



Insecticide Susceptibility of *An. gambiae* s.l to Chlorfenapyr and Piperonyl Butoxide (PBO) Effect in Areas of High Pyrethroid Resistance from Côte d'Ivoire: Implications for Malaria Vector Control

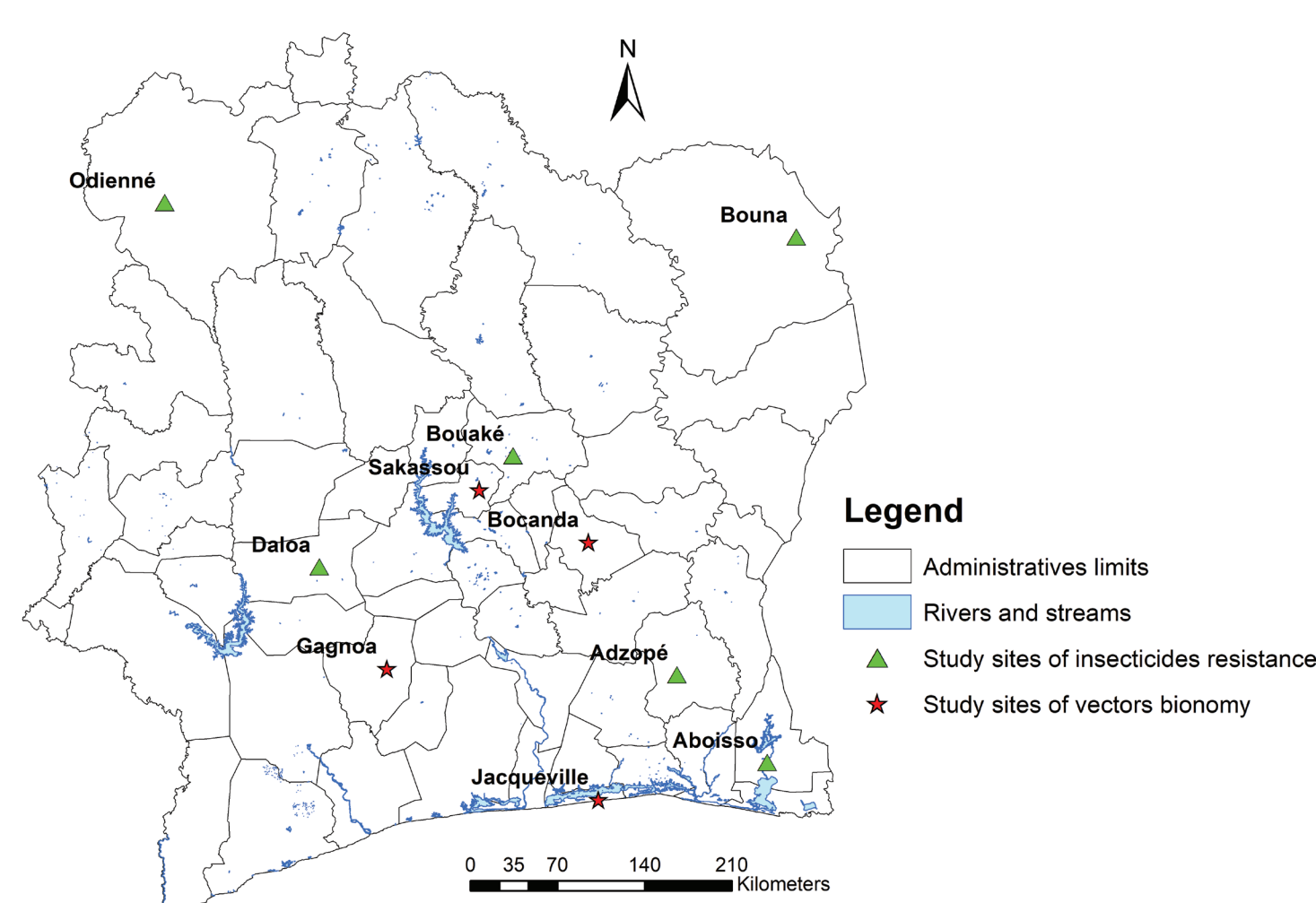
Bernard L. Kouassi¹; Ndombour G. Cissé¹; Cecilia Flatley²; Dereje Dengela²; Constant Edi³; Antoine M. Tanoh⁴; Pascal Zinzindohoue⁵; Blaise Kouadio⁵; Andre McKenzie⁵; Seth Irish⁶; Jennifer Armistead⁷; Joseph Chabi¹

