

# Global Forum on Biological Control and Training Workshop on Biological Control

Nairobi, Kenya 26-30 June 2023

## Diversity of fall armyworm natural enemies in Africa

Subramanian Sevgan and Rhett Harrison

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# Diversity of Fall armyworm natural enemies in the America



## PARASITOIDS AND PARASITES OF *SPODOPTERA FRUGIPERDA* (LEPIDOPTERA: NOCTUIDAE) IN THE AMERICAS AND CARIBBEAN BASIN: AN INVENTORY

JAIME MOLINA-OCHOA<sup>1</sup>, JAMES E. CARPENTER<sup>2</sup> E. A. HEINRICHS<sup>3</sup> AND JOHN E. FOSTER<sup>3</sup>

<sup>1</sup>Facultad de Ciencias Biológicas y Agropecuarias, Universidad de Colima  
Apartado postal no. 36, Tecmán, Colima 28100, México

<sup>2</sup>United States Department of Agriculture, Agricultural Research Service  
Crop Protection & Management Research Laboratory, P.O. Box 748, Tifton, GA 31793-0748, USA

<sup>3</sup>University of Nebraska Lincoln, Department of Entomology  
312F Plant Industry Building, Lincoln, NE 68583-0816, USA

### ABSTRACT

An inventory of parasitoids and parasites of fall armyworm (FAW), *Spodoptera frugiperda* (J. E. Smith), was conducted using references describing parasitized FAW eggs, larvae, pupae and adults collected from different crops or habitats throughout the Americas and the Caribbean Basin. The crops and countries where these parasites were reported occurring in the Americas is also inventoried. Maize was the crop where the FAW was more frequently collected followed by rice. Overall, *Chelonus insularis* (Cresson) had the broadest natural distribution in the Americas. For the North American region *C. insularis*, *Chelonus* sp., and *Euplectrus platyhypenae* (Howard) were the most relevant parasitoids. In Central America, *C. insularis* was the most prevalent parasitoid, and in the South American region the most prevalent parasites were *Archytas incertus* (Macq.), *A. marmoratus* (Tns.), *C. insularis*, and *Meteorus laphygmae* (Viereck). *Diapetimorpha introita* (Cresson) is the most important pupal parasitoid of FAW occurring mainly in North America. An acugutturid, *Noctuidonema guyanense* (Remillet & Silvain), is the most important ectoparasitic nematode attacking adults of FAW and other noctuid moths in South and Southeastern US, and Mexico in North America, Caribbean Basin, Central America, and Northern South America.

Order	Family	No. of Species
Diptera	Bombyliidae	2
	Sarcophagidae	6
	Tachiniidae	60
Hymenoptera	Bethyliidae	1
	Braconidae	35
	Chalcididae	7
	Eulophidae	12
	Ichneumonidae	42
	Perilampidae	1
	Pteromalidae	2
	Scelionidae	2
	Trichogrammatidae	5
Nematoda	Acugutturidae	2





# Diversity of Fall armyworm predators in the America



Chapter 5. Biological Control and Biorational Pesticides for Fall Armyworm Management



## Biological Control and Biorational Pesticides for Fall Armyworm Management

Authors: Ivan Cruz, Embrapa, Brazil; Anani Bruce, CIMMYT-Kenya; Subramanian Sevgan, Komivi Senyo Akutse, Faris Samira Mohamed, Saliou Niassy, ICIPE, Kenya; Muniappan Rangaswamy, Jaspreet Sidhu, Virginia Tech, USA; Georg Goergen, IITA, Benin; Ivan Rwomushana, CABI, Kenya; Mwo Kasina, KALRO, Kenya; Malick Ba, ICRISAT, Niger; Ebenezer Aboagye, NPPO, Ghana; Dietrich Stephan, Joerg Wenmann, Julius-Kühn Institut, Germany; Ernst Neering, NPPO, Netherlands; and Wilfred Mushobazi, Crop Bioscience Ltd., Tanzania.

Order	Family	No. of Species
Coleoptera	Coccinellidae	4
	Carabidae	1
Dermaptera	Forficulidae	2
Hemiptera	Reduviidae	1
	Lygaeidae	1
	Anthocoridae	1
	Nabidae	1
	Pentatomidae	1
	Formicidae	3
Neuroptera	Chrysopidae	1
Hymenoptera	Vespidae	1

