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Impact of heat waves on pollinator *E. kamerunicus*

JP. Caliman, D. N. Izzati, R. Subawati K, A.D. Advento, M. Naim

SMART Research Institute

PT SMART (Indonesia)

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Importance of pollinators in oil palm,

and its sensitivity to abiotic factors

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Importance of pollination and pollinators for palm oil production

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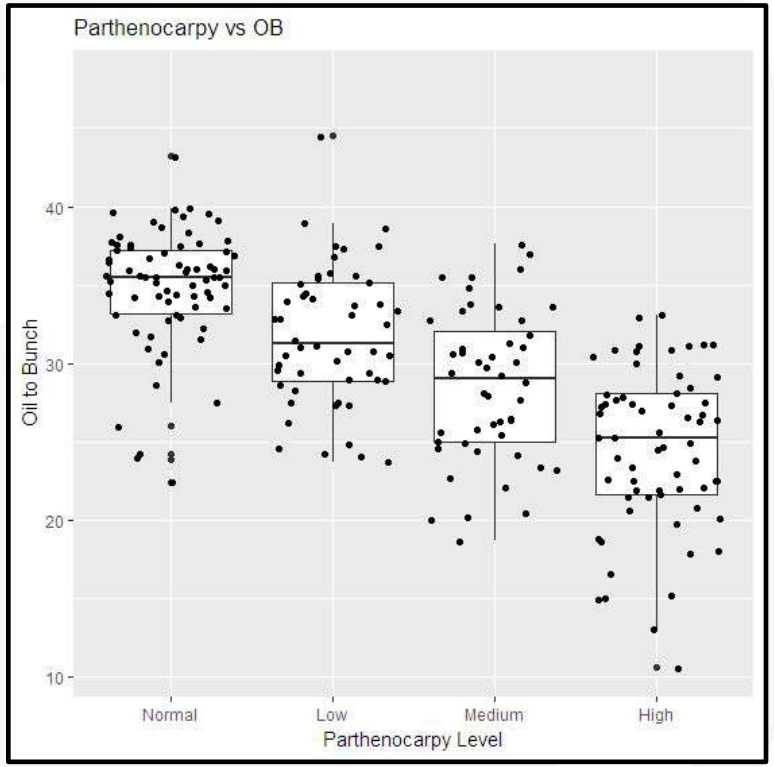
Financial value of oil palm pollinators: USD 5 to 7 billion/year



Sensitivity of *E. kamerunicus* to abiotic factors

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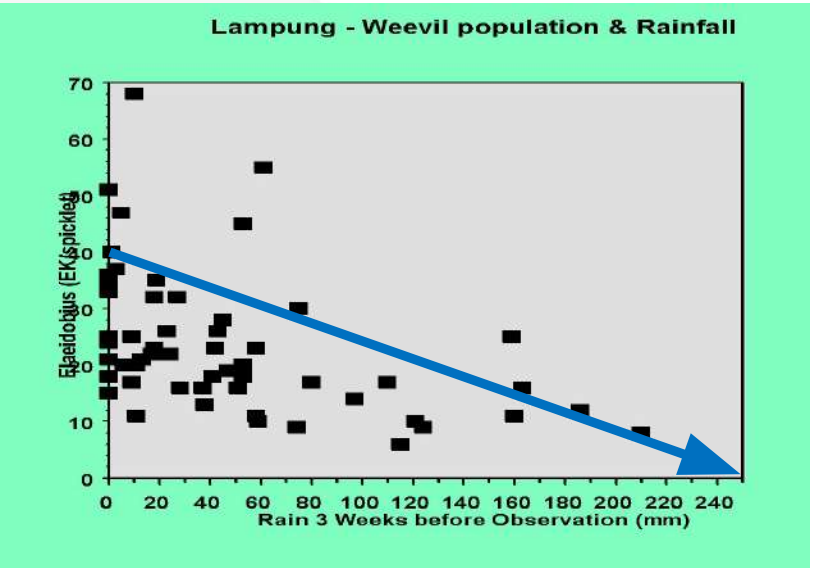
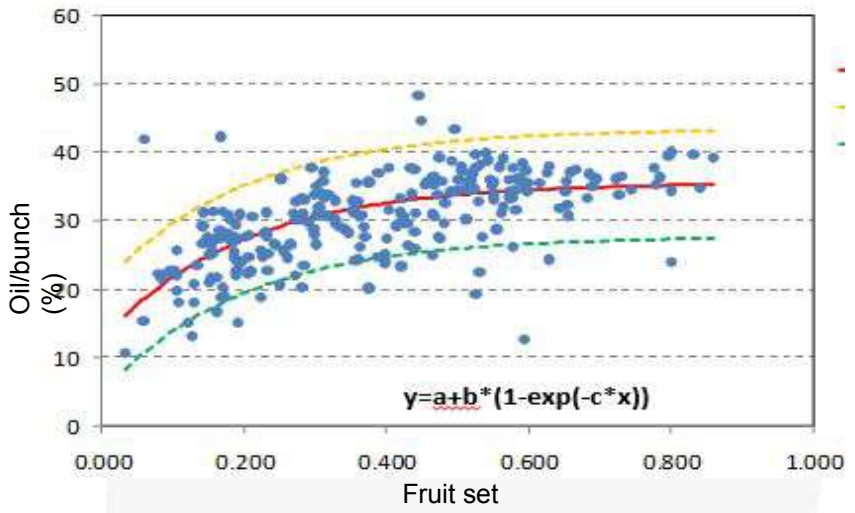
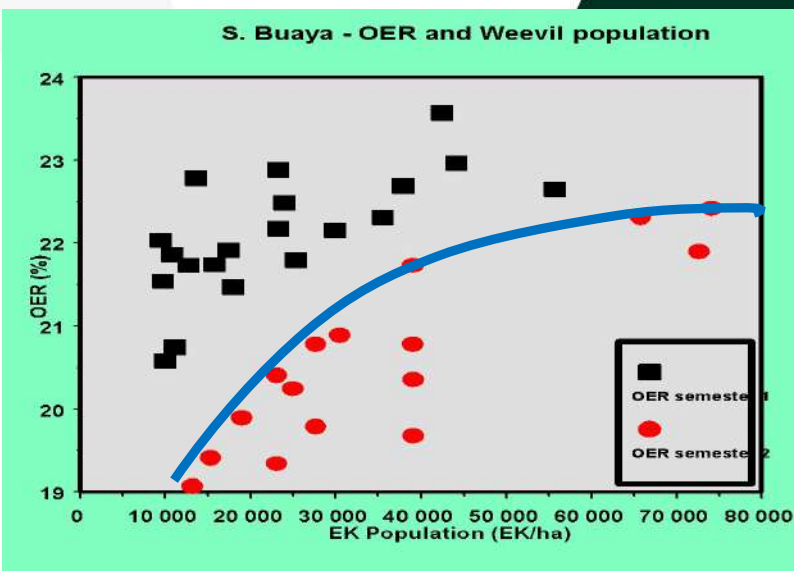
Negative impact of high rainy pattern on *E. kamerunicus population*:

