AARHUS
UNIVERSITET
INSTITUT FOR AGROØKOLOGI

Varroa-virus samspil og symptomer på bitab

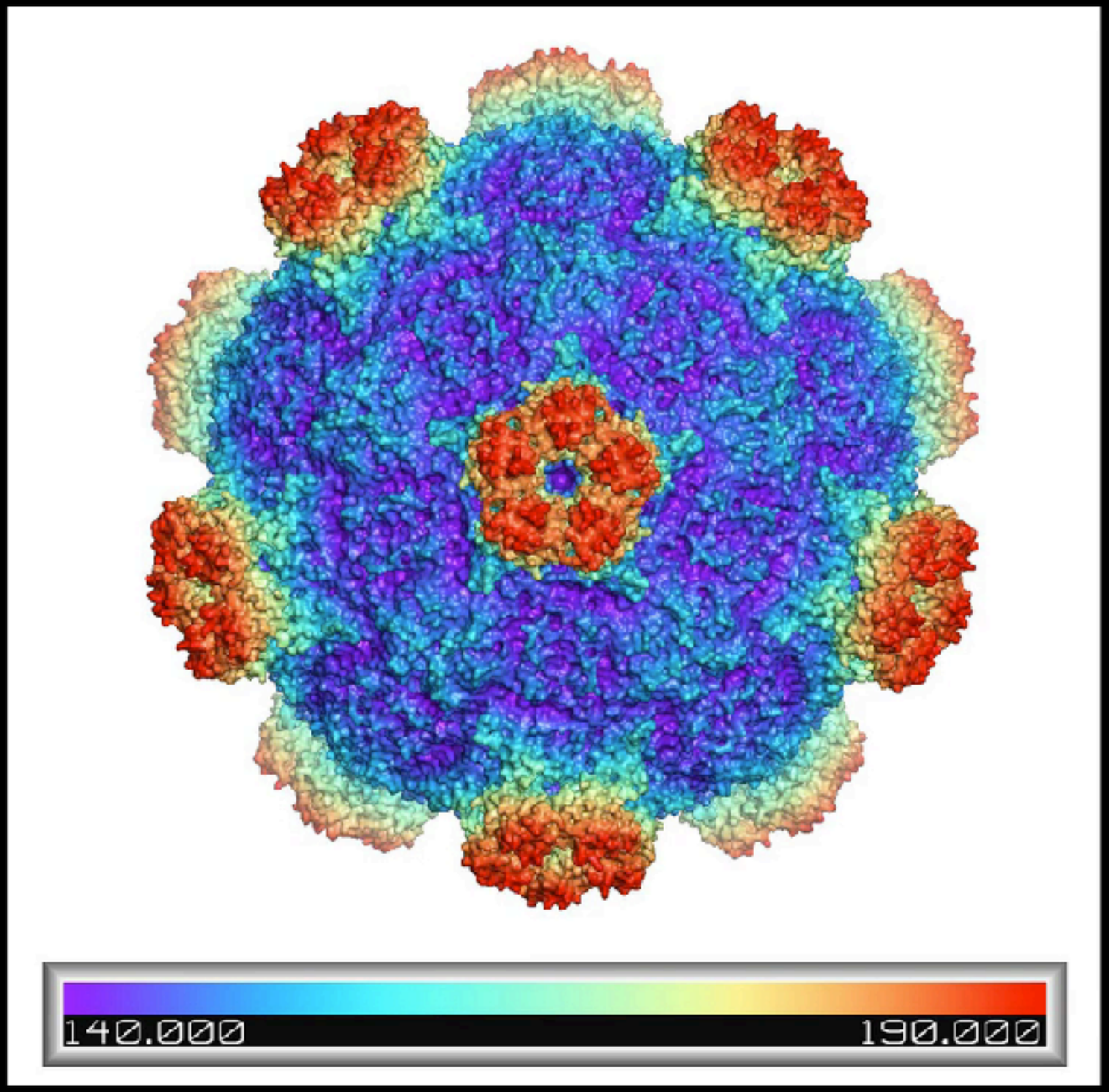
Vidensdeling 2020

Varroa vækst

MITE INDEX	A01	A02	A03	A04	A05	A06	A07	A08	A09	A10	A11	B01	B02	B03	B04	B05	B06	B07	B08	B09	C01	C02	C03
April 2011	0.0	0.5	0.0	4.4	1.1	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.6	0.0	0.5	0.5	0.0	0.7	3.0	1.3	2.5
May 2011	0.9	0.4	0.5	1.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	2.6	0.0	1.0	2.2	1.6	2.7
June 2011	0.0	0.0	0.0	0.5	8.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	1.5	0.8	0.0	4.0	1.4	0.5
July 2011	1.4	0.0	0.4	0.5	4.1	0.0	1.1	0.0	0.0	0.0	0.0	0.0	1.3	1.4	0.6	0.4	1.1	2.2	0.0	0.0	4.2	8.1	2.7
August 2011	1.3	2.3	1.2	4.1	16.1	0.0	0.0	0.0	0.0	1.9	0.0	1.4	0.9	0.0	0.6	2.9	0.0	2.6	9.7	1.6	19.9	0.5	8.7
September 2011	9.9	12.3	13.2	27.7	74.9	1.1	0.0	1.6	0.0	0.0	1.1	0.6	0.7	3.0	0.8	4.9	0.0	16.3	2.4	3.0	17.7	6.2	4.5
October 2011	1.5	20.2	20.4	9.4	9.8	2.8	1.7	1.1	0.0	0.7	2.8	7.3	11.5	2.6	7.1	2.5	2.6	1.0	7.7	14.9	31.1	x	18.1
April 2012	0.0	0.0	0.0	x	x	0.0	0.0	0.0	x	0.0	0.0	1.3	0.0	0.0	0.0	0.0	1.0	0.0	0.0	x	x	x	x

AKI IN MITES	A01	A02	A03	A04	A05	A06	A07	A08	A09	A10	A11	B01	B02	B03	B04	B05	B06	B07	B08	B09	C01	C02	C03
April 2011	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0
May 2011	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5
June 2011	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.3
July 2011	0.0	0.0	0.0	2.8	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.4	2.7	0.0	2.6	3.1	0.0	0.0	2.9	0.0	0.0
August 2011	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.6	0.0	2.8	0.0	0.0	5.3	0.0	0.0	0.0	0.0	2.7	4.6	2.5	3.7
September 2011	0.0	0.0	2.9	6.6	3.9	2.7	0.0	3.1	0.0	0.0	0.0	4.0	2.7	3.5	2.7	0.0	0.0	2.6	0.0	0.0	9.2	7.0	5.4
October 2011	3.2	4.1	3.4	7.1	4.8	4.1	5.3	2.4	0.0	0.0	3.8	4.0	0.0	0.0	3.2	2.9	5.8	4.1	3.1	3.6	8.3	x	6.9
April 2012	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

