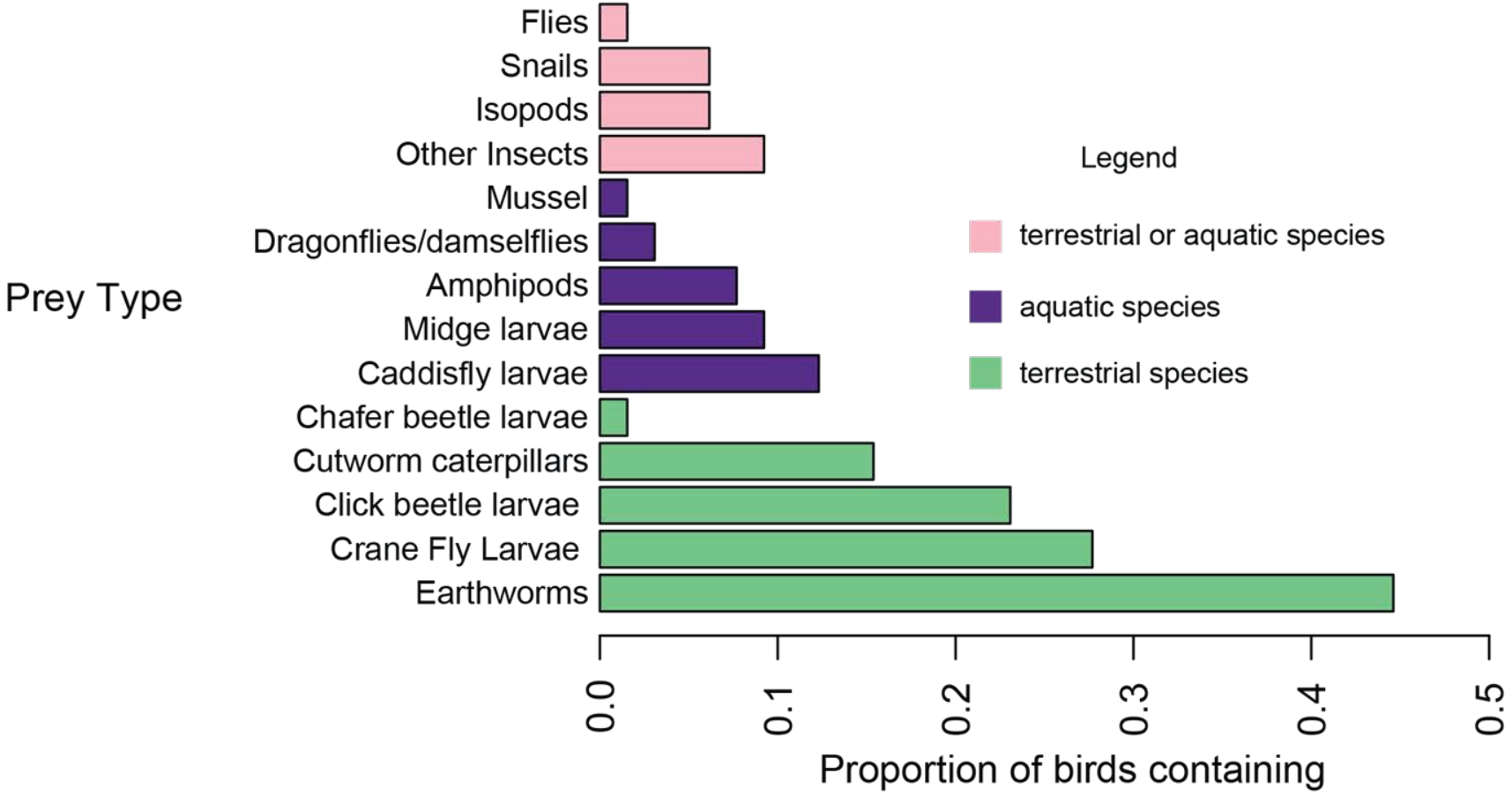

Jr. Ng cull MALL ♂
13 Dec 2017 1607 pst
A5D


14 FEB 1136
MALL ♂ CULL 1220g


NOFI ♂
23/III/2018 - 1315
Cull


18 APR 2017 0125
MALL ♂ A5F CULL


MALL ♂
cull A5G
Jan 8 2018, 2115 pst


Prey Type
Flies
Snails
Isopods
Other Insects
Mussel
Dragonflies/damselflies
Amphipods
Midge larvae
Caddisfly larvae
Chafer beetle larvae
Cutworm caterpillars
Click beetle larvae
Crane Fly Larvae
Earthworms
Legend
terrestrial or aquatic species
aquatic species
terrestrial species
0.0
0.1
0.2
0.3
0.4
0.5
Proportion of birds containing

Earthworms, family Lumbricidae

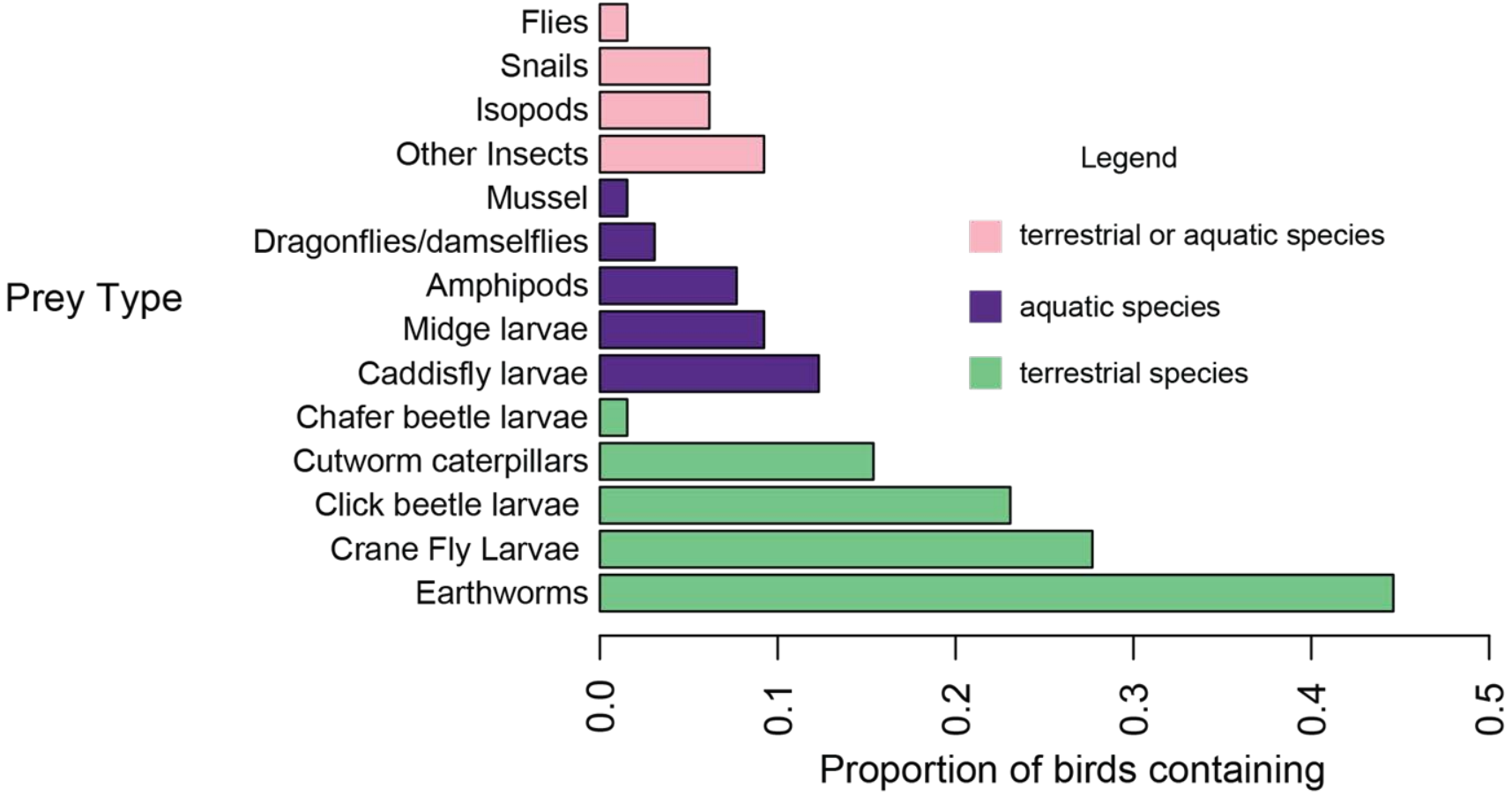
Crane flies: family Tipulidae
Primarily *Tipula paludosa* and *Tipula oleracea*