Continuous rains levels > 80 mm/week during > 3 consecutive weeks often results in a decline of *E.k.* population, and subsequently in a decline of OER at mills







Sensitivity of *E. kamerunicus* to abiotic factors

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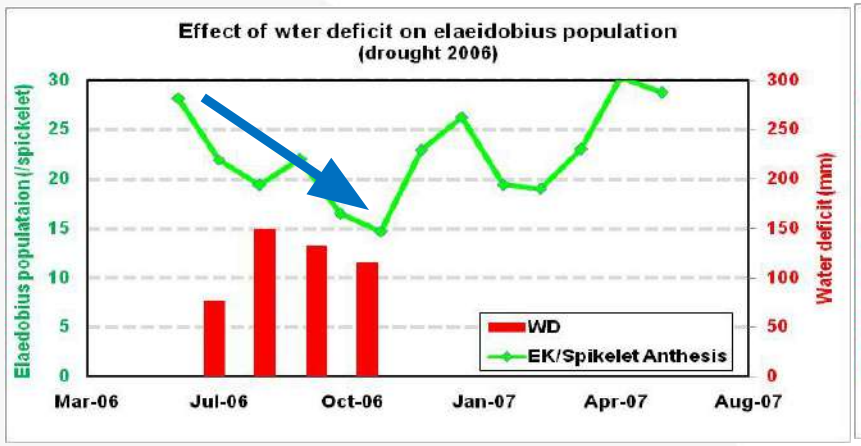
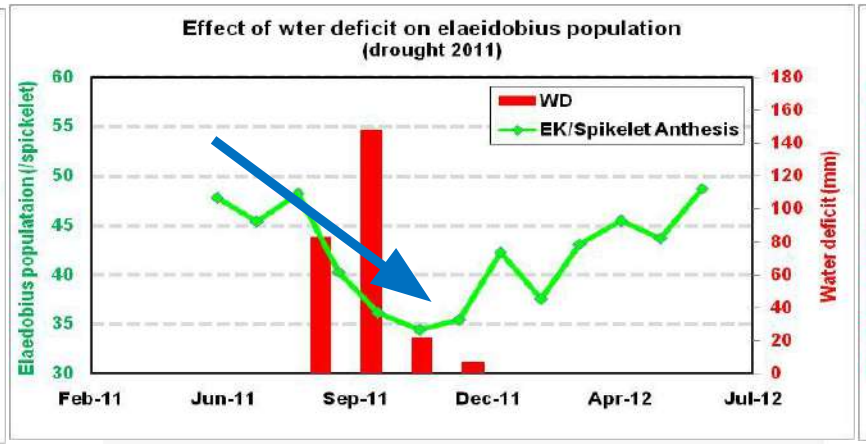
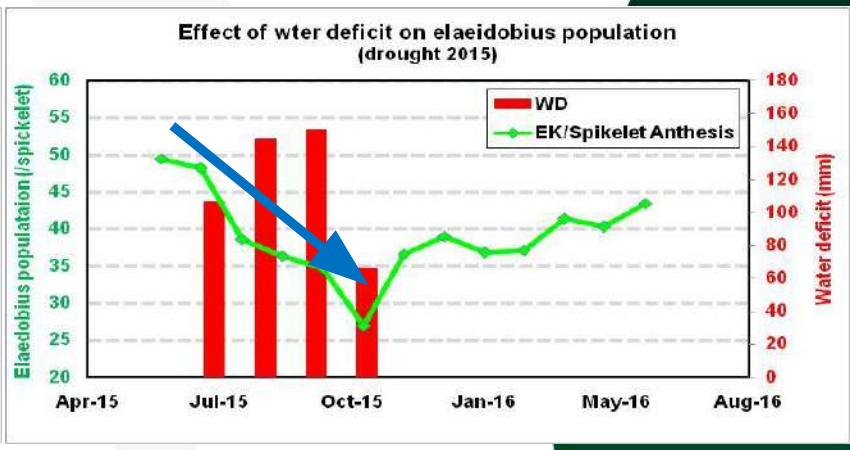
Negative impact of drought on *E. kamerunicus population*:

2006 to 2017: av.= - 22 %

(after/before dry periods with water deficit)