# Natural enemies of FAW eggs



## Egg parasitoids

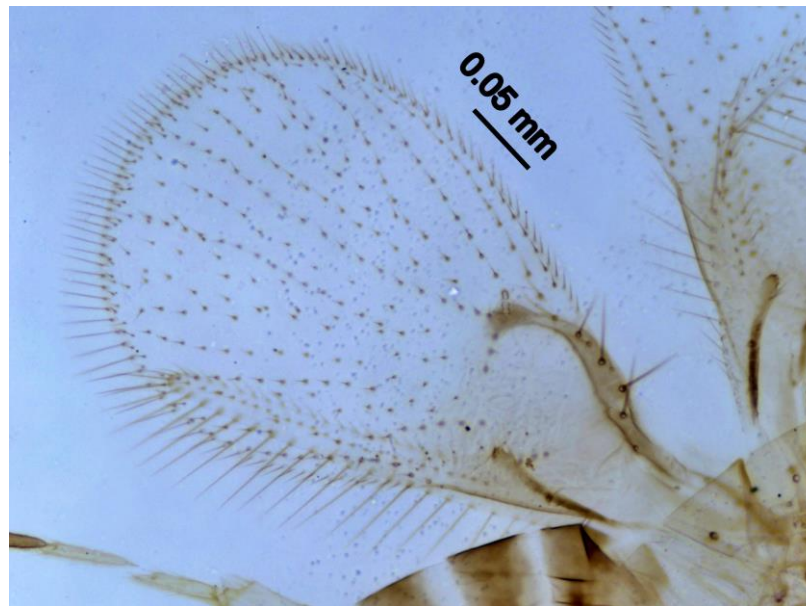
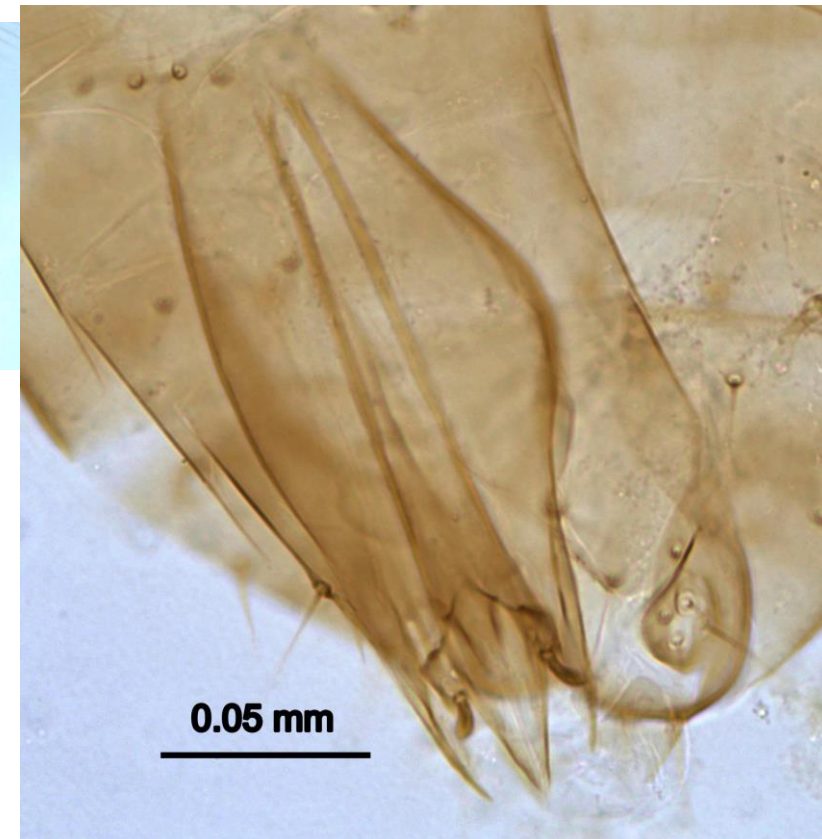
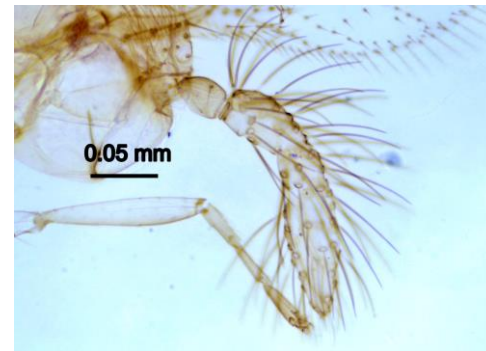


Family	Species	Countries where reported
Trichogrammatidae	<i>Trichogramma chilonis</i>	Kenya, Tanzania, India
	<i>Trichogramma mwanzai</i>	Kenya, Tanzania, India
	<i>Trichogrammatoidea</i> sp.	Niger
	<i>Trichogramma pretiosum</i>	
	<i>Trichogramma</i>	
Scelionidae	<i>Telenomus remus</i>	Across sub-Saharan Africa, Asia



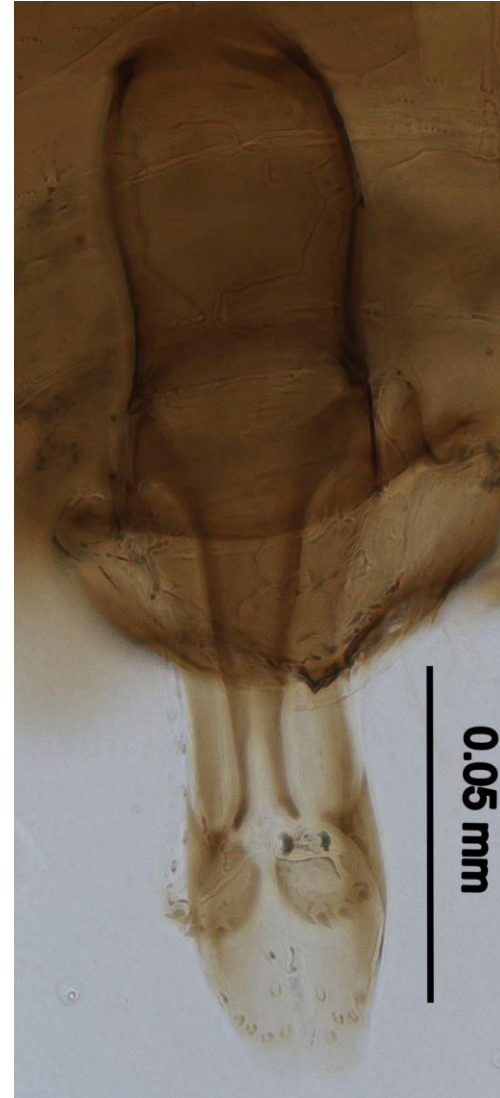
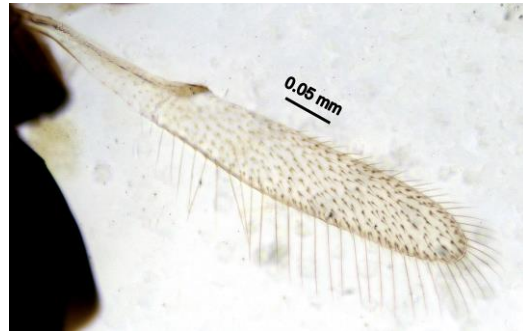
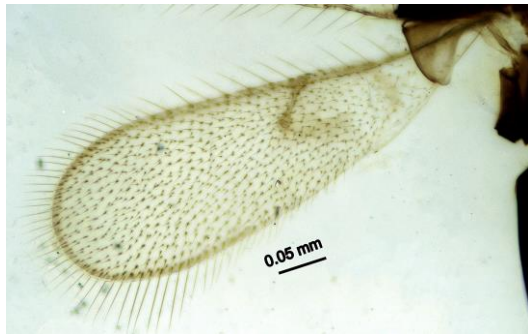
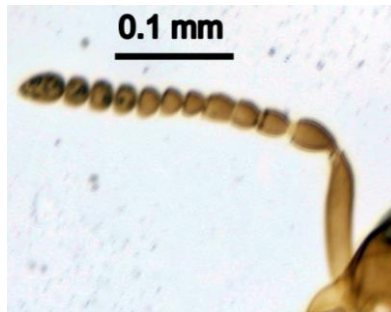
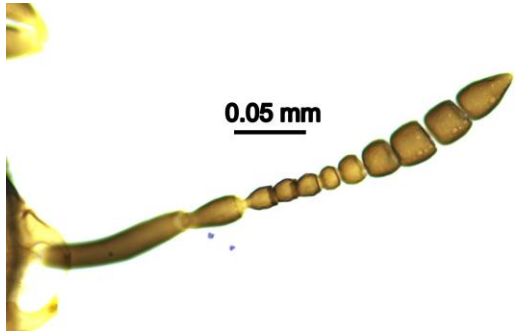