¹Abt Associates, PMI VectorLink Project, Côte d'Ivoire; ²Abt Associates, PMI VectorLink Project, USA; ³Swiss Center of Scientific Research in Côte d'Ivoire, Côte d'Ivoire; ⁴National Malaria Control Programme, Côte d'Ivoire; ⁵U.S. President's Malaria Initiative, USAID, Côte d'Ivoire; ⁶U.S. President's Malaria Initiative, Malaria Branch, U.S. Centers for Disease Control and Prevention, USA; ⁷U.S. President's Malaria Initiative, USAID, USA

Background

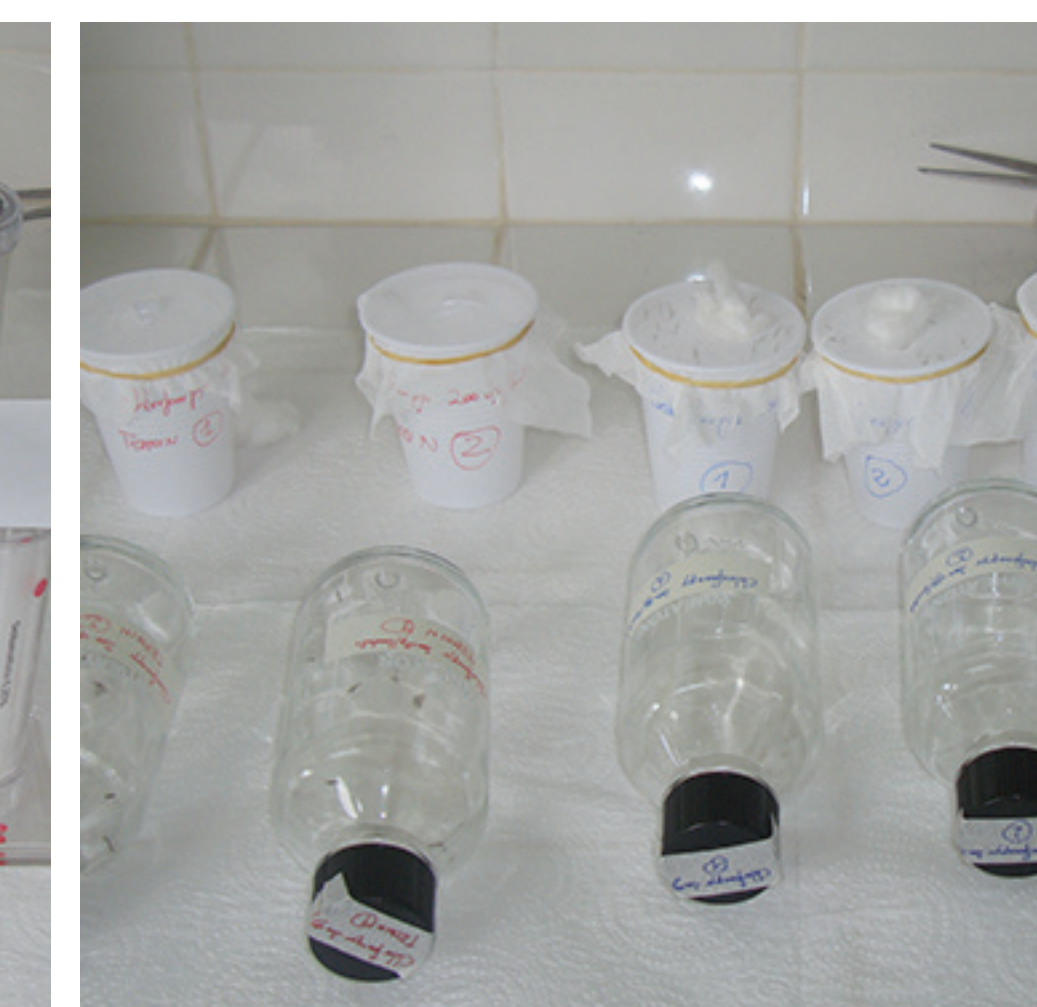
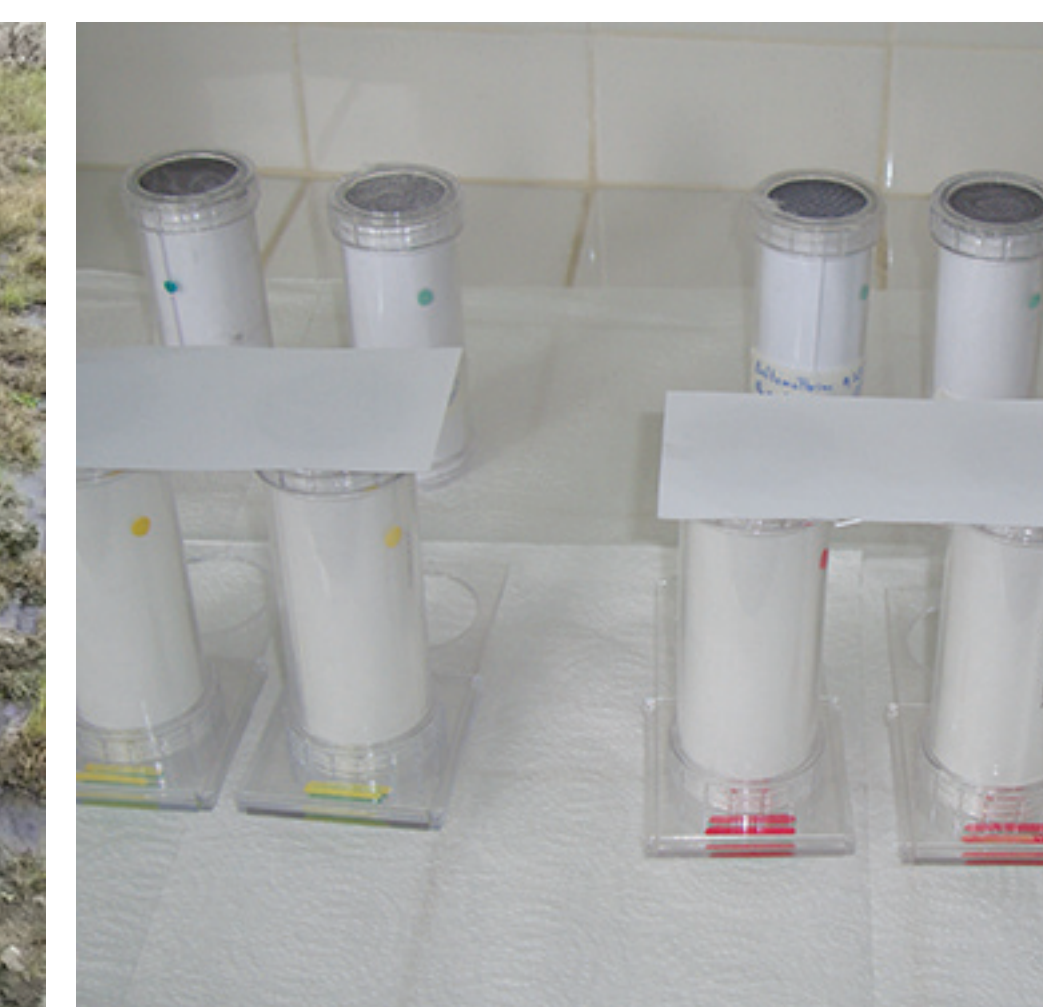
Pyrethroid-treated mosquito nets are currently the main stay of vector control in Côte d'Ivoire. However, resistance to pyrethroids has been reported across the country, limiting options for insecticide resistance management. Interceptor[®]G2, a long-lasting net with a combination of chlorfenapyr and alpha-cypermethrin, believed to help in the control of pyrethroid-resistant mosquitoes, recently received World Health Organization prequalification listed (WHO PQ). We investigated the susceptibility of *An. gambiae* s.l to chlorfenapyr and furthermore the resistance status to pyrethroid insecticides with and without pre-exposure to piperonyl butoxide (PBO) in ten sites across the country.