Sensitivity of *E. kamerunicus* to abiotic factors

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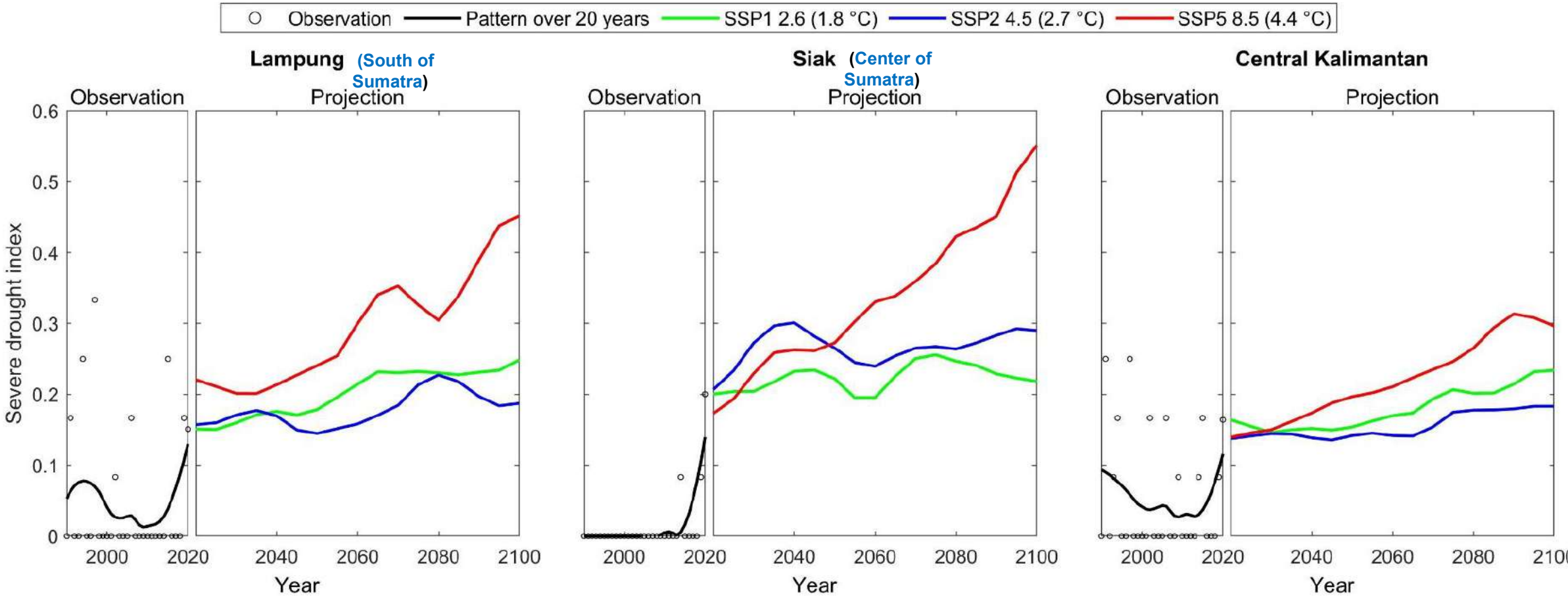
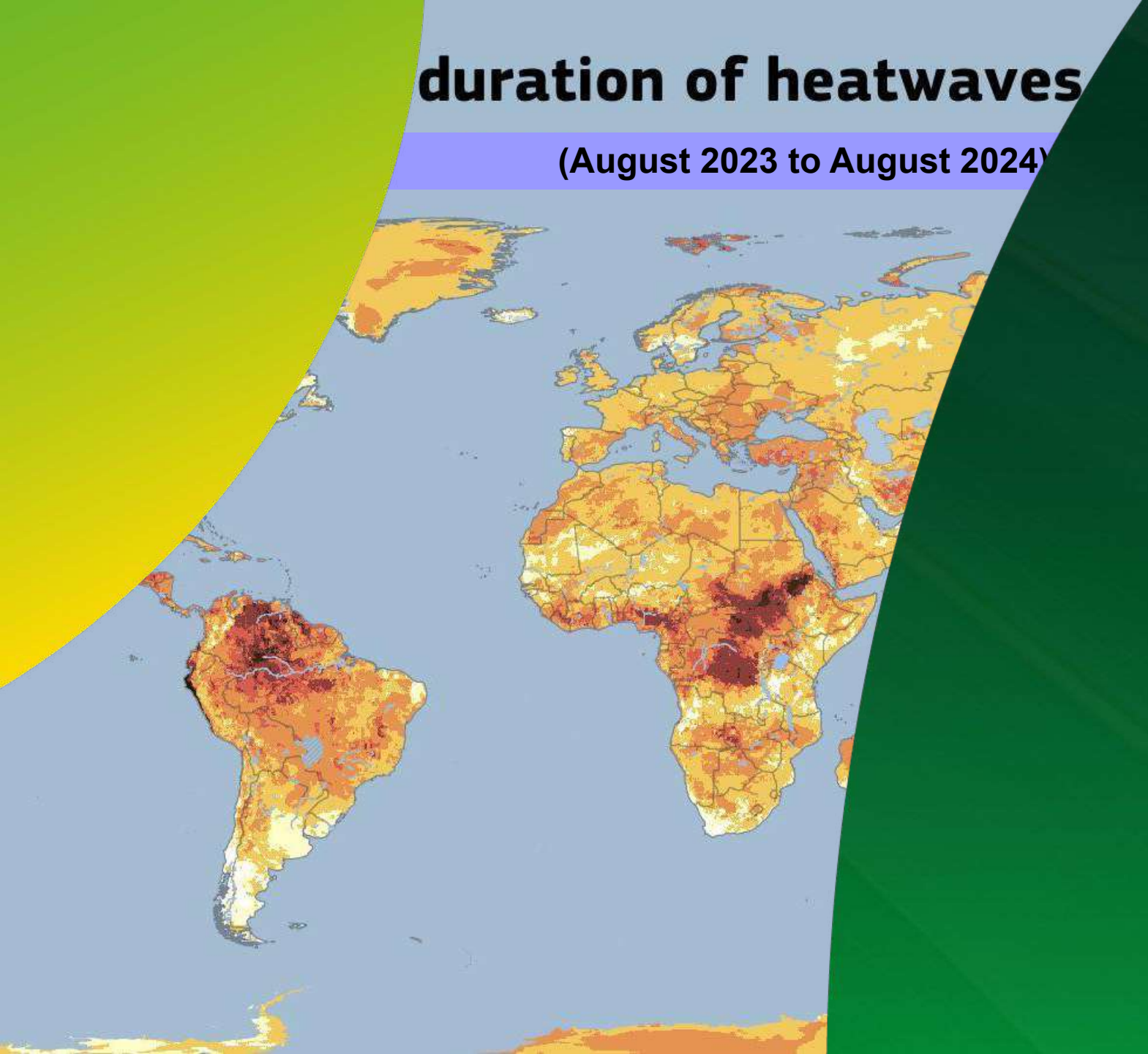
Long term projection of drought index: simulation until 2100



Severe drought = standardized precipitation-evapotranspiration index (SPEI) < -2 in 3 months rolling window



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Heatwaves

and simulations of impact on *E. kamerunicus*

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Heatwaves striking all around the world