Wireworms: family Elateridae
AKA click beetles, clickers

Agriotes lineatus, a European click beetle

Winter cutworm, larva of *Noctua pronuba* Lepidoptera: Noctuidae

Noctua pronuba, a European moth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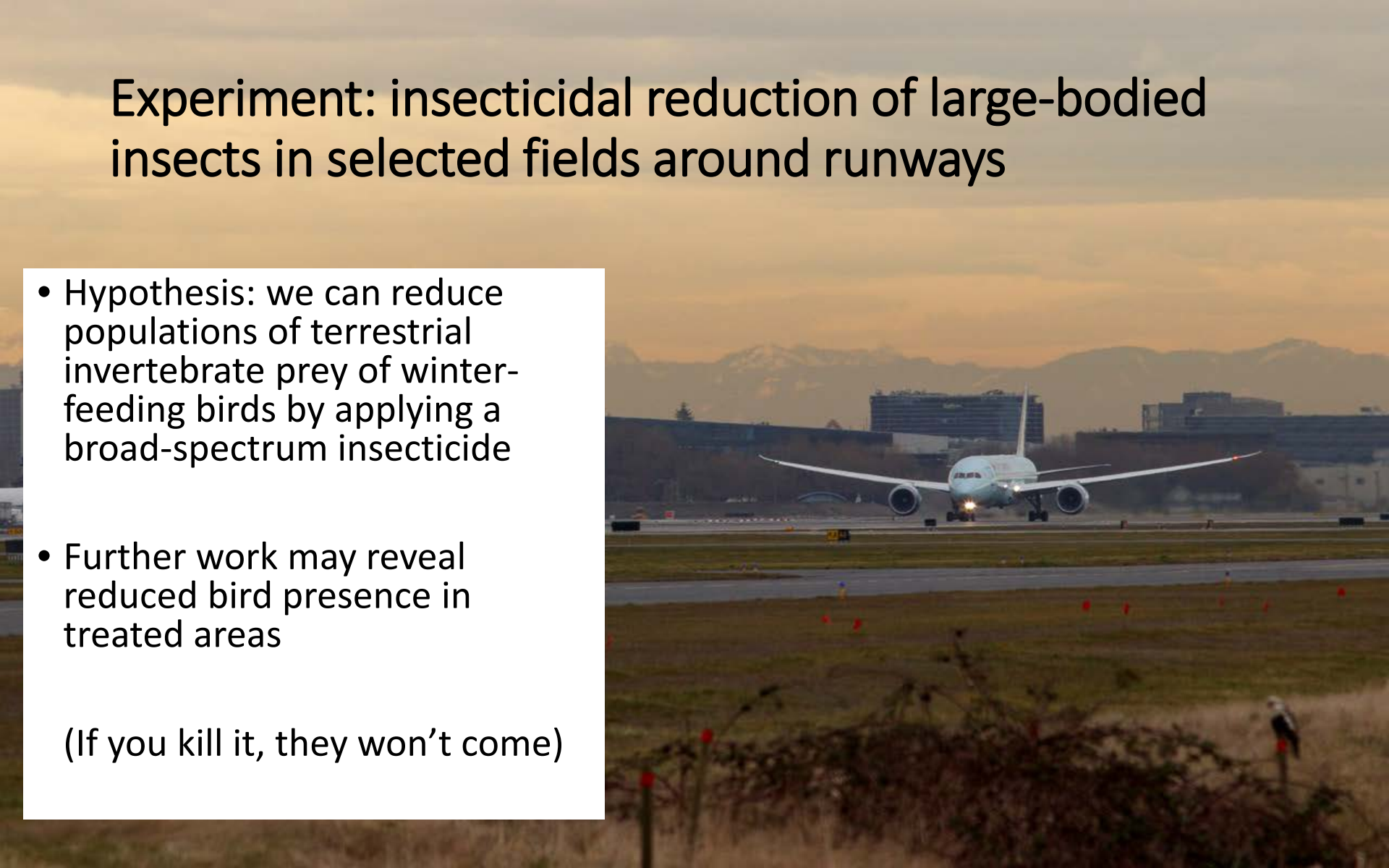
Legend
terrestrial or aquatic species
aquatic species
terrestrial species
0.0
0.1
0.2
0.3
0.4
0.5
Proportion of birds containing

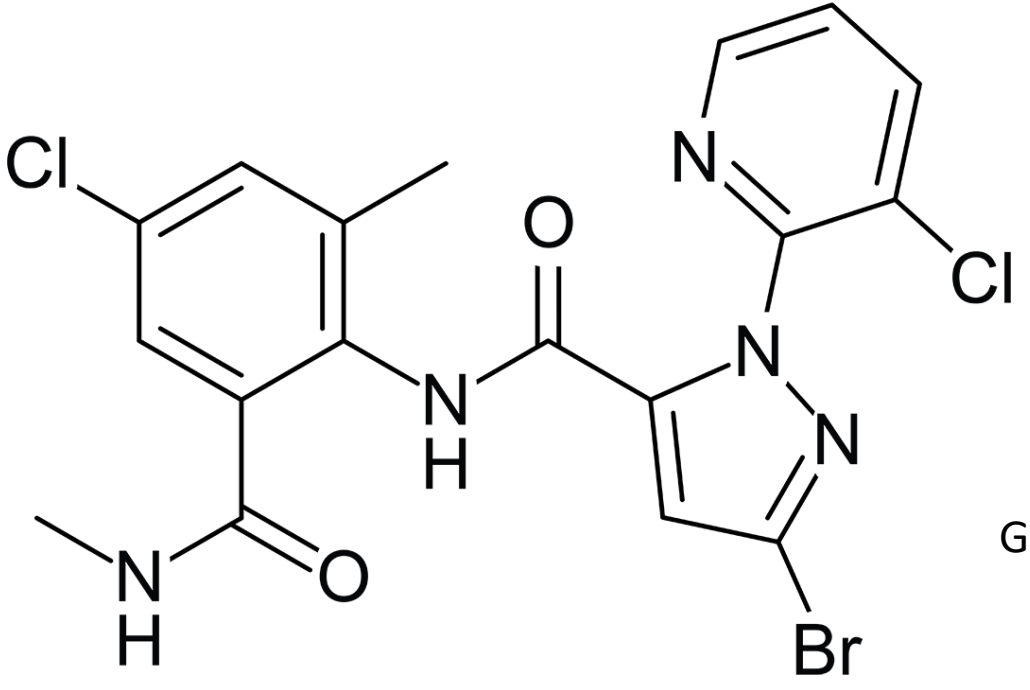
Experiment: insecticidal reduction of large-bodied insects in selected fields around runways

- Hypothesis: we can reduce populations of terrestrial invertebrate prey of winter-feeding birds by applying a broad-spectrum insecticide
- Further work may reveal reduced bird presence in treated areas

(If you kill it, they won't come)