DWV IN MITES	A01	A02	A03	A04	A05	A06	A07	A08	A09	A10	A11	B01	B02	B03	B04	B05	B06	B07	B08	B09	C01	C02	C03
April 2011	0.0	0.0	0.0	4.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8	0.0	3.8	0.0	0.0	0.0	0.0	0.0	5.8
May 2011	0.0	0.0	0.0	3.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.4	0.0	0.0	5.0
June 2011	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	5.9	0.0
July 2011	3.8	0.0	3.8	4.9	6.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.3	4.9	4.6	4.2	4.5	6.8	0.0	0.0	8.9	8.7	5.1
August 2011	0.0	3.9	0.0	6.4	6.9	0.0	0.0	0.0	0.0	7.3	0.0	4.8	8.7	0.0	6.5	0.0	0.0	7.7	6.6	6.1	8.6	5.0	8.6
September 2011	6.5	7.7	6.1	8.6	9.6	7.2	0.0	8.9	0.0	0.0	7.5	4.5	4.4	4.9	6.6	6.4	0.0	9.2	8.6	10.2	11.7	7.8	10.9
October 2011	5.0	8.1	10.4	9.9	9.7	6.4	9.2	8.2	0.0	3.9	5.8	7.0	10.6	7.1	5.5	5.4	8.2	9.7	8.8	10.2	11.6	x	10.7
April 2012	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x


140.000
190.000

Akut biparalysevirus symptomer i yngelleje

SCIENTIFIC REPORTS

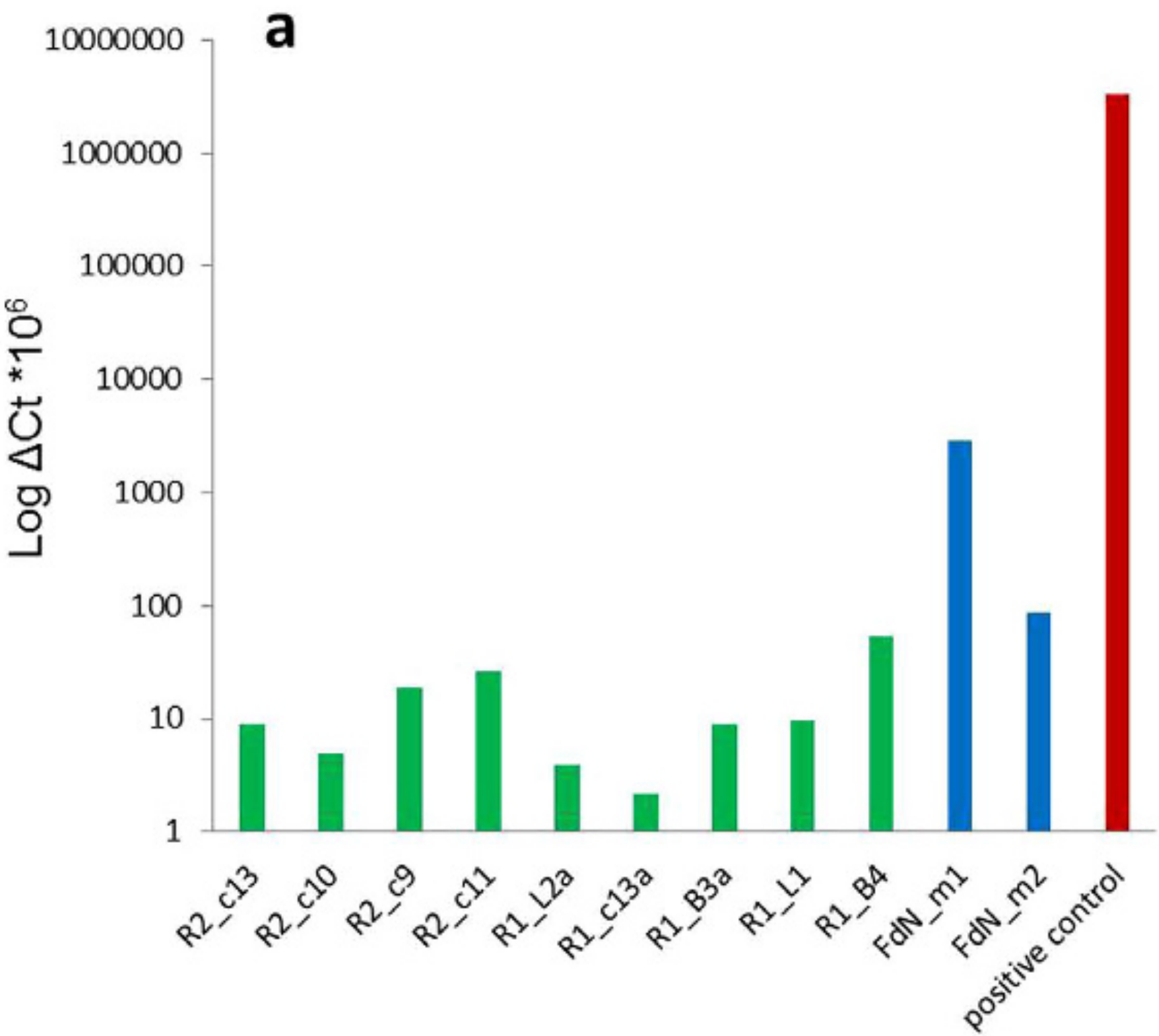
Oldest *Varroa* tolerant honey bee population provides insight into the origins of the global decline of honey bees