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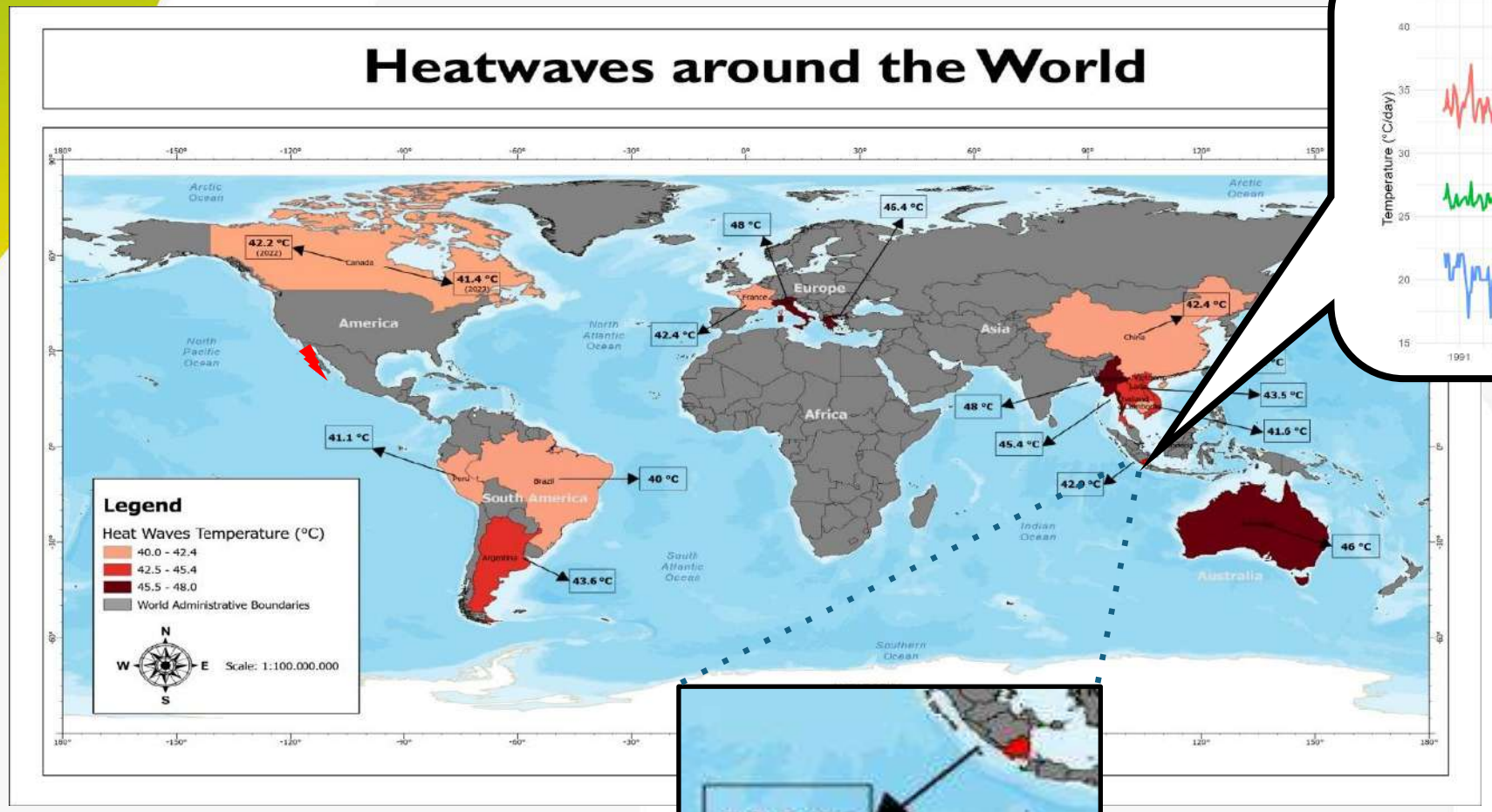
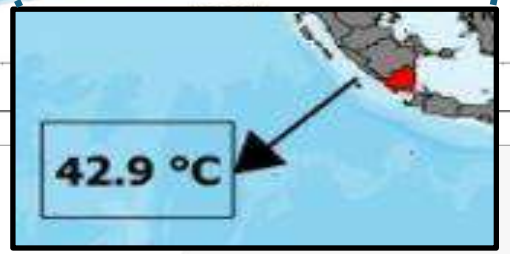
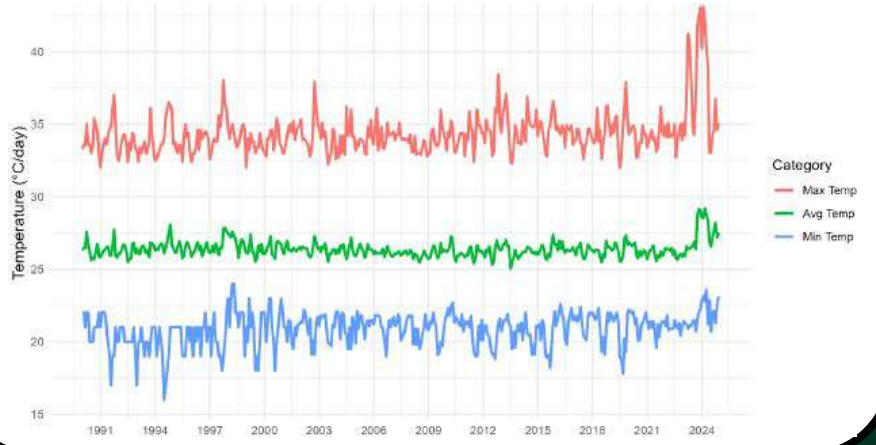




Extreme high temperature in Lampung (South Sumatra)



Sensitivity of *E. kamerunicus* larvae to extreme temperatures

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Test serie 1:

Exposure of *E.k.* larvae in spikelets to extreme high and low temperatures for 14 consecutive days

Procedure:

- Use day-3 of anthesis male flowers (90-100% anthesis)
- 4 spikelets/position (upper, middle and below)
- Exposed to high, medium, and low temperature in PGC
- 30 replicates.

No	Treatment	Grow chambers temperature set	Incubation location
1	Room temp	Ranged from 26^0 C – 30^0 C (control)	Insectary
2	15^0 C	15^0 C (09:00 – 17:00) and 10^0 C (17:00 – 09:00)	PGC
3	30^0 C	30^0 C (09:00 – 17:00) and 20^0 C (17:00 – 09:00)	PGC
4	45^0 C	45^0 C (09:00 – 17:00) and 35^0 C (17:00 – 09:00)	PGC

Growth Chambers (GC)