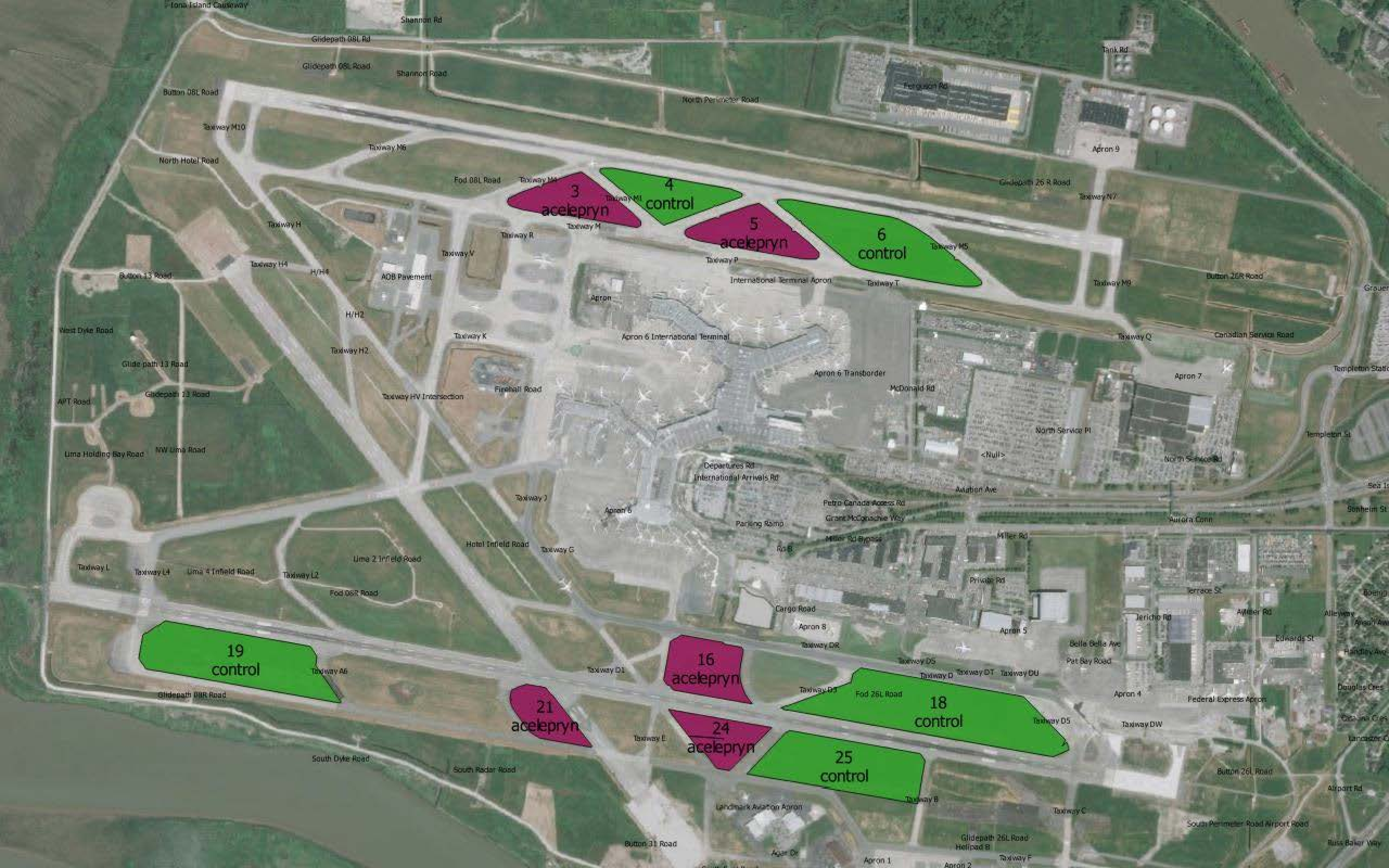


Experiment: insecticidal reduction of large-bodied insects in selected fields around runways



Acelepryn (Chlorantraniliprole)
Group 28 – Ryanodine receptor modulator


JOHN DEERE
GATOR
RDO



3
acelepryn
4
control
5
acelepryn
6
control
19
control
16
acelepryn
21
acelepryn
24
acelepryn
18
control
25
control
Iona Island Causeway
Shannon Rd
Glidepath 08L Rd
Glidepath 08L Road
Shannon Road
Button 08L Road
North Perimeter Road
Ferguson Rd
Tank Rd
Apron 9
Taxiway M10
Taxiway N6
North Hotel Road
Fod 08L Road
Taxiway M4
Taxiway M1
Taxiway M
Glidepath 26 R Road
Taxiway N7
Taxiway H
Taxiway R
Taxiway V
Taxiway M5
Taxiway P
International Terminal Apron
Taxiway T
Taxiway H4
H/H4
Button 13 Road
AOB Pavement
Apron
Taxiway M9
Button 26R Road
H/H2
West Dyke Road
Taxiway K
Apron 6 International Terminal
Taxiway Q
Canadian Service Road
Taxiway H2
Glide path 13 Road
Glidepath 13 Road
APT Road
Taxiway HV Intersection
Firehall Road
Apron 6 Transborder
McDonald Rd
Apron 7
North Service Pl
Templeton St
Lima Holding Bay Road
NW Lima Road
<Null>
North Service Rd
Departures Rd
International Arrivals Rd
Aviation Ave
Taxiway J
Apron 6
Petro Canada Access Rd
Grant McConachie Way
Parking Ramp
Aurora Conn
Miller Rd Bypass
Miller Rd
Hotel Infield Road
Taxiway G
Lima 2 Infield Road
Taxiway L
Taxiway L4
Lima 4 Infield Road
Taxiway L2
Fod 08R Road
Private Rd
Terrace St
Cargo Road
Apron 8
Jericho Rd
Apron 5
Taxiway DR
Bella Bella Ave
Pat Bay Road
Edwards St
Taxiway A6
Taxiway D1
Taxiway DS
Taxiway D
Taxiway DT
Taxiway DU
Glidepath 08R Road
Taxiway D3
Fod 26L Road
Apron 4
Federal Express Apron
Taxiway D5
Taxiway DW
Taxiway E
South Dyke Road
South Radar Road
Button 26L Road
Taxiway B
Landmark Aviation Apron
Taxiway C
South Perimeter Road Airport Road
Glidepath 26L Road
Helipad B
Button 31 Road
Agar Dr
Apron 1
Apron 2
Taxiway F

Sampling protocols:

Earthworms: 2 applications of allyl isothiocyanate (mustard oil) in water, collection of expelled earthworms (November 2018)