# Trichogramma





# Telenomus



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# Natural enemies of FAW egg - larva



## Egg - larval parasitoids

Family	Species	Countries where reported
Braconidae	<i>Chelonus curvimaculatus</i>	Kenya, Tanzania, Ethiopia
	<i>Chelonus bifoveolatus</i>	Kenya, Uganda, West Africa
	<i>Chelonus insularis</i>	America, Africa?



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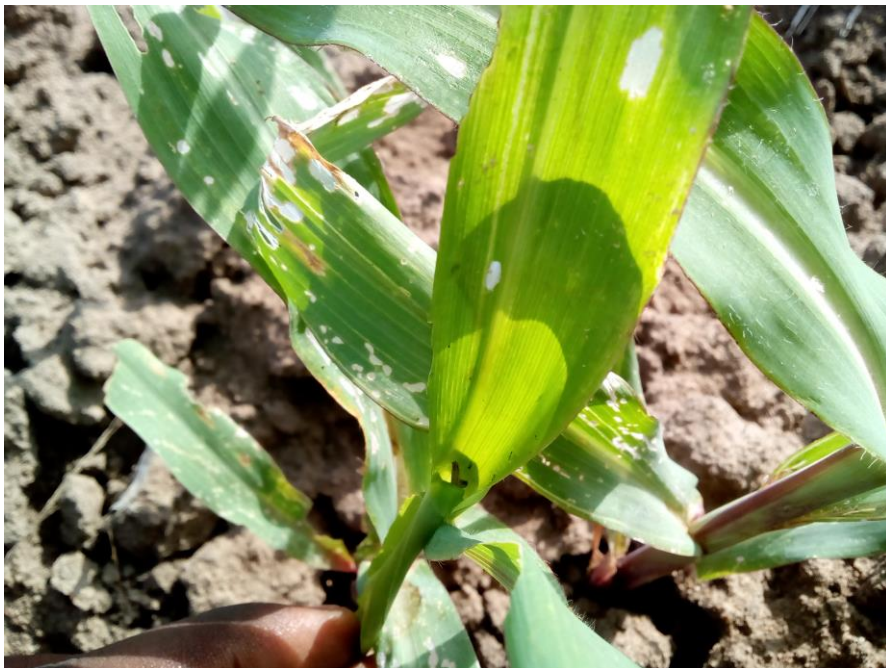




# Natural enemies of FAW larva



## larval parasitoids



Family	Species	Countries where reported
Braconidae	<i>Cotesia icipe</i>	Ghana, Yemen, Kenya, Ethiopia
	<i>Cotesia marginiventris</i>	America potential for classical biological control
	<i>Coccygidium luteum</i>	Kenya, Benin, Ghana, Gambia, Saudi Arabia, Mozambique



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# Natural enemies of FAW larva

## Larval parasitoids



Family	Species	Countries where reported
Ichneumonidae	<i>Charops sp.</i>	Kenya, Tanzania, Ethiopia, Mozambique
	<i>Metopius cf. discolor</i>	Mozambique
	<i>Eiphosoma laphygmae</i>	South America – prospects for classical biological control