L. E. Brettell & S. J. Martin

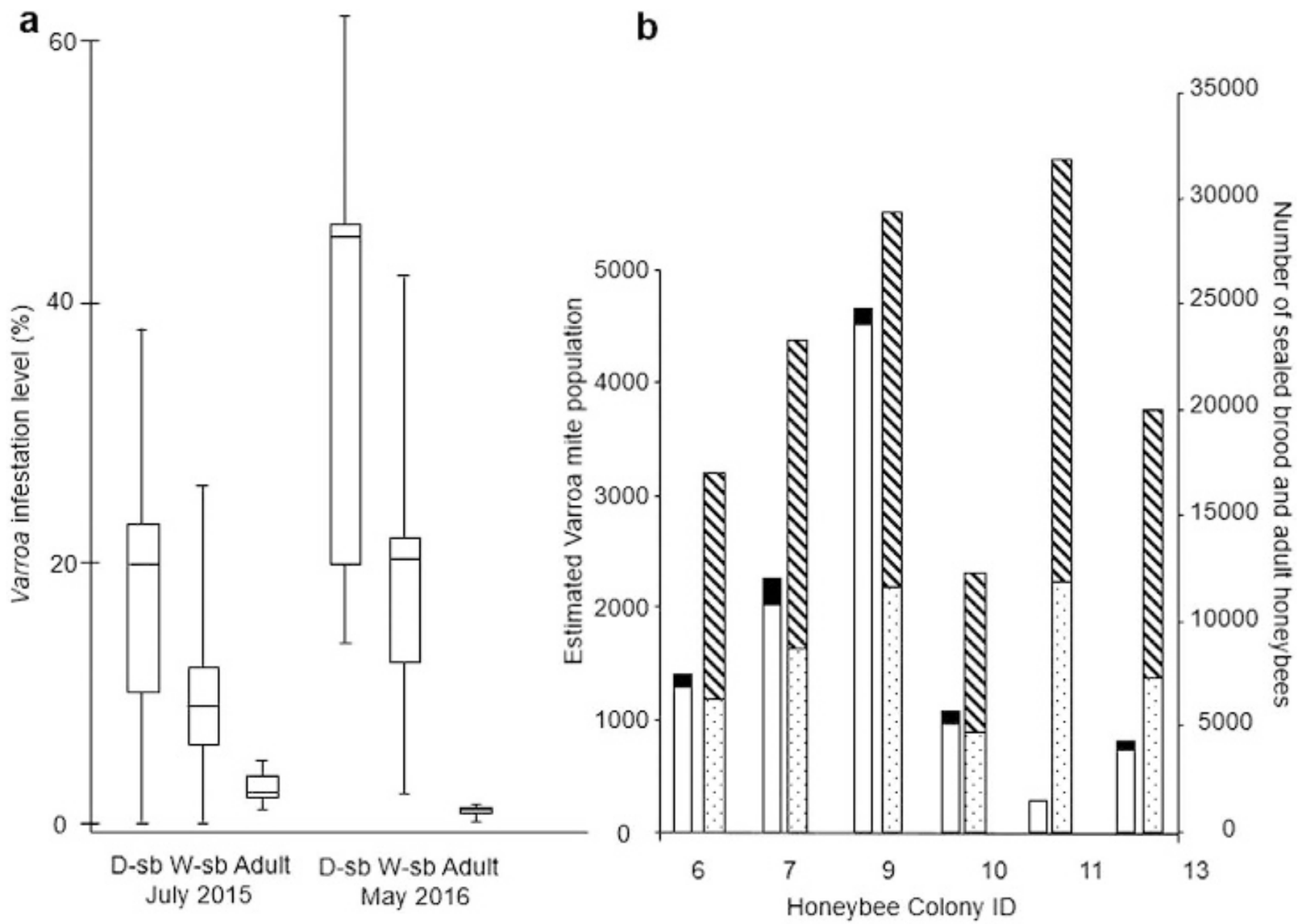
Første varroa tolerante honningbi population belyser oprindelse til globale honningbi tab

Øen Fernando de Noronha, Brasilien

Der forekommer deform vingvirus på øen, men små mængder



Stor mængder varroa i bifamilierne



a) Andel droneyngel
arbejderyngel
voksne bier med mider

b) Antal mider i yngel
Yngel og voksne bier

Konklusion

- Varroa er et problem på øen
- Deform vingevirus (DWV) er mindre skadelige end andre steder
- Årsagen til bitab er altså tæt knyttet til DWV
- Øens 350 km afstand til fastland beskytter

- Varroa på Anholt i 2019, kun 2 bifamilier i live

Varroasyge

- Varroa forårsager skader på bierne
- Deform vingevirus spredes af varroa bifamilierne svinder ind i løbet af foråret
- Akut biparalysevirus spredes af varroa bifamilierne er tit døde ved oxalsyre
- Uanset, bør bekæmpelsesstrategi revurderes

Varroasyge fortsat

- “Gjort som jeg plejer, det plejer at virke!”
- Hvilke faktorer mangler vi kontrol over?
- Klima forandringer
- Trækforhold især pollen
- Smitte fra omgivelserne

Haemolymph removal by *Varroa* mite destabilizes the dynamical interaction between immune effectors and virus in bees, as predicted by Volterra's model