Glass tube & male spickelets

Day-3 anthesis male flower

Sensitivity of *E. kamerunicus* larvae to extreme temperatures

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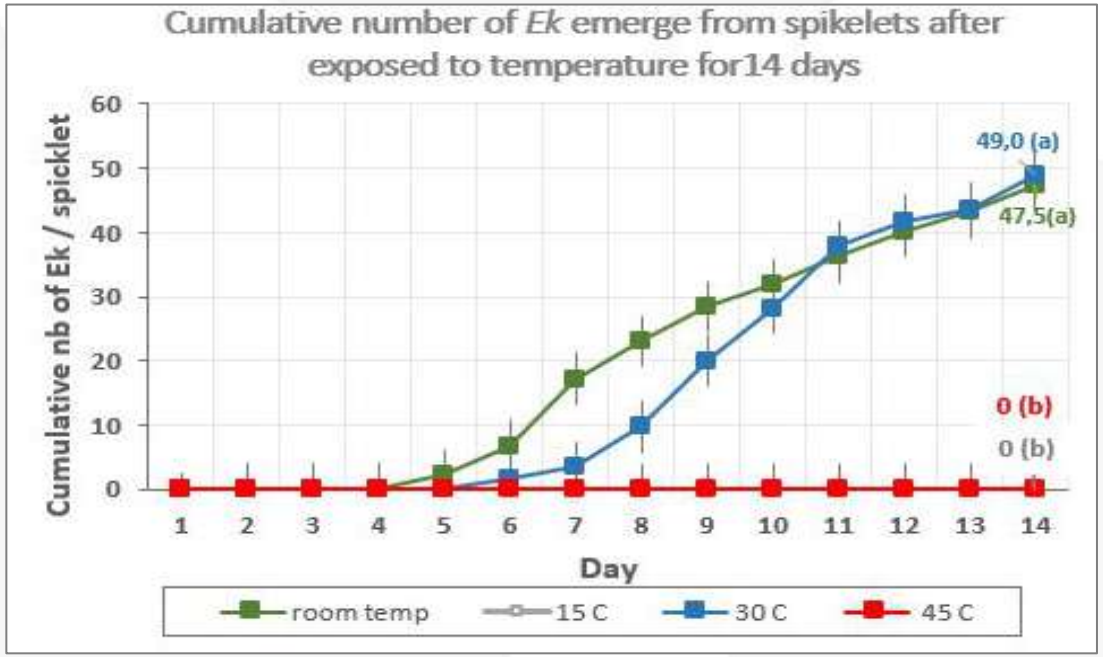
Emergence of adult *E. kamerunicus*

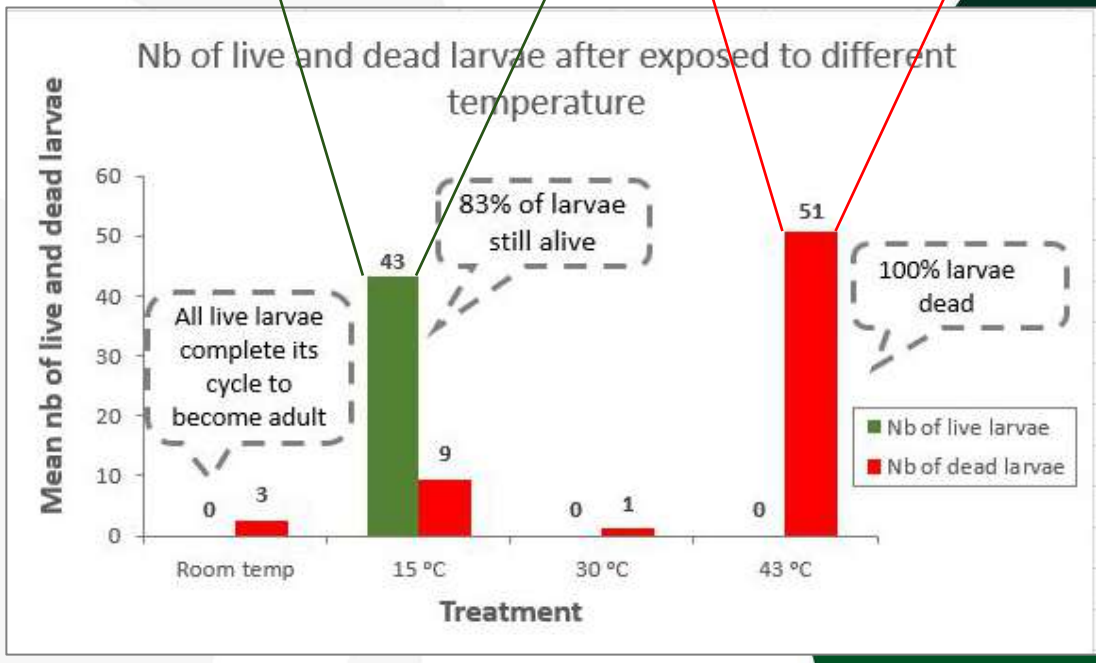
(exposure: 14 days)

- **No emergence on extreme temperature conditions**
- **100% dead larvae on extreme high temperature**
- **Delayed emergence on extreme cold temperature**

E. k.: slow development

E. k.: died





Sensitivity of *E. kamerunicus* larvae to extreme temperatures

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Test serie 2:

Exposure of *E.K.* larvae in spikelets to extreme high and low temperature during variable time length (1 to 11 days)

Procedure:

- Use day-3 of anthesis male flowers (90-100% anthesis)
- 24 spikelets/position (upper, middle and below)
- Exposed to high, medium, and low temperature in GC
- 6 durations (1 to 11 days). 30 replicates

Temperature set	1st incubation in Growth Chambers	2nd incubation in room temperature
. Room temp (Control) . 15⁰C . 30⁰C . 45⁰C	1 day	13 days
	3 days	11 days
	5 days	9 days
	7 days	7 days
	9 days	5 days
	11 days	3 days

Growth Chambers (GC)