*Charops sp.*



*Eiphosoma laphygmae*

Source: Tim Haye, CABI



*Metopius sp*

Source: iNaturalist © Alan Manson

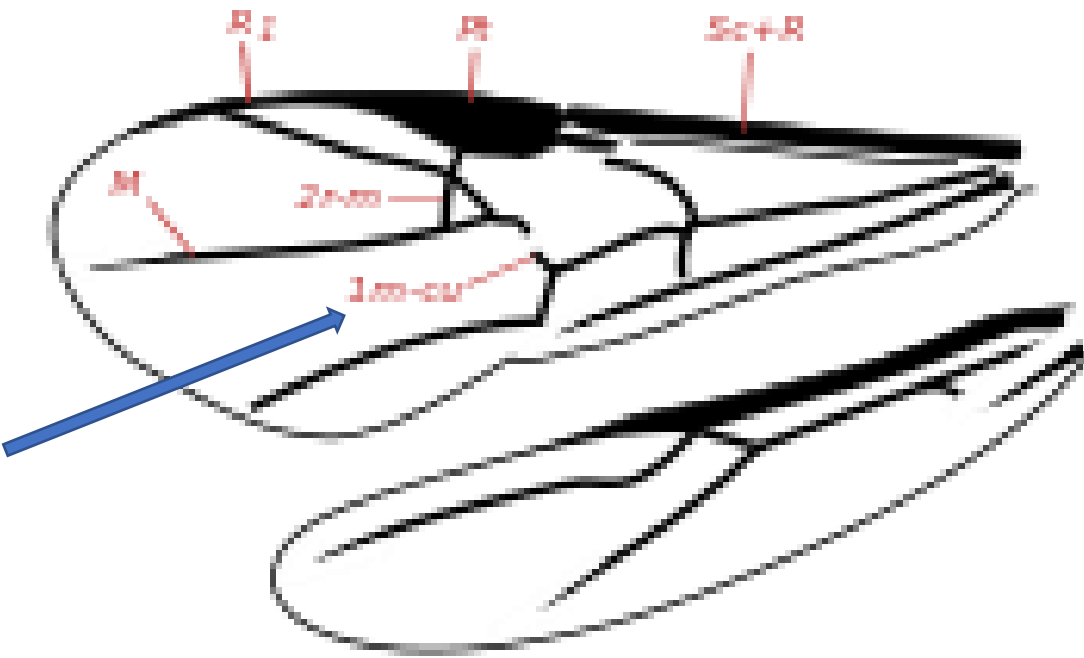


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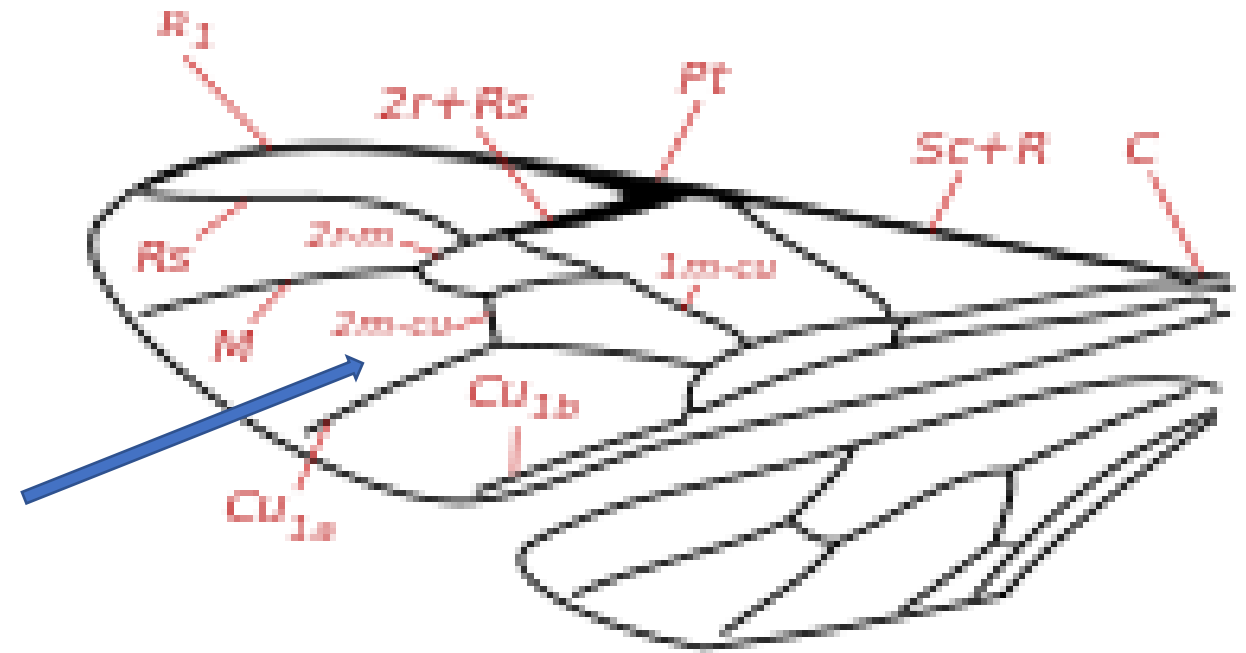




# Braconidae



# Ichneumonidae



# Natural enemies of FAW larva



## Larval parasitoids



Family	Species	Countries where reported
Eulophidae	<i>Euplectrus laphygmae</i>	Nigeria, Kenya

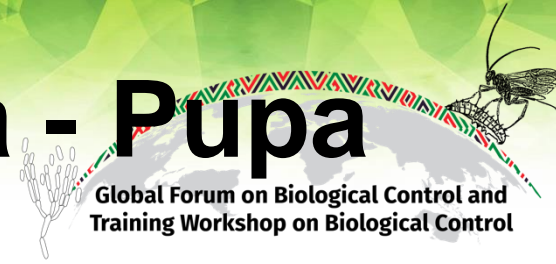


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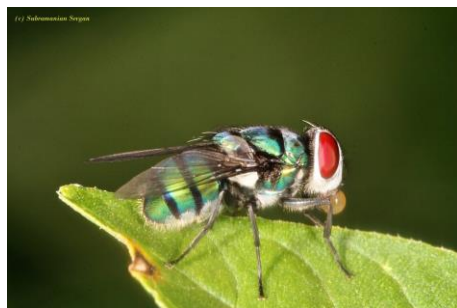
# Natural enemies of FAW larva - Pupa



## Larval - Pupal parasitoids



Family	Species	Countries where reported
Tachnidae	<i>Palexorista zonata</i>	Kenya, Tanzania, Ethiopia
	<i>Sturmiopsis parasitica</i>	Uganda
	<i>Drino quadrizonula</i>	Mozambique
	<i>Exorista xanthaspis</i>	India



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# Common predators of FAW in Africa



Family	Species
Forficulidae	<i>Forficula</i> sp.
	<i>Doru lutipes</i>

## Earwigs - Dermaptera



African Common Earwig (*Forficula senegalensis*)

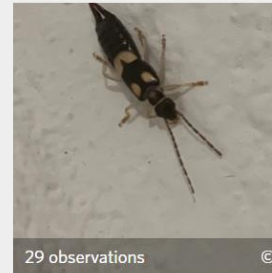
[More Photos](#)



Lined Earwig  
(*Doru taeniatum*)



Spine-tailed Earwig  
(*Doru aculeatum*)



*Doru albipes*



*Doru lineare*



*Doru davisi*



*Doru gracilis*



*Doru luteipes*

*Doru* sp

Source: iNaturalist



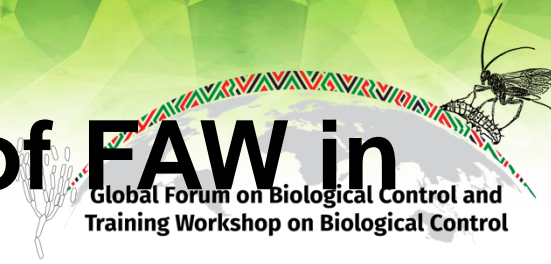
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# Hemiptera

## Common predators of FAW in Africa



### Family

Reduviidae

Anthocoridae

Pentatomidae - Subfamily Asopinae

Geocoridae



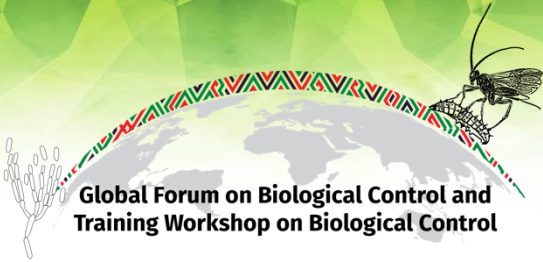
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# Common predators of FAW in Africa

## Beetles - Coleoptera



Family	Species
Coccinellidae	<i>Cheilomenes lunatus</i>
	<i>Cheilomenes sulphurea</i>

*Cheilomenes sulphurea*



?