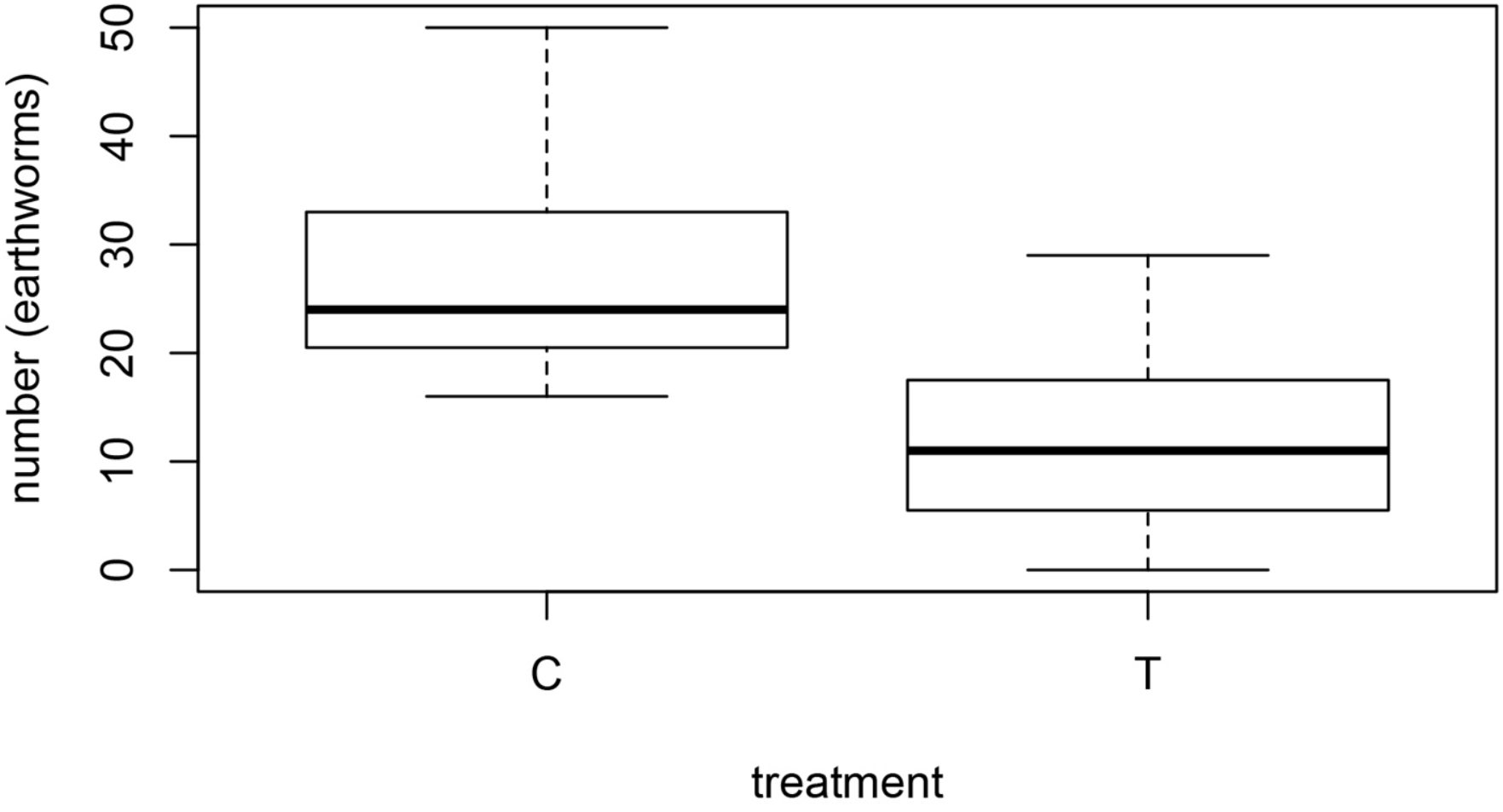
- Counted, weighed in lab

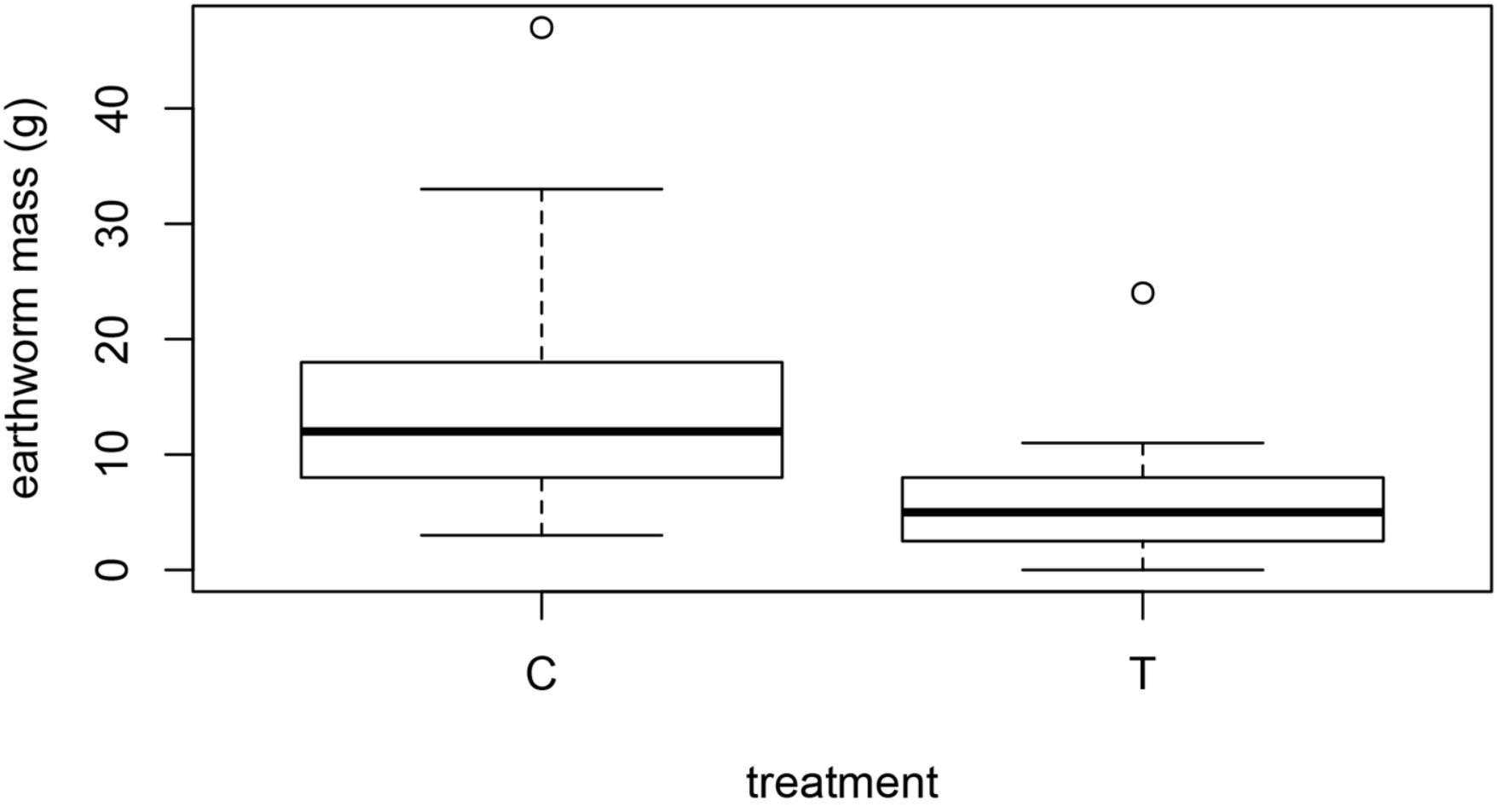
Noctua pronuba: sweep netting of grass in daylight (5 X 20 sweeps), identification, counting (November 2018)

Wireworms: grass/soil cores, hand searching for larvae (November 2018)