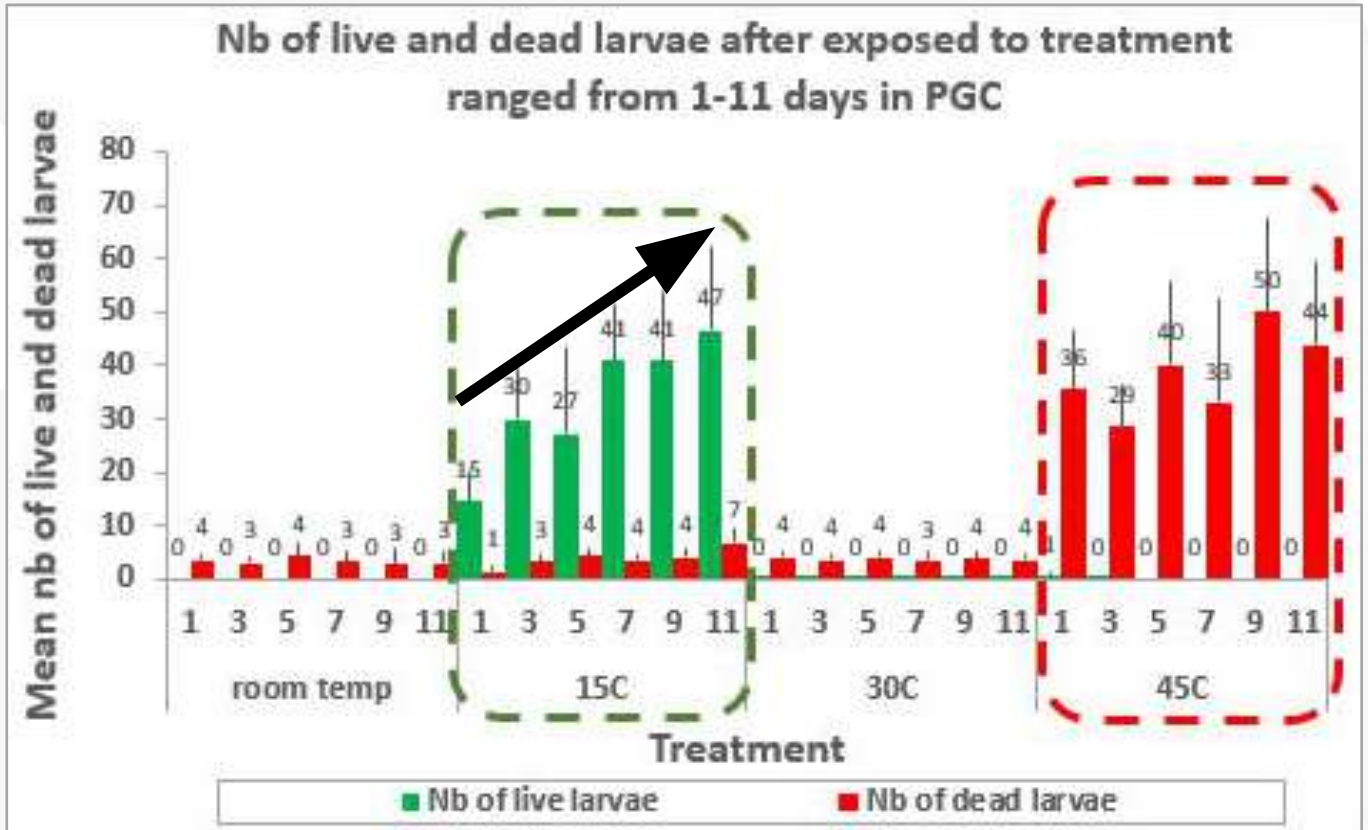
Glass tube & male spickelets

Day-3 anthesis male flower

Sensitivity of *E. kamerunicus* larvae to extreme temperatures

Emergence of adult *E. kamerunicus* (exposure: variable number of days)

- 100% dead larvae on extreme high temperature even after 1 day exposure
- Increasing delayed emergence on extreme cold temperature with number of days exposure



Sensitivity of *E. kamerunicus* larvae to extreme temperatures

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Test serie 3:

Exposure of larvae in spikelets to extreme high and low temperature during very short time (30 mn to 24 hours)

Procedure:

- Use day-3 of anthesis male flowers (90-100% anthesis)
- 36 spikelets/position (upper, middle and below)
- Exposed to high, medium, and low temperature in GC
- 9 durations (30 mn to 24 h). 15 replicates

Temperature set	1st incubation in Grow Chambers	2nd incubation in room temperature
• Room temp (Control) • 15⁰C • 30⁰C • 45⁰C	0,5 hour	13 days and 23.5 hours
	2 hours	13 days and 22 hours
	4 hours	13 days and 20 hours
	6 hours	13 days and 18 hours
	8 hours	13 days and 16 hours
	12 hours	13 days and 12 hours
	16 hours	13 days and 8 hours
	20 hours	13 days and 4 hours
	24 hours	13 days

Growth Chambers (GC)

Glass tube & male spickelets

Day-3 anthesis male flower

Sensitivity of *E. kamerunicus* larvae to extreme temperatures

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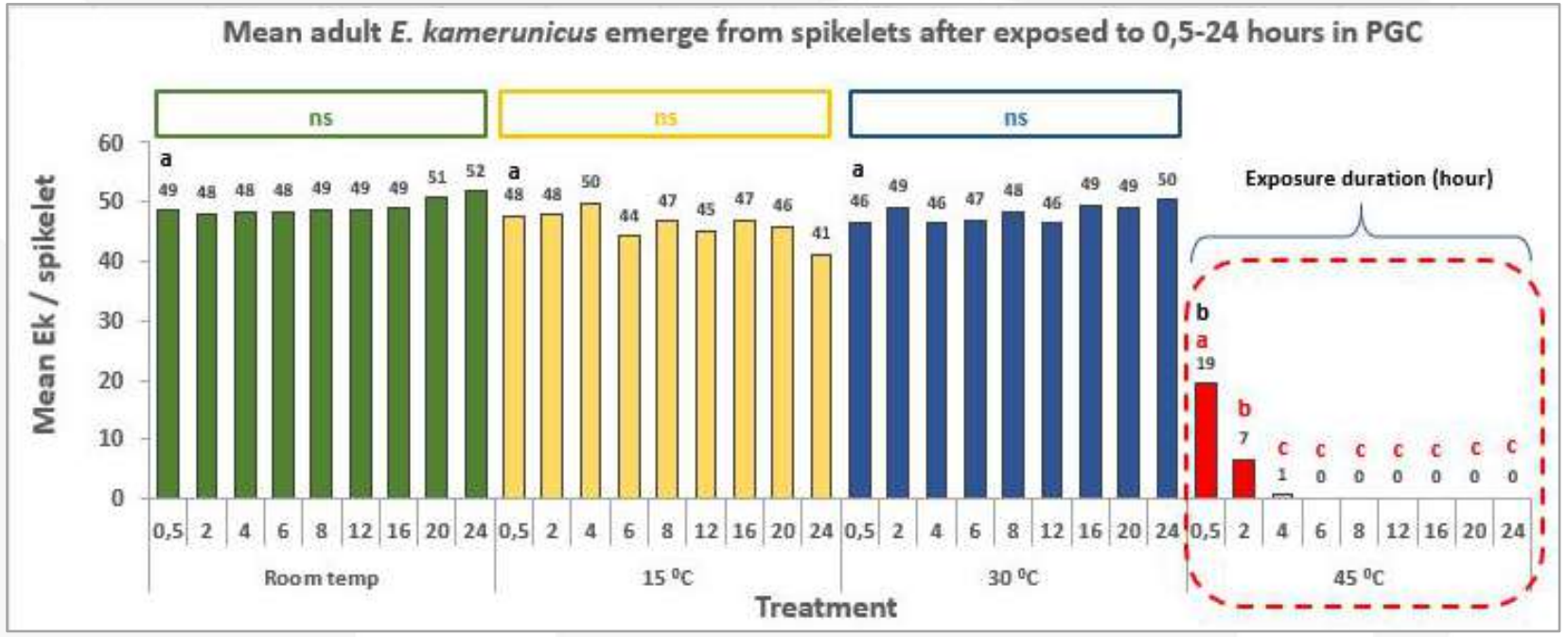
Emergence of adult *E. kamerunicus* (exposure: short time 30 mn to 24 h)