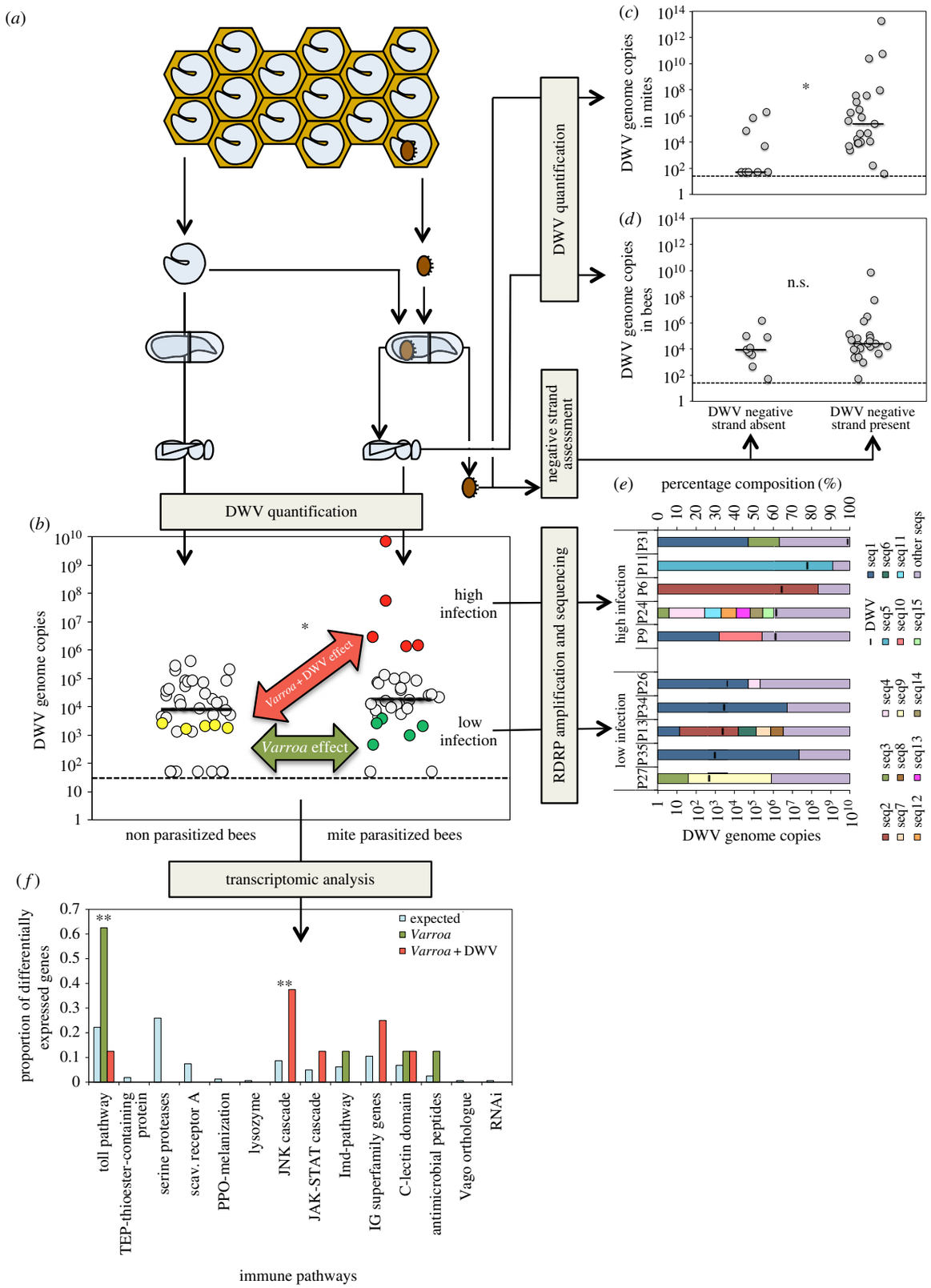
PROCEEDINGS B

royalsocietypublishing.org/journal/rspb

Research

Desiderato Annoscia[1], Sam P. Brown[2], Gennaro Di Prisco[3,4], Emanuele De Paoli[1], Simone Del Fabbro[1], Davide Frizzera[1], Virginia Zanni[1], David A. Galbraith[5], Emilio Caprio[3], Christina M. Grozinger[5], Francesco Pennacchio[3] and Francesco Nazzi[1]

Fjernelse af hæmolymfe (biblod) af varroamiden destabilisere samspil mellem immunforsvar og virus i honningbier, Volterras model