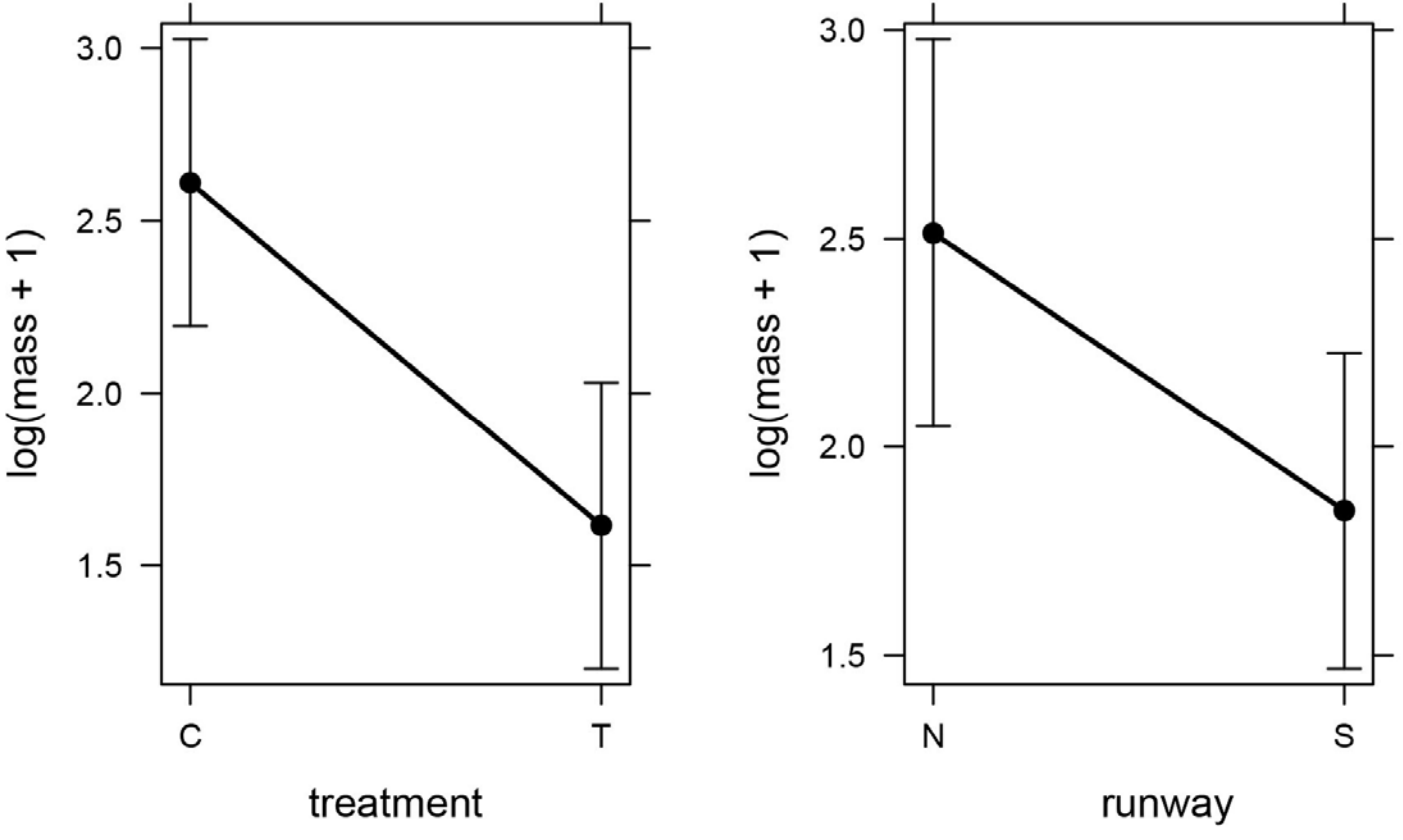
Tipulids: grass/soil cores, hand searching for larvae (April 2019)

Earthworm sampling

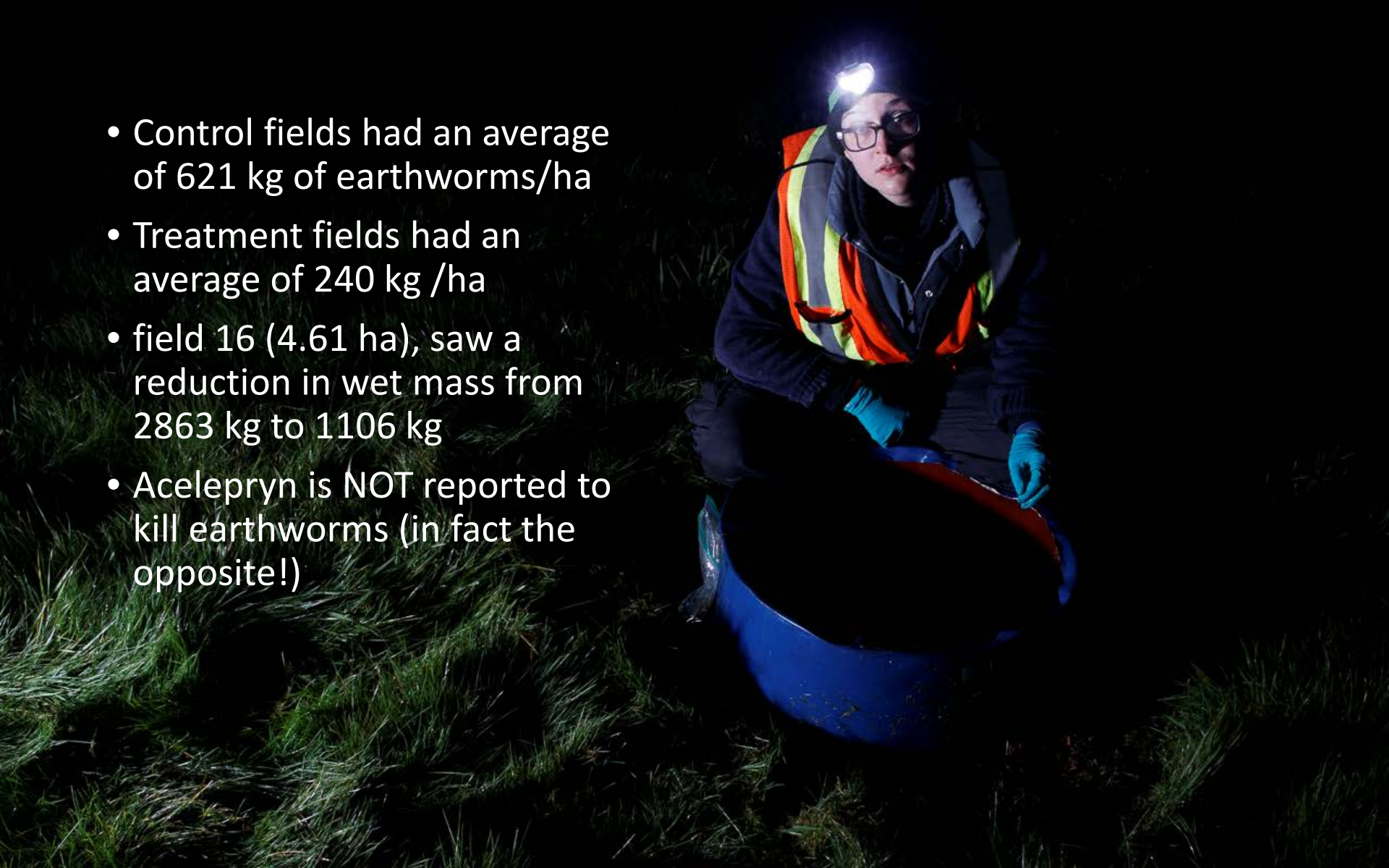

number (earthworms)
0
10
20
30
40
50
C
T
treatment


earthworm mass (g)
0
10
20
30
40
C
T
treatment

Effects on earthworms



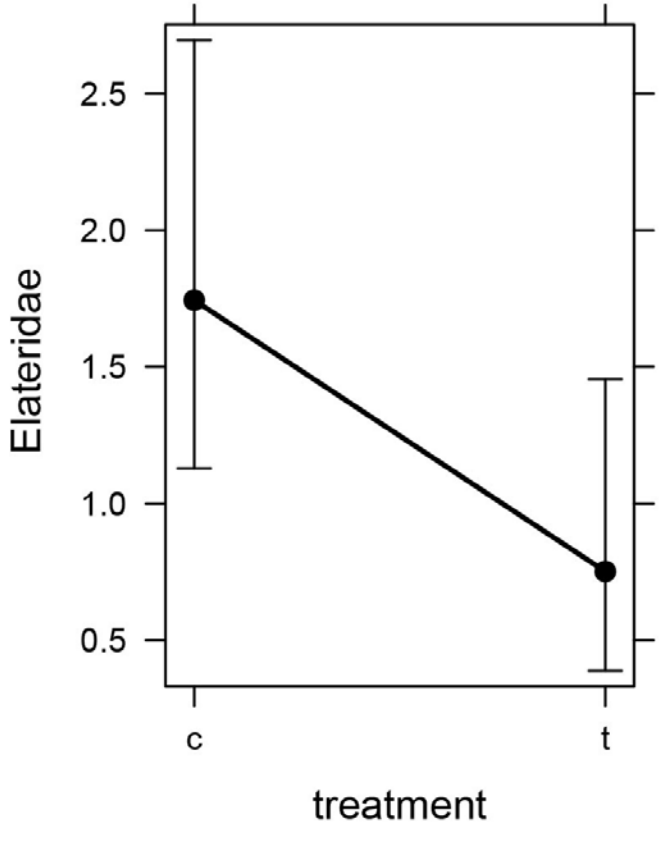
- Control fields had an average of 621 kg of earthworms/ha
- Treatment fields had an average of 240 kg /ha
- field 16 (4.61 ha), saw a reduction in wet mass from 2863 kg to 1106 kg
- Acelepryn is NOT reported to kill earthworms (in fact the opposite!)