*Cheilomenes lunatus*



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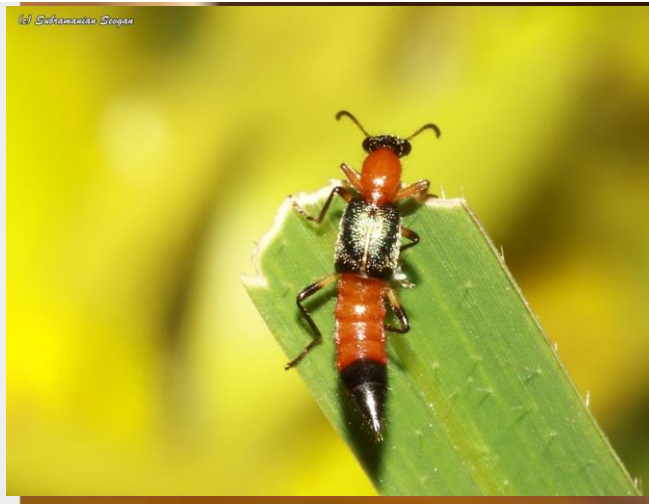


# Common predators of FAW in Africa



## Beetles - Coleoptera

### Rove beetles - Staphylinidae



Whiplash Beetles  
(Genus *Paederus*)



Genus *Holobus*



Genus *Platydracus*

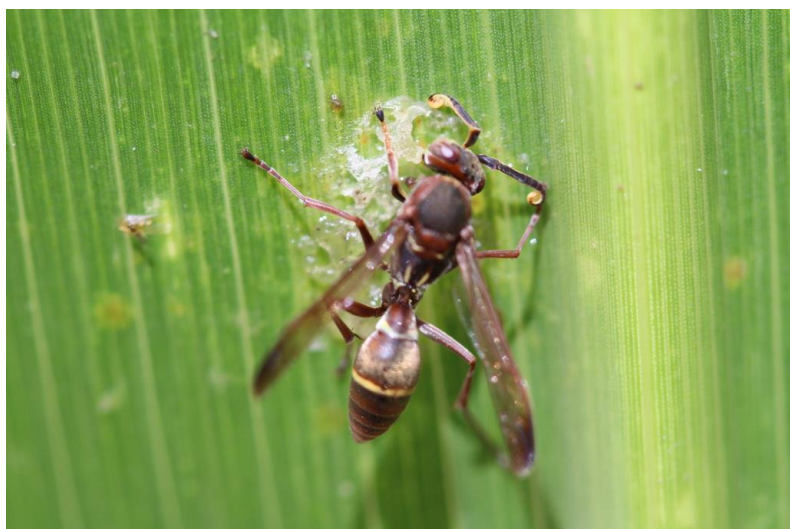


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# Common predators of FAW in Africa

## Hymenoptera



*Polistes* sp



*Ropalidia* sp

Family	Species
Vespidae	<i>Polistes</i> sp.
	<i>Ropalidia</i> sp.



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# Common predators of FAW in Africa

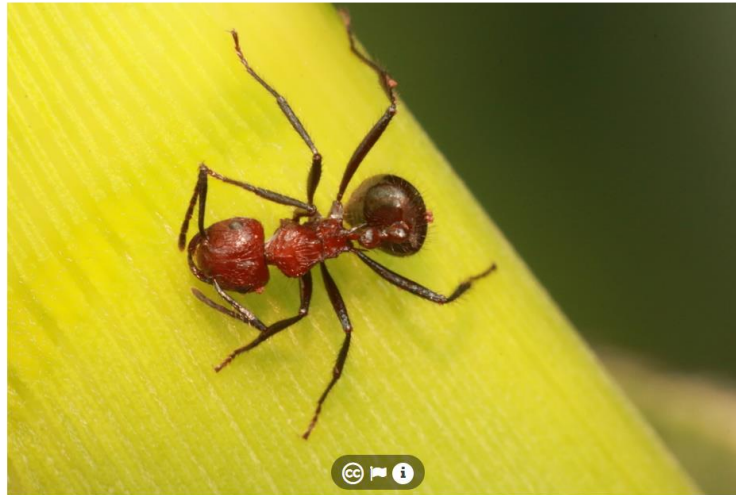
## Hymenoptera



*Camponotus* sp

Family	Species
Formicidae	<i>Pheidole megacephala</i>
	<i>Camponotus</i> sp
	<i>Myrmicaria</i> sp.

Droptail Ants (Genus *Myrmicaria*) Needs ID



*Pheidole megacephala*



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# Using predators for biological control of Fall armyworm