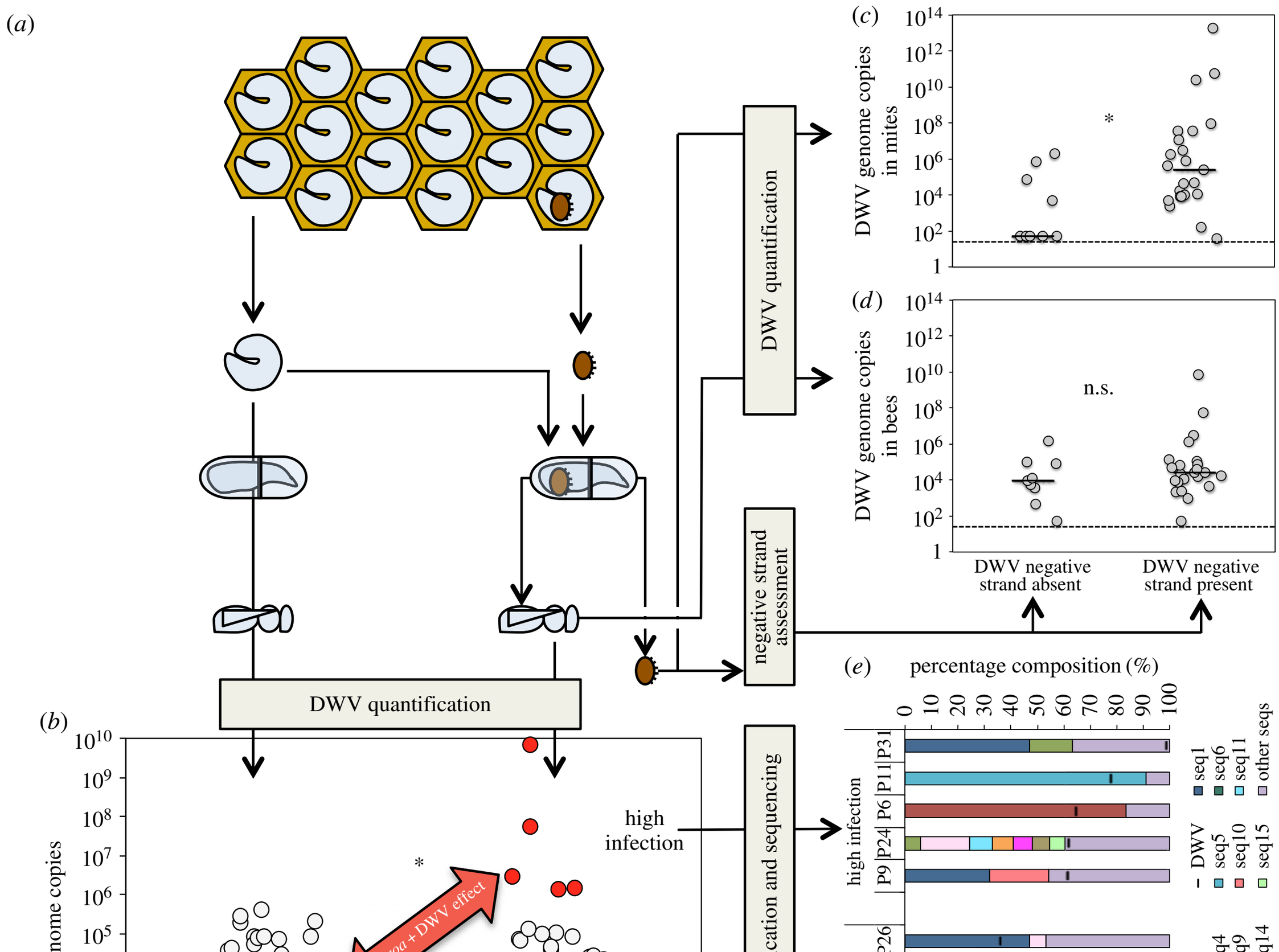


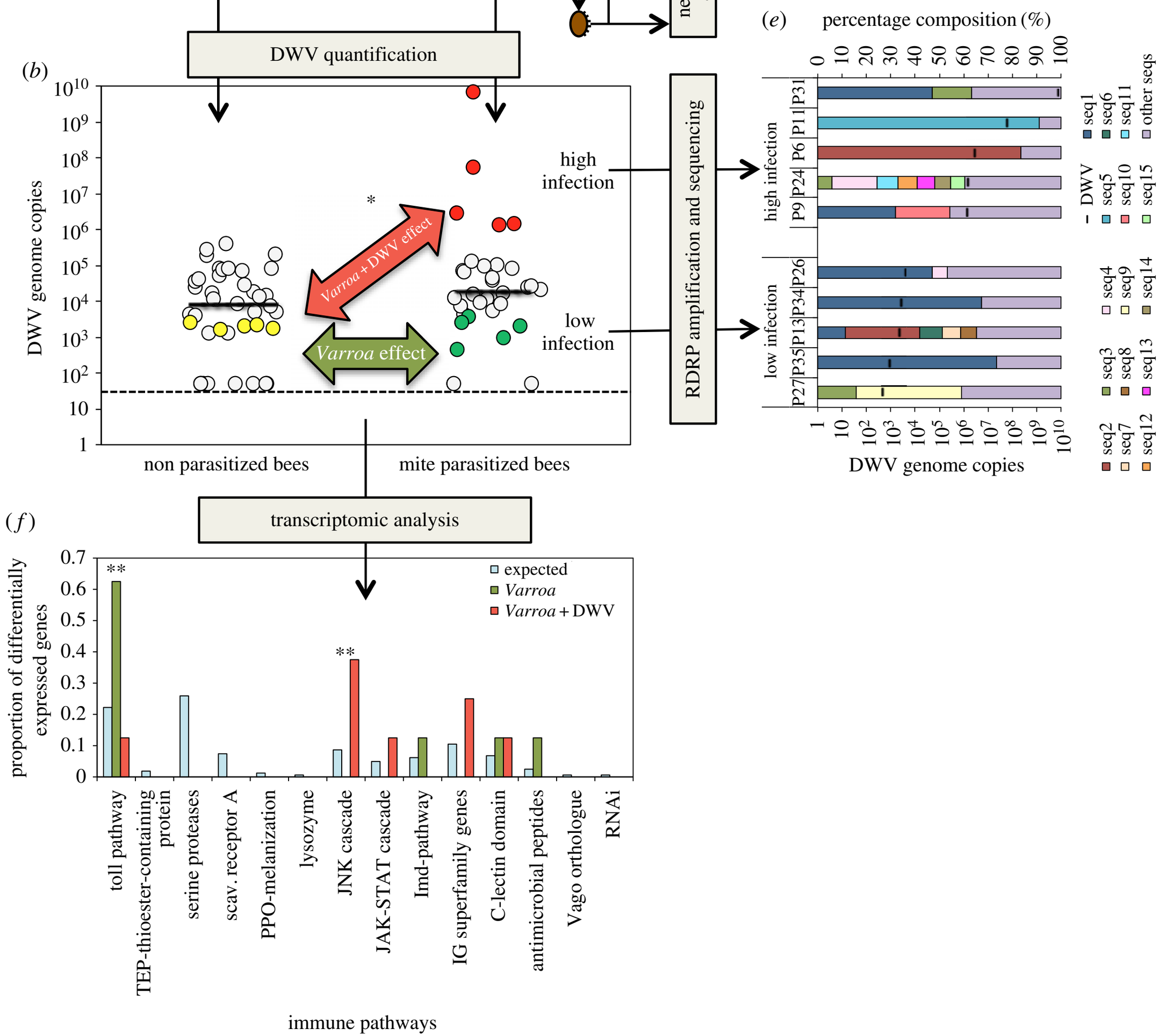
Kompleks figur!