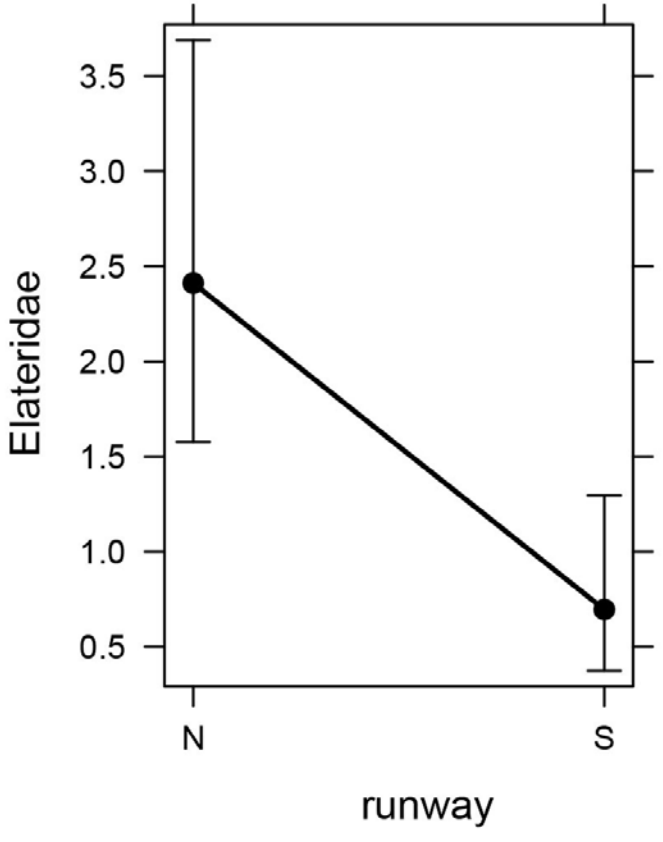


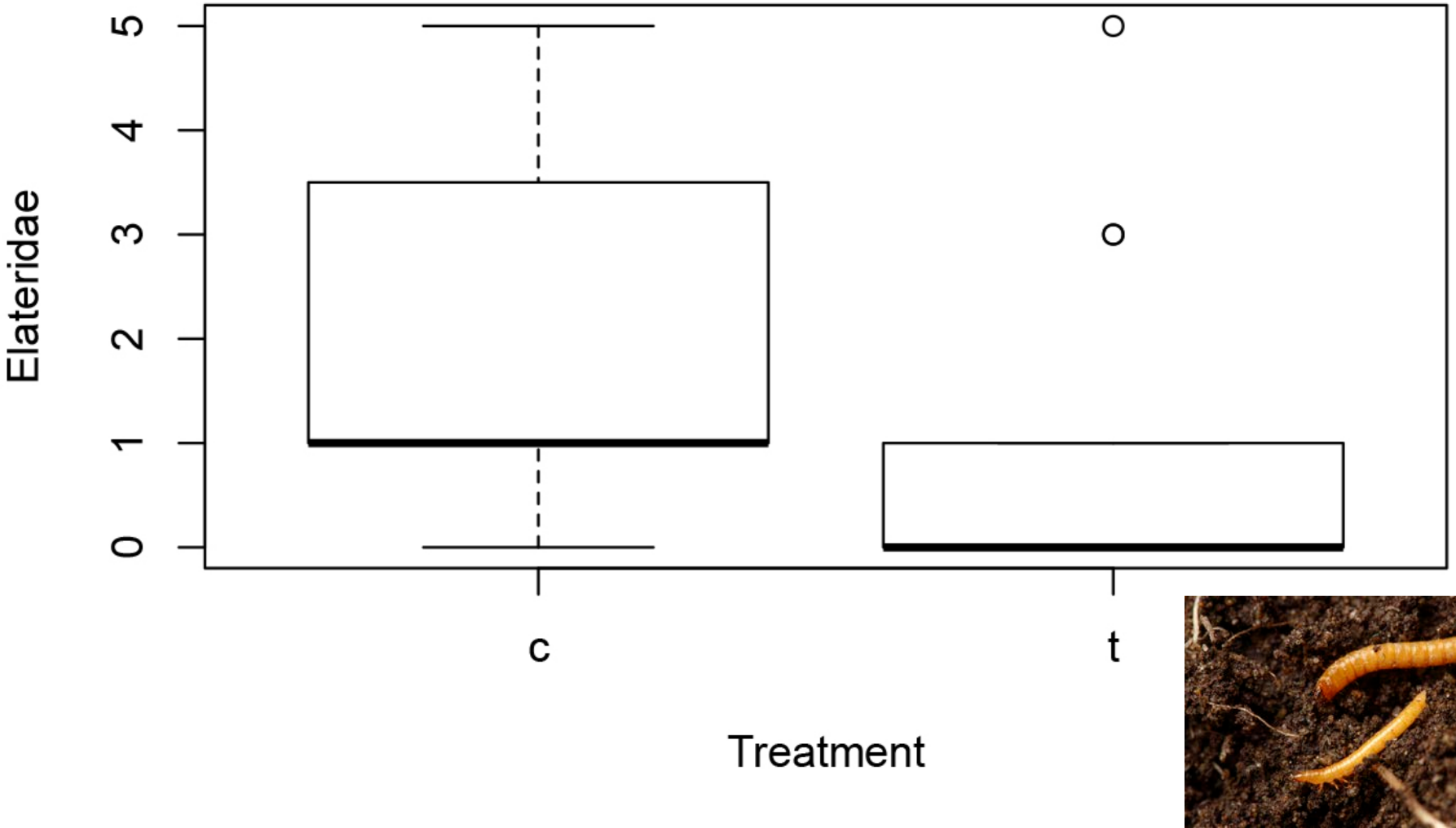
Soil sampling


couver International Airport (YVR)
ect samples 2017
Notes: extremely black soil, strong
oots, lots of moss
sam #5
treat nt: c
Coll r: McCann, Sean
Map 18943, -123.19506