Rhett D Harrison

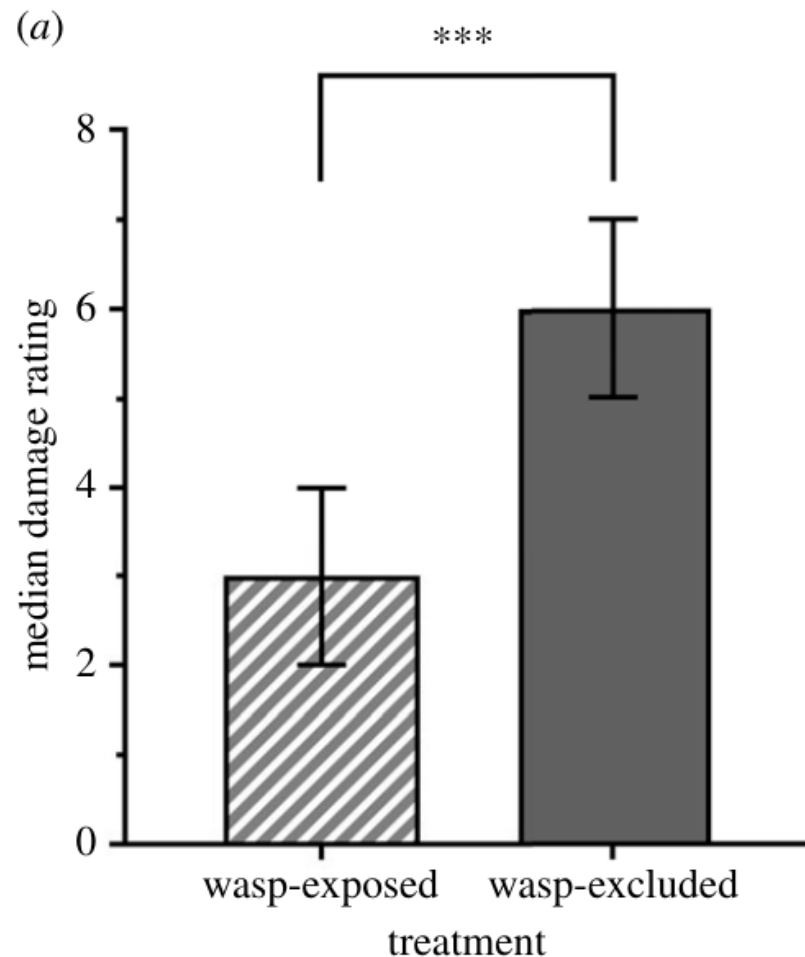


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# Social wasps as control agents



Southon et al 2019 Proc. R. Soc. B 286:20191676



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# Social wasps as control agents



Social wasps are among the most common larval predators encountered in maize fields in Zambia

We\* investigated the potential for FAW control through a screen-house experiment

\*Seirian Summer and Ruben Douglas from Imperial College, London (plus ZARI and CIFOR-ICRAF)

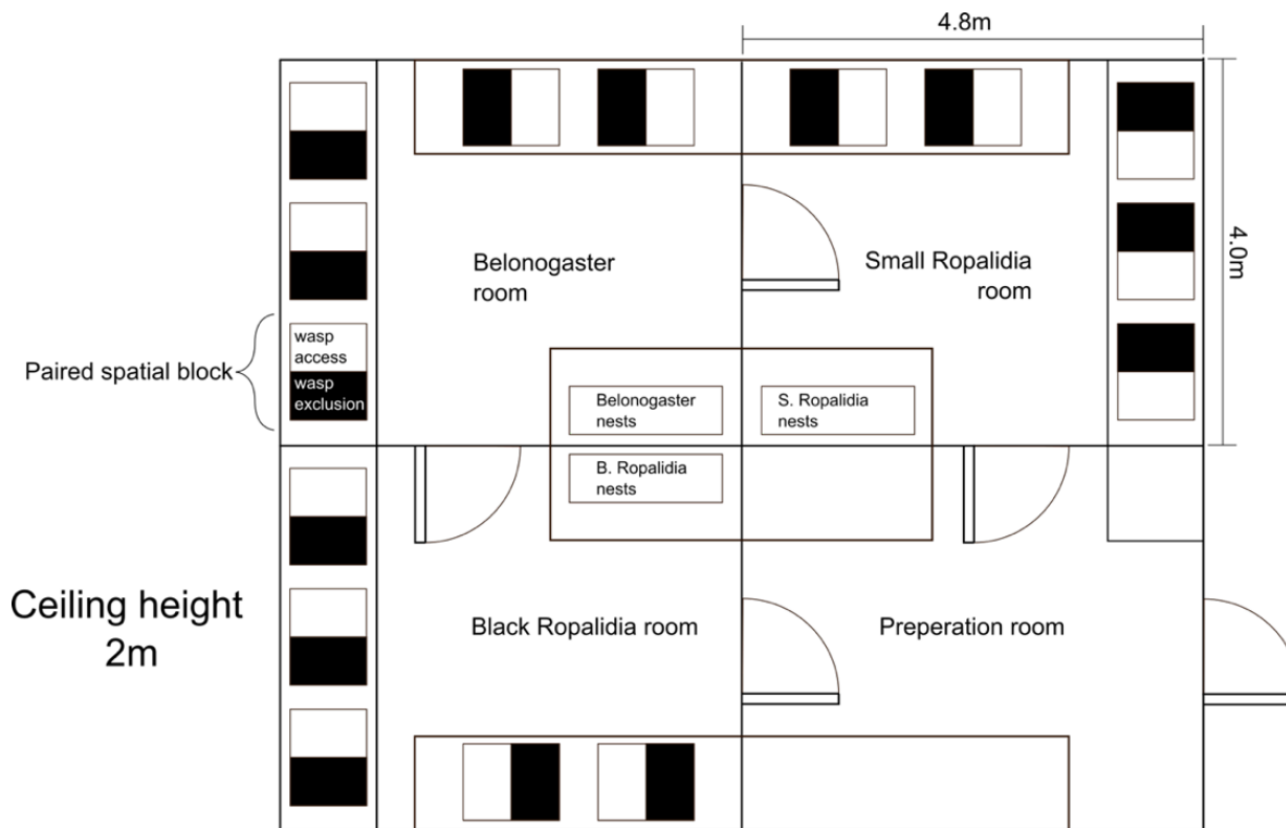


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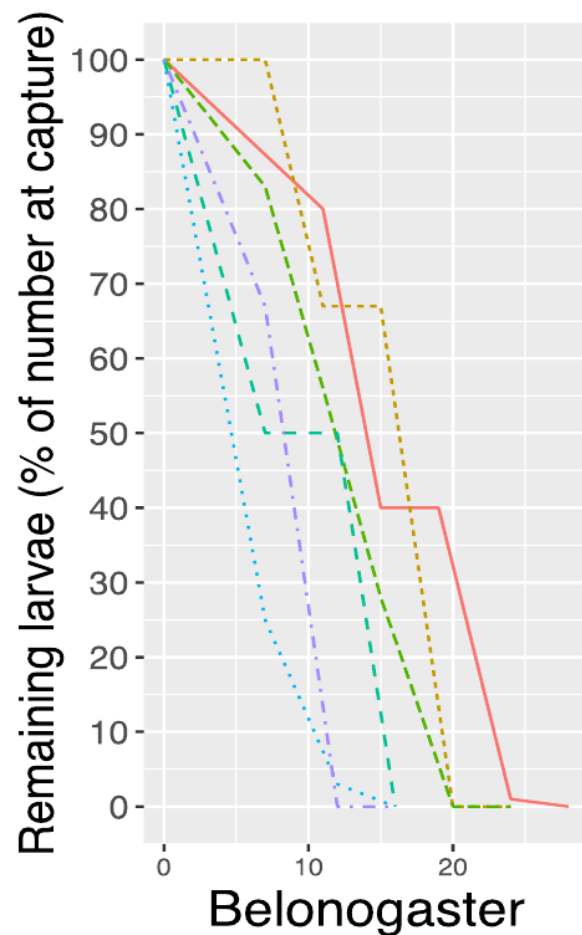