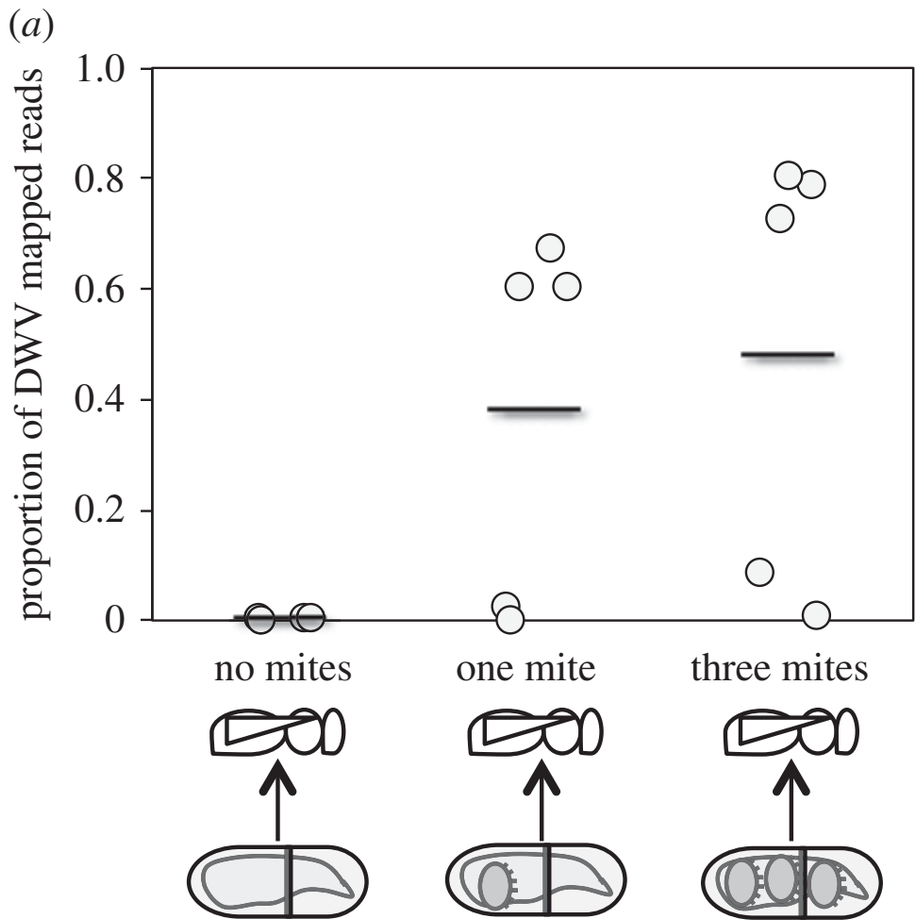
Varroa påvirker bier negativt

Deform vingevirus i få bier når meget højt niveau

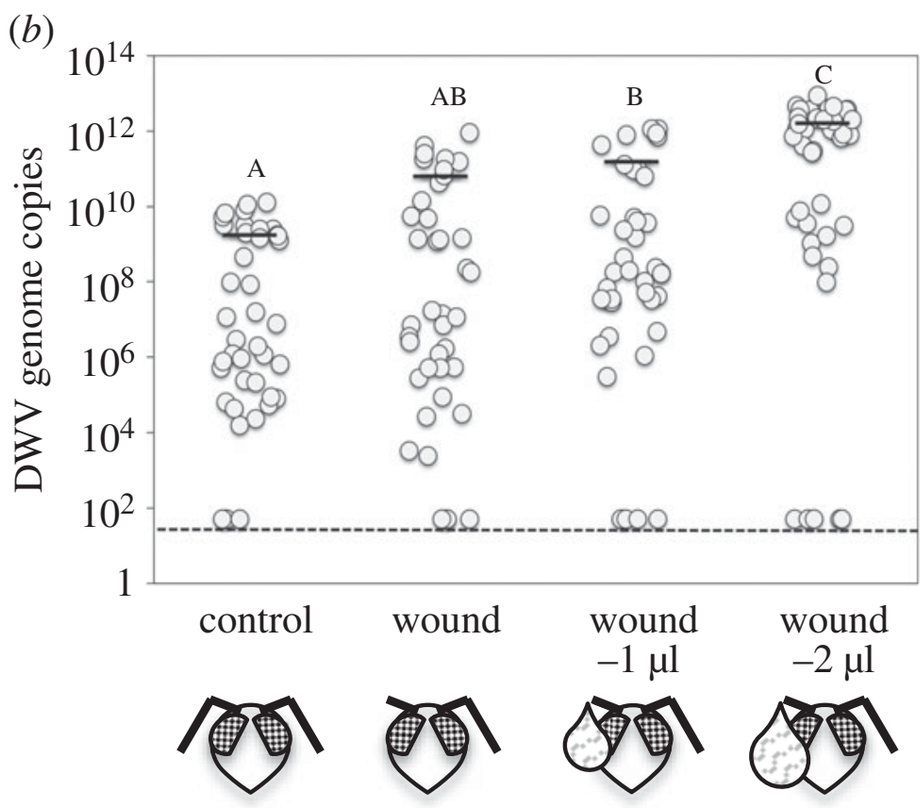
DWV påvirker biers immunforsvar


(a)
DWV quantification
negative strand assessment
(c)
DWV genome copies in mites
*
(d)
DWV genome copies in bees
n.s.
DWV negative strand absent
DWV negative strand present
(b)
DWV genome copies
*
Varroa + DWV effect
high infection
DWV quantification and sequencing
(e)
percentage composition (%)
high infection
P9
P24
P6
P11
P3
P26
DWV
seq1
seq5
seq6
seq10
seq11
seq15
other seqs
seq4
seq9
seq14


DWV quantification
(b)
DWV genome copies
high infection
low infection
Varroa + DWV effect
Varroa effect
non parasitized bees
mite parasitized bees
RDRP amplification and sequencing
(e)
percentage composition (%)
high infection
low infection
P9
P24
P6
P11
P31
P27
P35
P13
P34
P26
DWV genome copies
seq1
seq2
seq3
seq4
seq5
seq6
seq7
seq8
seq9
seq10
seq11
seq12
seq13
seq14
seq15
other seqs
transcriptomic analysis
(f)
proportion of differentially expressed genes
expected
Varroa
Varroa + DWV
toll pathway
TEP-thioester-containing protein
serine proteases
scav. receptor A
PPO-melanization
lysozyme
JNK cascade
JAK-STAT cascade
Imd-pathway
IG superfamily genes
C-lectin domain
antimicrobial peptides
Vago orthologue
RNAi
immune pathways



Varroa påvirker virus i bier, flere mider øger mængden af virus kopier i nogle bier, men ikke altid Få bier, med mange virus Mange bier, med lidt virus



Fjernelse af hæmolymfe giver flere bier med meget virus, men der vedbliver at være bier med få virus

Volterras model

- Fjernes store rovfisk i en sø ved fiskeri øges mængden af deres bytte - flere små fisk
- Varroamiden fjerner hæmolymfe fra bierne
- Derved mindskes mængden af hæmocyter (blodceller) i cirkulation
- Hæmocyternes funktion er at opfange virus Hvis balancen forstyrres kan virus opformeres

viruses

Opinion

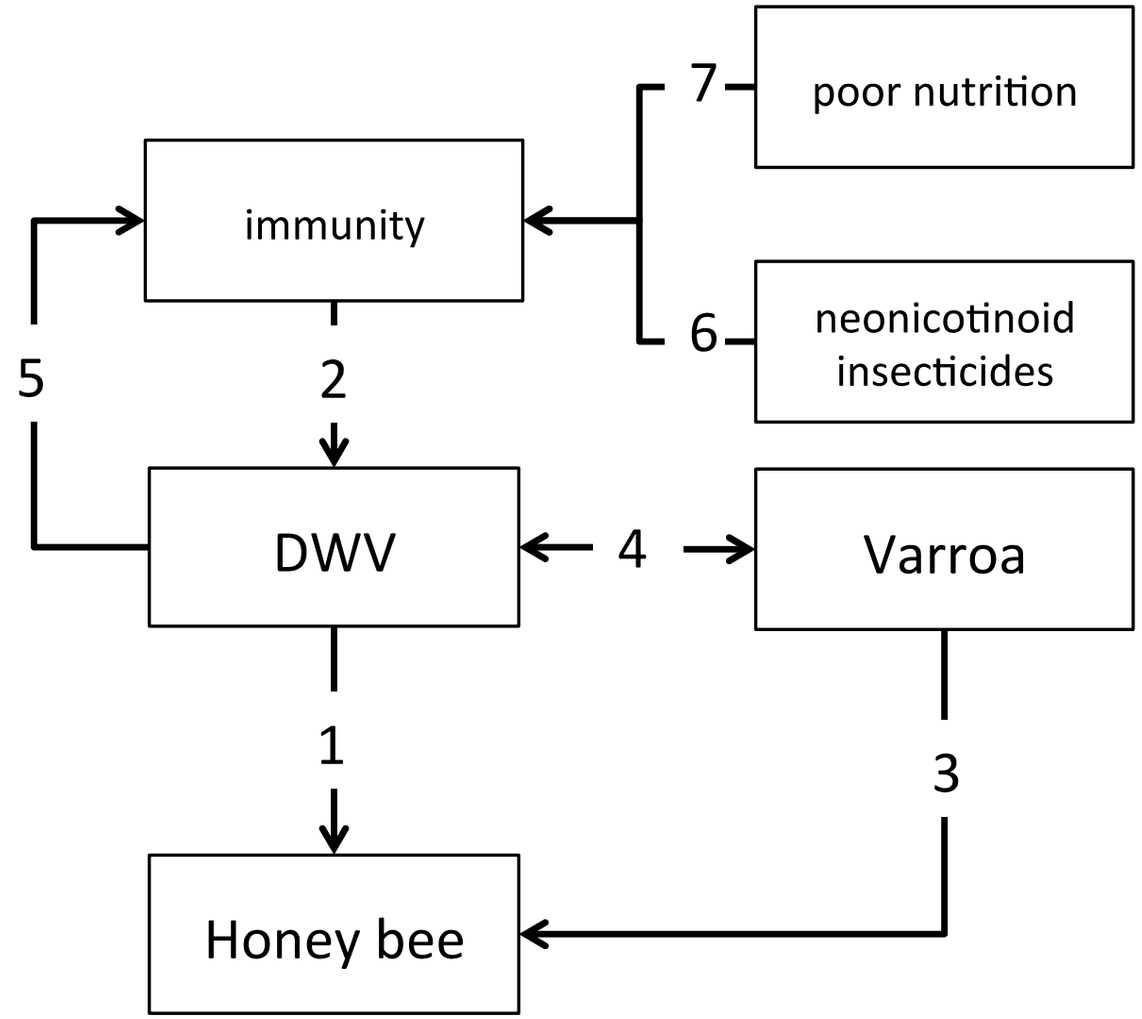
Honey Bee Antiviral Immune Barriers as Affected by Multiple Stress Factors: A Novel Paradigm to Interpret Colony Health Decline and Collapse