Effects on soil dwellers: wireworms

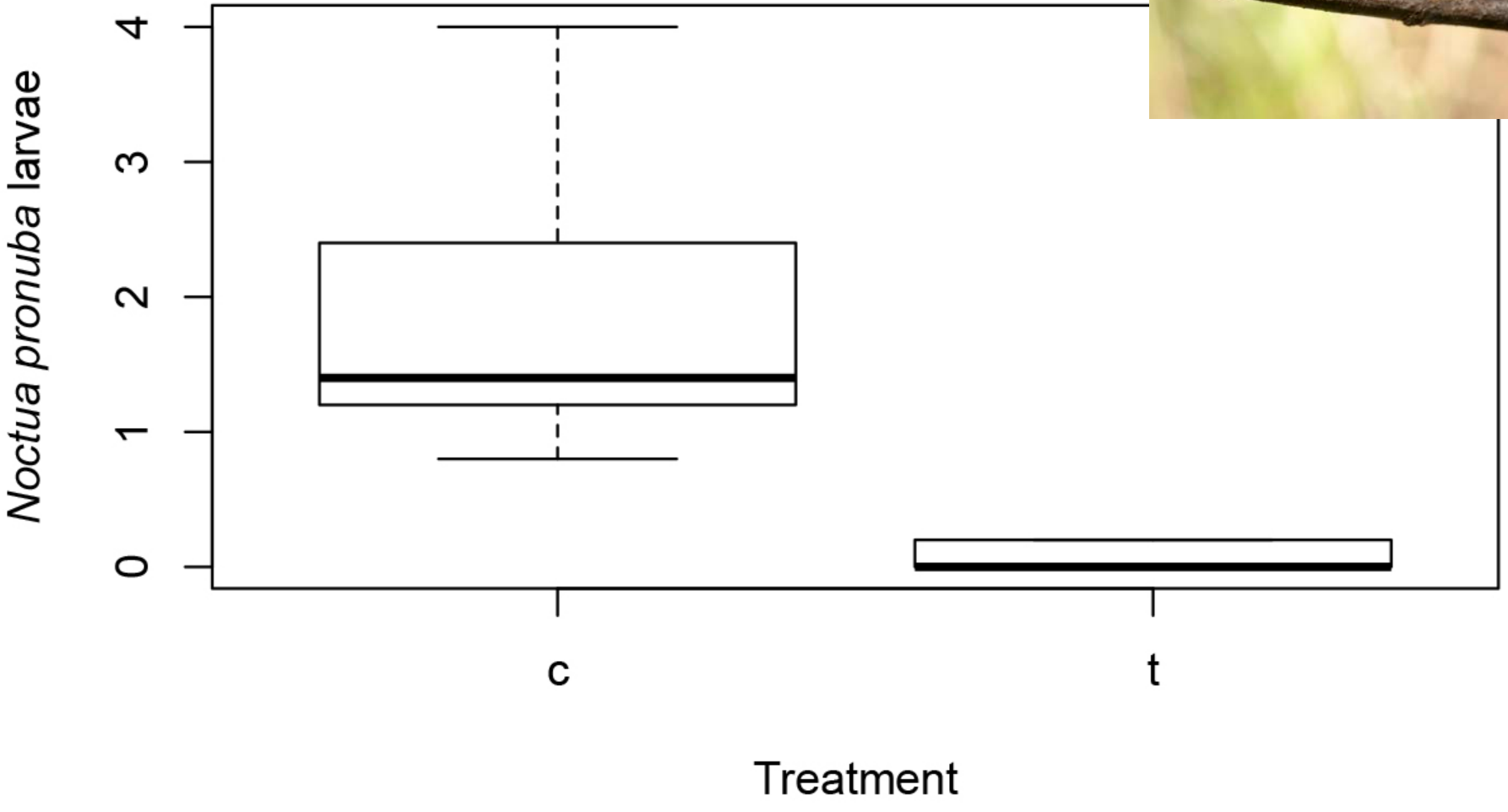




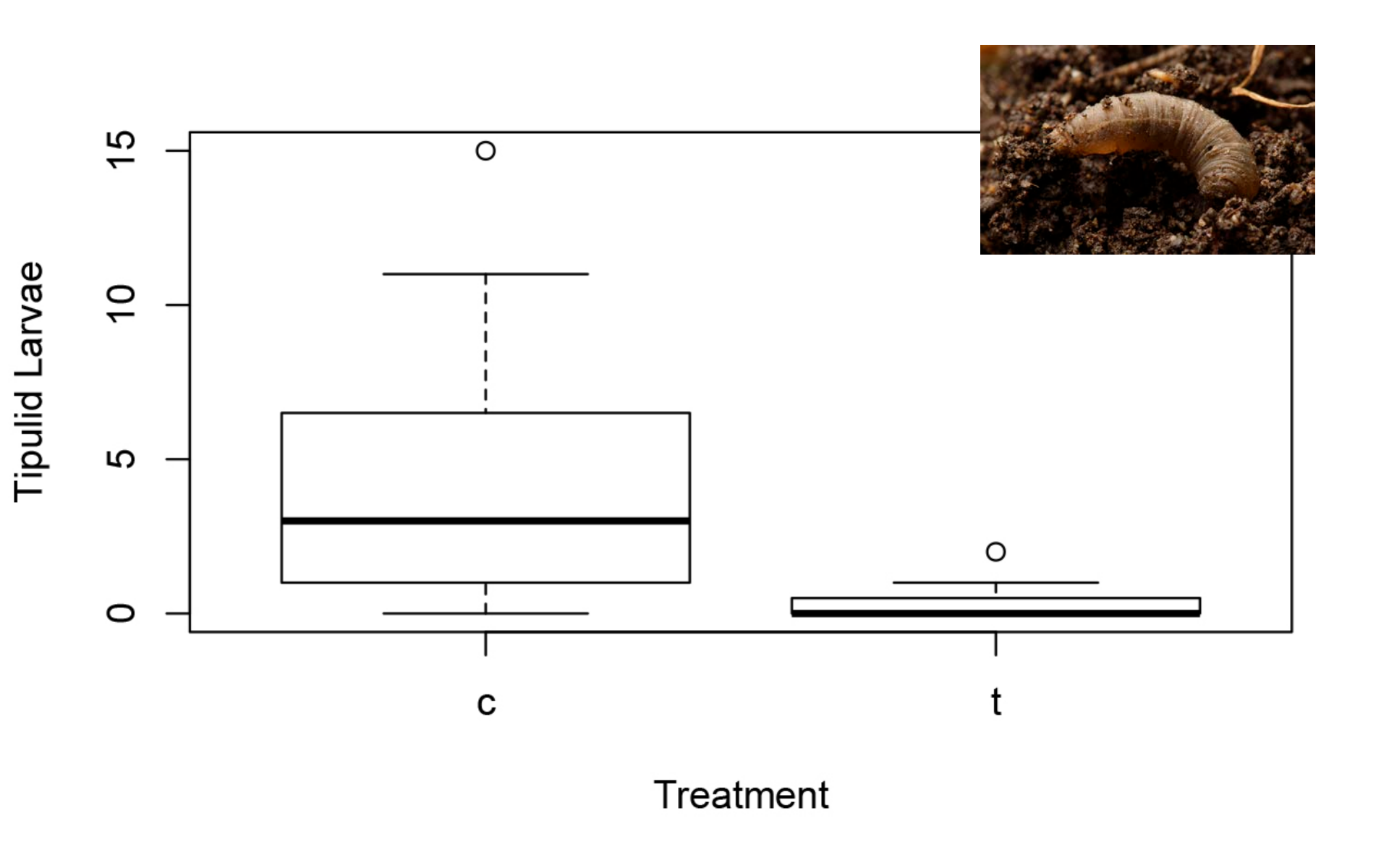

Elateridae
0
1
2
3
4
5
c
t
Treatment

Effects on winter cutworms

Effects on winter cutworms



Effects on tipulid larvae


Tipulid Larvae
0
5
10
15
c
t
Treatment

Taxon	Numerical reduction (%)	Estimated control biomass (kg/ha)	Estimated reduced biomass (kg/ha)
Earthworms	55.2	624	240 
Craneflies	93.3	429	31.5 
Noctua	99.9	NA	a lot! 
Click beetles	56.3	NA	NA 

- Substantial biomass reductions possible with Acelepryn application in fall

- But the price is very high!

- Pesticide interventions do reduce numbers in critical time periods, but it is unclear whether this in turn reduces bird presence
- Invertebrate bonanza at YVR could to be related to a monocrop system
- Ultimately, transforming the landcover may be a more permanent solution

Cultural control methods?