# Social wasps as control agents



# Social wasps as control agents



Social wasps fed on FAW larvae and were effective control agents under these controlled conditions

Wasp species selected larvae based on size, thus different wasp species feed on different sized larvae

Only the female wasps forage and only when they have larvae to feed, hence their effectiveness will depend on phenology which varies locally

Douglas (2020) MSc thesis Imperial College, London

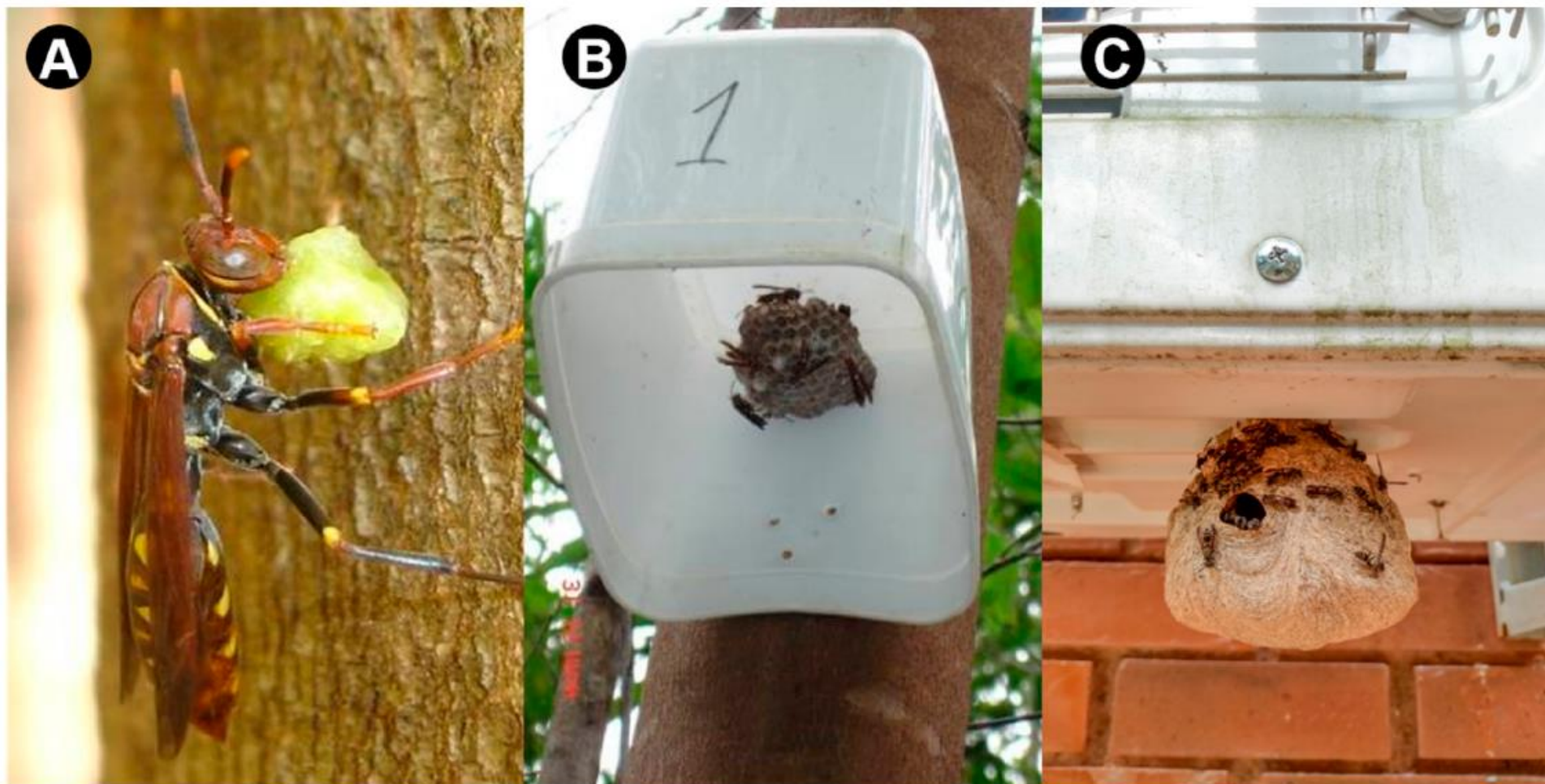


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# Social wasps – augmentative biocontrol



Prezoto et al (2019) Insects 10, 192



# Assassin bugs – augmentative biocontrol



Assassin bugs are common predators of FAW in fields

Through this research we are investigating the %predation and different levels of pest density and different levels of predator density

Mutibo, PhD candidate, University of Zambia



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# Order Araneae



Grass lynx spiders – *Oxyopes* sp.