Francesco Nazzi [1,*] and Francesco Pennacchio [2]

Honningbiers antivirus immunbarrier påvirkes af mange stress faktorer: Ny forståelse af skader på bifamiliers sundhed og kollaps

Bemærk det lille ord - “Mening”

(a)



(b)

Til venstre Democles sværd, hænger i et hestehår. 1) Deform vingevirus er sværdet, der truer. 2) Normalt beskytter immunforsvar bierne. Varroa påvirker 3) bier og 4) virus. Virus hæmmer immunitet 5). Miljøet påvirker immunforsvar, neonics 6) og pollenmangel 7)

Varroasyge konklusion

- Vi mister bier, især på grund af varroa og virus
- Forskes ivrigt i deform vingevirus
  (18500 artikler finder google scholar)
- Akut biparalysevirus (10600 artikler)
- Varroa (32000), *Varroa destructor* (13900)
  Varroa jacobsonii (12300)
- Honningbiers immunitet (28800), Neonics (9140)

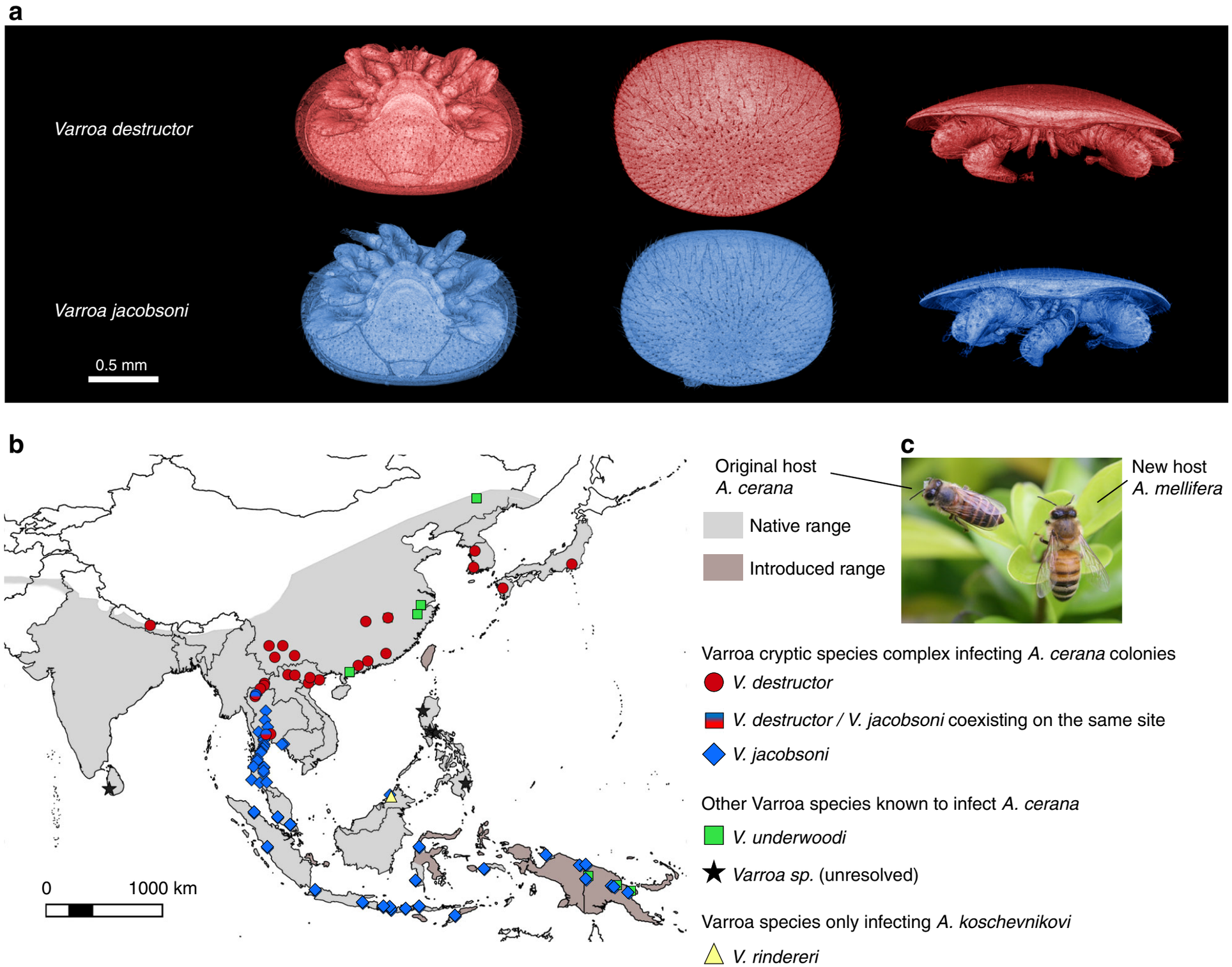
COMMUNICATIONS BIOLOGY

ARTICLE

https://doi.org/10.1038/s42003-019-0606-0 OPEN

Divergent evolutionary trajectories following speciation in two ectoparasitic honey bee mites