- Very short period (30 mn) of extreme high temperature kills EK. larvae
- Above 2 h are sufficient to fully destroy the entire generation



Sensitivity of *E. kamerunicus* larvae to high temperatures

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Test serie 4:

Exposure of larvae in spikelets to high temperature during very short time
(30 mn to 24 hours)

Procedure:

- Use day-3 of anthesis male flowers (90-100% anthesis)
- 9 spikelets/position (upper, middle and below)
- Exposed to high, medium, and low temperature in GC
- 9 durations (30 mn to 24 h). 2 or 3 replicates

- **8 temperatures:**
  32ºC; 34ºC; 36ºC; 38ºC; 40ºC; 41ºC; 42ºC; 43ºC

Growth Chambers (GC)

Glass tube
& male spickelets

Day-3 anthesis
male flower

Sensitivity of *E. kamerunicus* larvae to high temperatures

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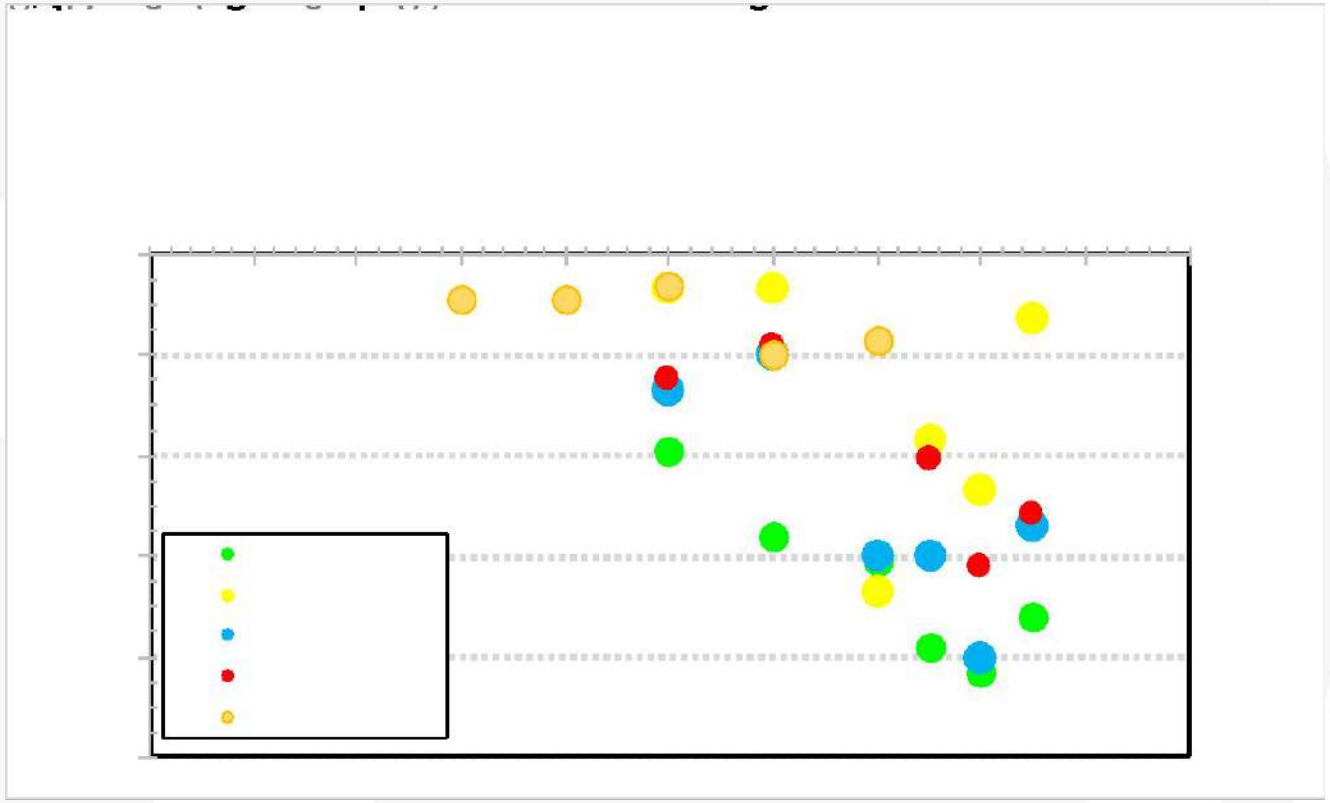
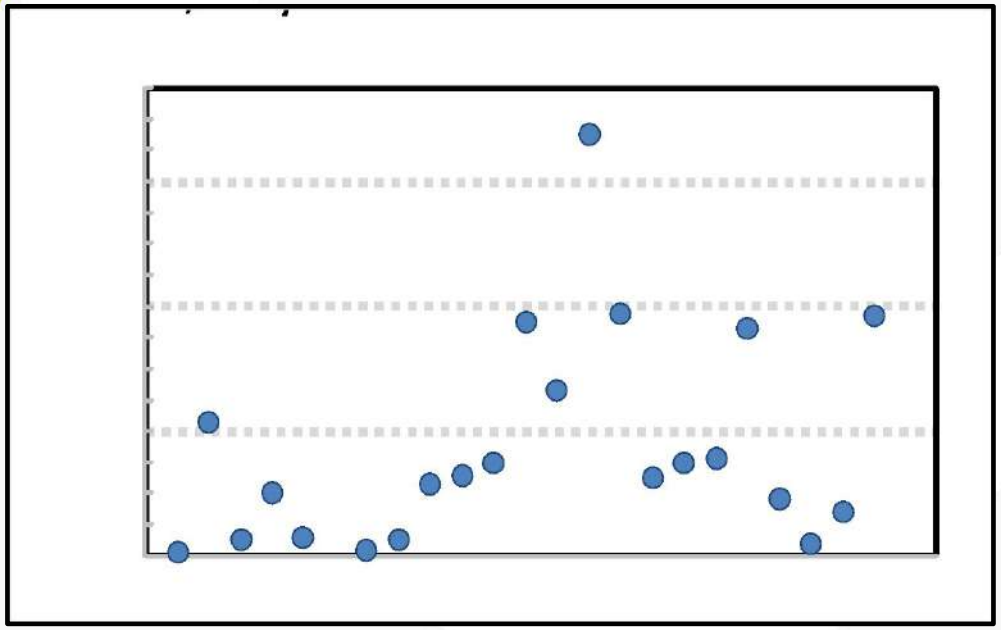
Emergence of adult *E. kamerunicus* (exposure: short time 30 mn to 24 h)