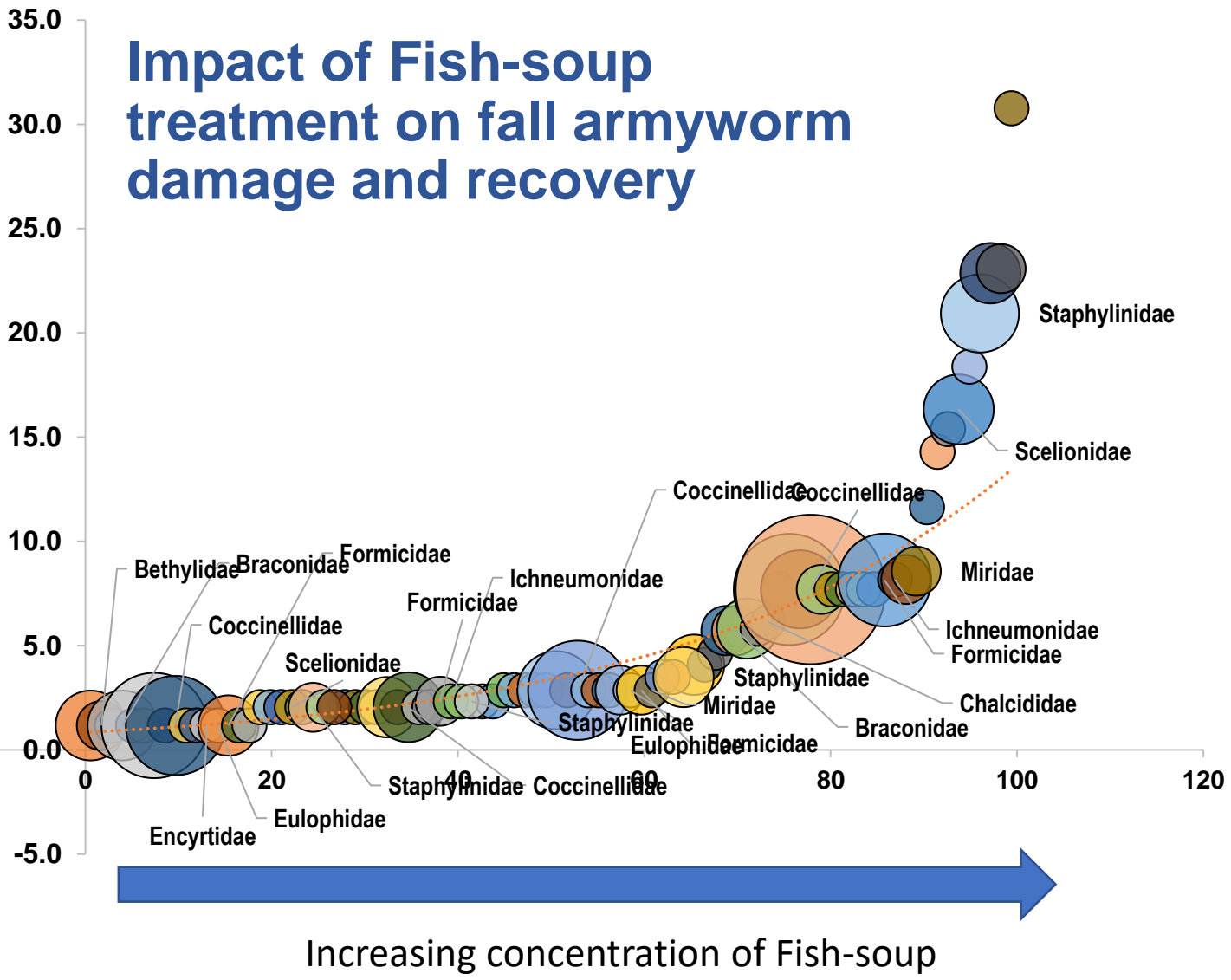
Long jawed orbweaver - *Tetragnatha*



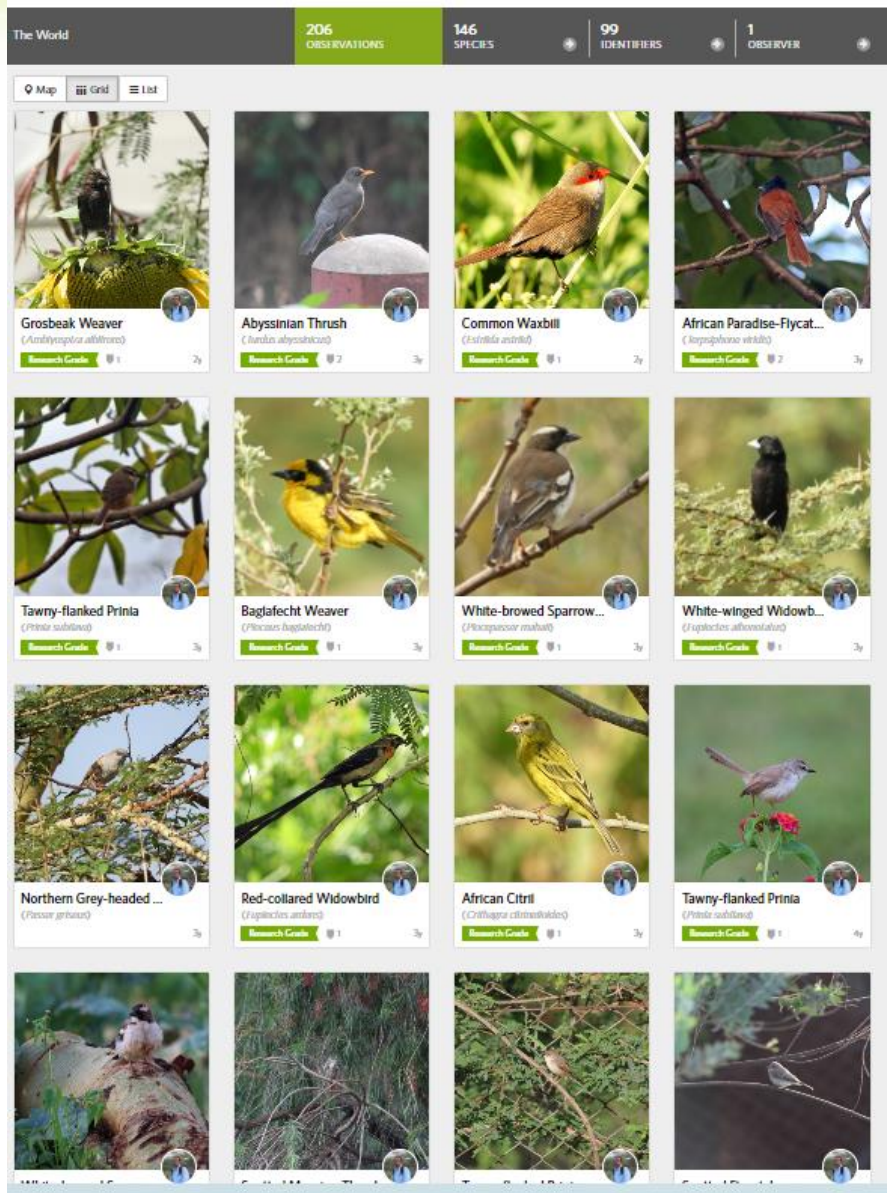
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## Birds belonging to the order Passeriformes – Perching birds



Red-billed Quelea bird XXX

© Lip Kee source: inaturalist



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Ashutosh Shinde - Mantid from Thane, India



145,884,092

Observations to Date

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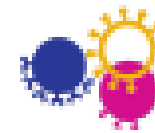
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