Maeva A. Techer[1*], Rahul V. Rane[2,3], Miguel L. Grau[1], John M.K. Roberts[2], Shawn T. Sullivan[4], Ivan Liachko[4], Anna K. Childers[5], Jay D. Evans[5] & Alexander S. Mikheyev[1,6*]



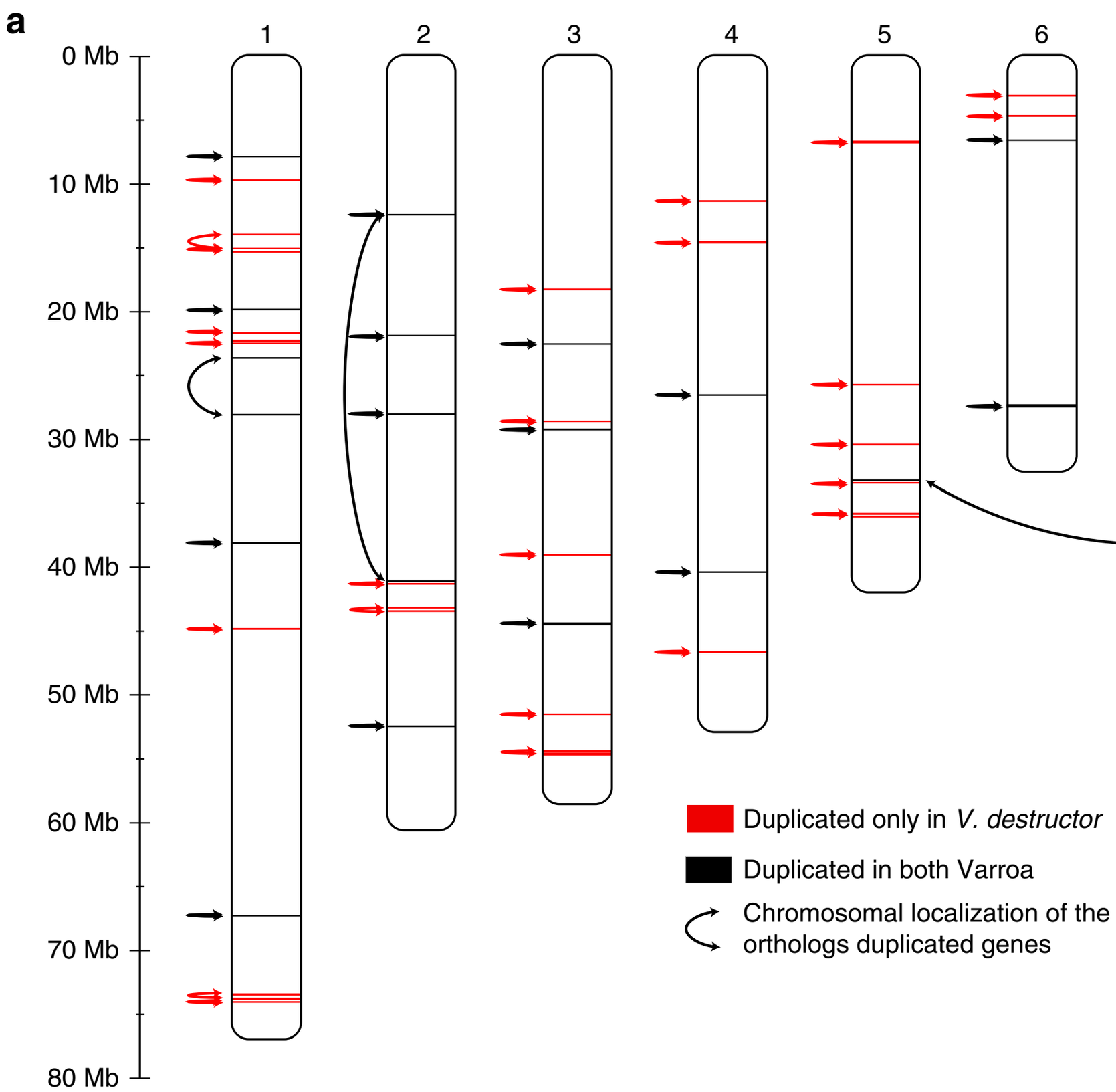

a
1
2
3
4
5
6
7
0 Mb
10 Mb
20 Mb
30 Mb
40 Mb
50 Mb
60 Mb
70 Mb
80 Mb
Duplicated only in *V. destructor*
Duplicated in both Varroa
Chromosomal localization of the orthologs duplicated genes

Table 2 Genes undergoing positive selection or duplication, that have been implicated in tolerance to external stressors and stimuli

	V. destructor (Vdes_3.0)		*V. jacobsoni* (Vjacob_1.0)	
	Annotated gene under positive selection	**Annotated gene undergoing duplication**	**Annotated gene under positive selection**	**Annotated gene undergoing duplication**
Stress from in-hive temperature				
Heat Shock 70 Kda protein-like[123]		6		
Nutrition				
Guanine metabolism[124]			1	
Detoxification				
Glutathione-S-transferase[80]			1	
Sodium channel related[125]	4		2	
Transmembrane proteins	3		4	2
G-protein coupled receptors	1			
Esterases[126]	2			
GABA-gated ion channels[127]	1			
ATP-binding cassette gene family[128]	1		2	2
Molting and reproduction				
Ecdysteroids pathway with cytochrome P450[45]			3	
Cuticular protein	2	4		1
Nutrition and reproduction				
Fatty acid metabolism[118,129,130]	3			
Chemosensory receptors				
Sensory neuron membrane protein			1	
Ionotropic glutamate receptor	1		1	

Research on Acari and *V. destructor*, in particular, has identified a large number of genes involved in stress and detoxification (possibly leading to acaricide resistance), nutrition, reproduction and chemosensing in interaction with the host. Intriguingly, many of these genes appear to be under ancestral positive selection, as *V. jacobsoni* has not been extensively targeted by acaricides on *A. mellifera*, and most of the evolutionary history captured by positive selection analyses occurred in *A. cerana*, given that coevolution with *A. mellifera* is a relatively recent evolutionary phenomenon, particularly for *V. jacobsoni*.

Varroa tilpasser sig

- *Varroa destructor* der har levet længe på *Apis mellifera* bier klare sig ikke godt på *A cerana*
- Evolution sker hurtigt, når man finder ny vært
- Tolerance for bekæmpelsesmidler findes
- Det kan ses i midernes genom

Tak til:
Jer for opmærksomheden

Det nationale biavlsprogram 2019-2022
samt

per.kryger@agro.au.dk

per.kryger@agro.au.dk

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