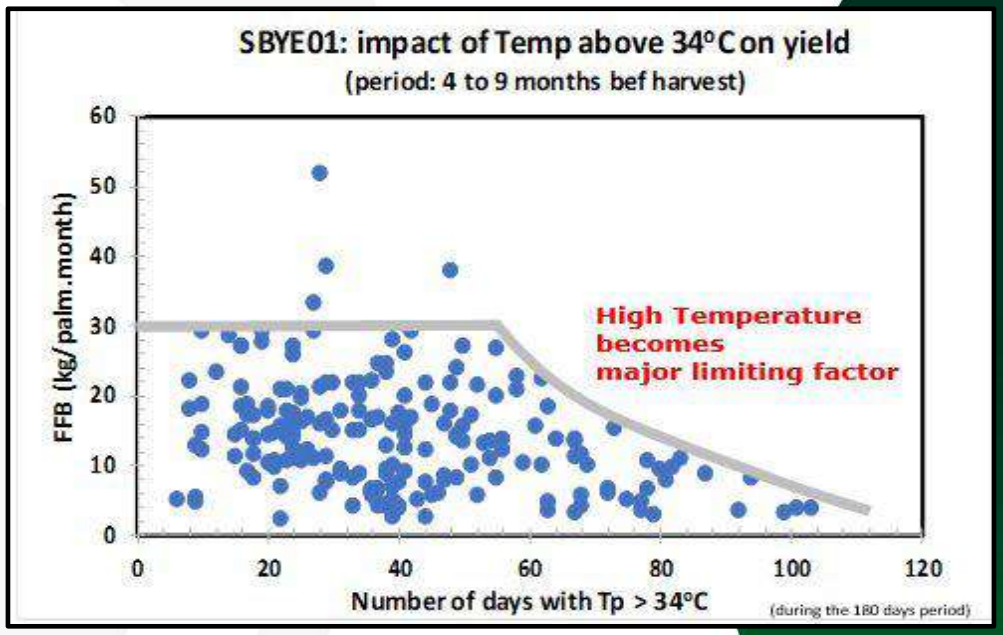
- Temperature above 34 ºC reduces the emergence of E.K. larvae
- Short length of time with high temperature is sufficient for negative impact



Increasing the frequency of high temperatures and impact on oil palm yield

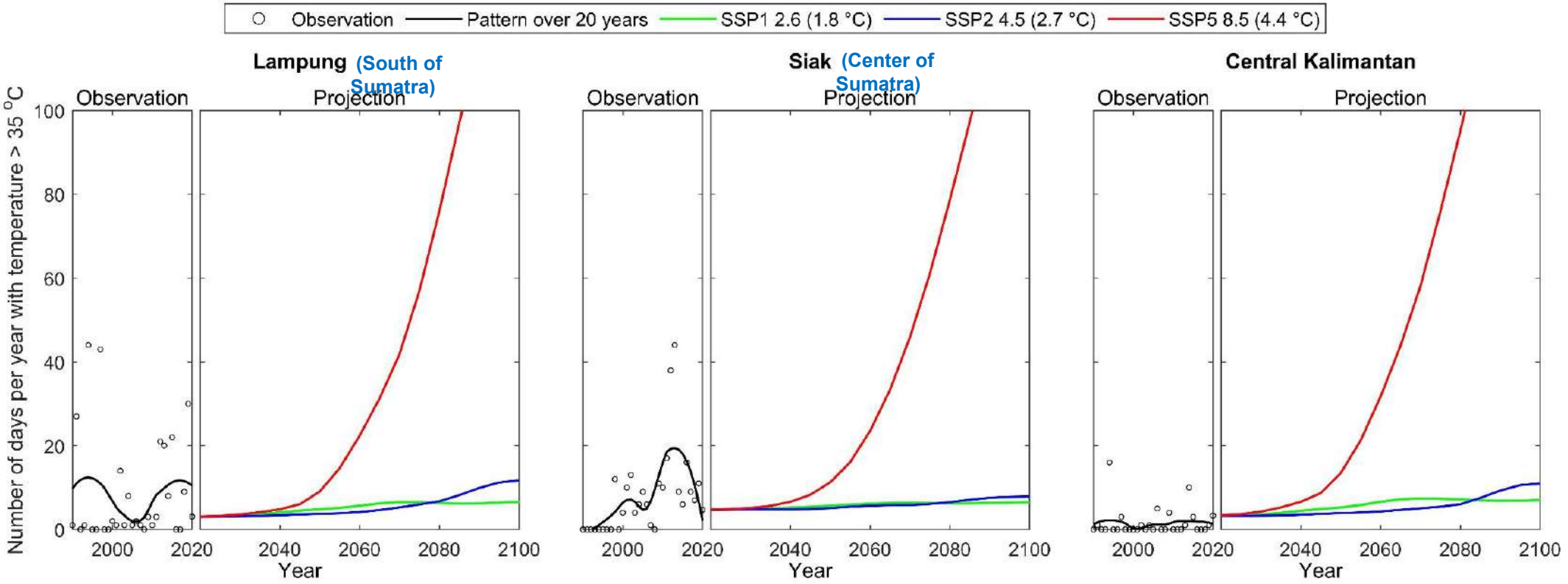


Increasing high temperature in the South of Sumatra is a reality



Increasing high temperature frequency on oil palm yield performance

Projection of high temperature (> 35ºC) frequency until 2100



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Take home points

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Conclusion

- High temperatures, above 34ºC, and heat waves affect negatively the emergence of *E. Kamerunicus*
- Short exposure (30 mn) is enough for a negative impact, while all larvae die after 2 h
- Need to study the sensitivity of other pollinators to these abiotic factors
- Projections indicate potential higher frequency of high temperatures in the future

Our main pollinator is in danger

MUCHAS GRACIAS

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