12 C
YVRWLCAM01
11/14/2017

Current experiment: Acelepryn as a barrier treatment

Photo by David Bradbeer

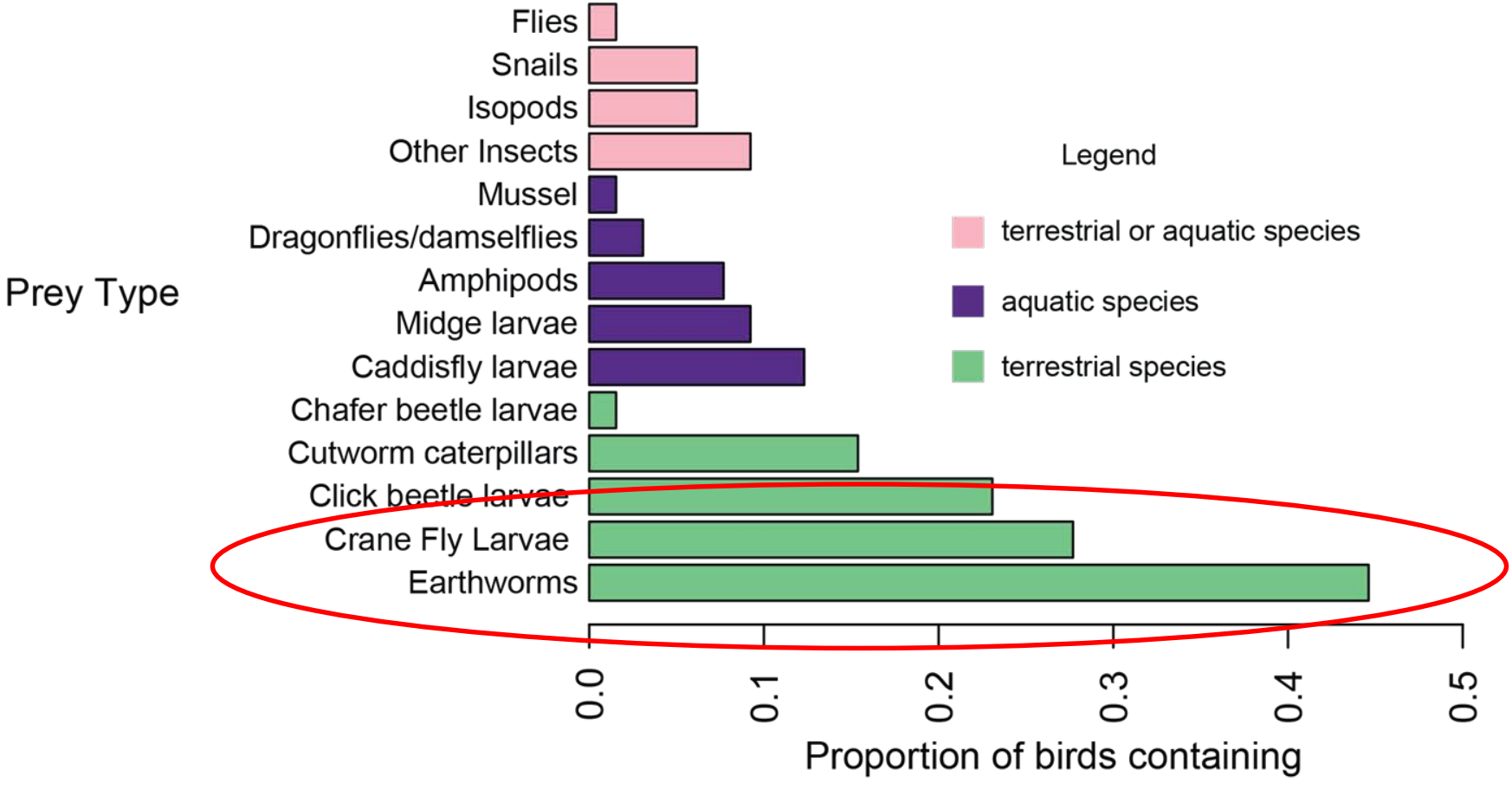
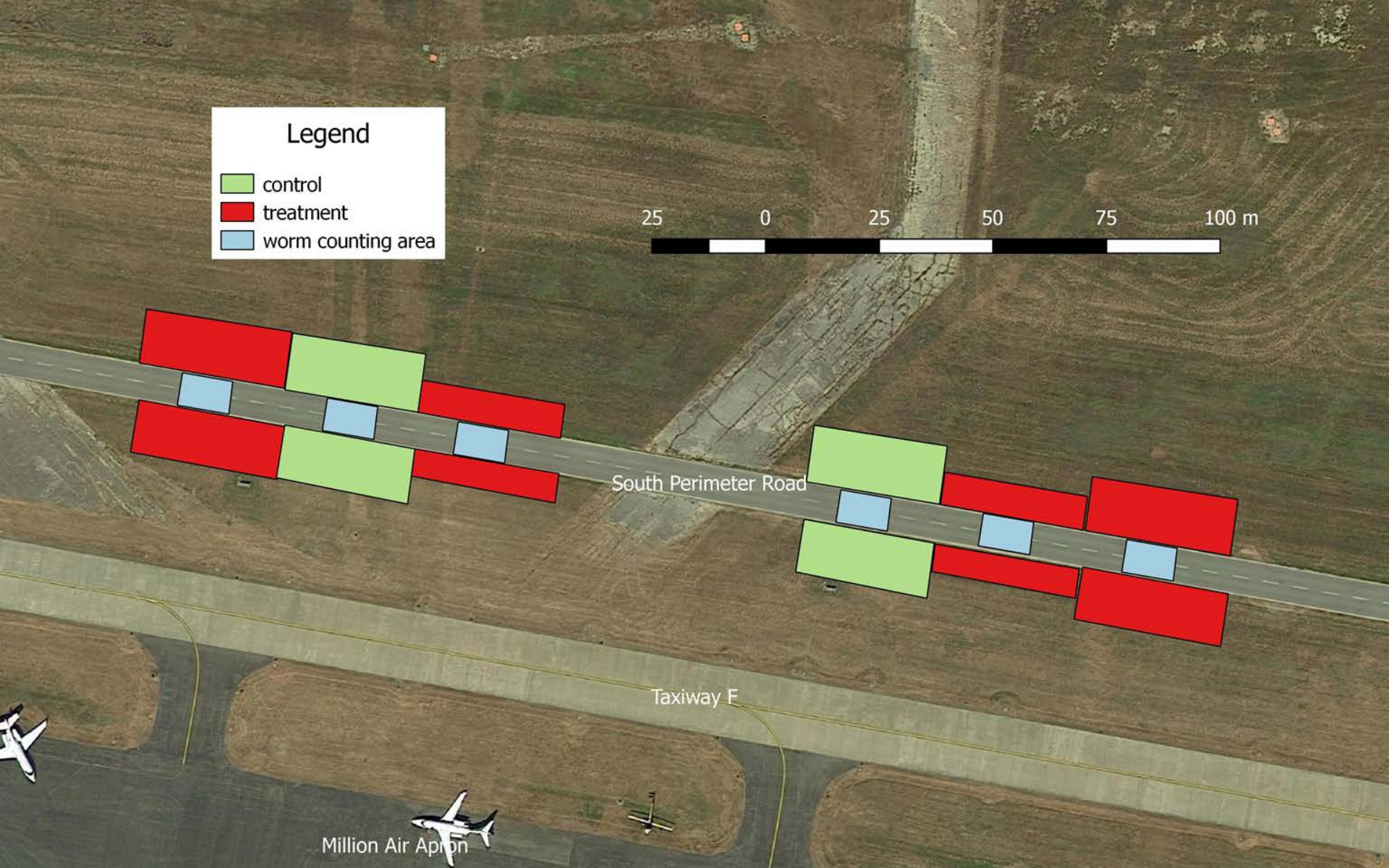

Prey Type
Flies
Snails
Isopods
Other Insects
Mussel
Dragonflies/damselflies
Amphipods
Midge larvae
Caddisfly larvae
Chafer beetle larvae
Cutworm caterpillars
Click beetle larvae
Crane Fly Larvae
Earthworms
Legend
terrestrial or aquatic species
aquatic species
terrestrial species
0.0
0.1
0.2
0.3
0.4
0.5
Proportion of birds containing

Photo by David Bradbeer


Photo by David Bradbeer


Legend
control
treatment
worm counting area
25
0
25
50
75
100 m
South Perimeter Road
Taxiway F
Million Air Apron

Future directions

- A demonstration of reduced bird activity (though getting valid data tough in an airport environment)
- Experiments to reduce grass productivity, nutrient content, or palatability
- Conversion of grass landcover to a less productive, more diverse ecosystem


AIR CANADA

Thank You!