Study Site



Materials and Methods

- Susceptibility tests were conducted on 2-4 day old adult females *An. gambiae* s.l. emerged from larval collections.
- The resistance status, intensity and synergist (PBO) assays of deltamethrin, permethrin and alpha-cypermethrin were tested using WHO susceptibility test kits.
- Two chlorfenapyr doses (100 and 200 g/bottle) were used to test the susceptibility of the mosquitoes using CDC bottle assay methods.



Results and Discussion

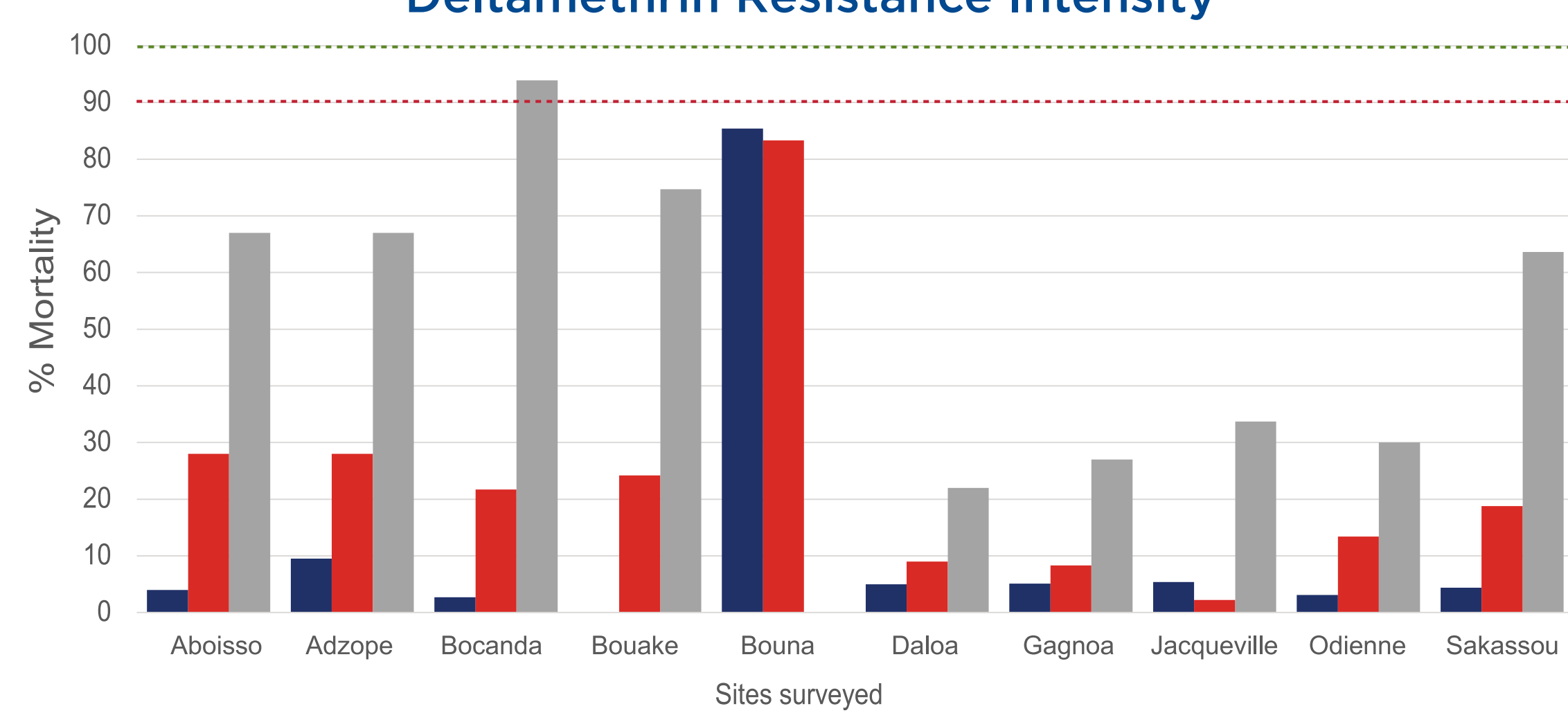
- An. gambiae* s.l. from 9 sites were highly resistant to the three pyrethroids tested (mortality between 0 and 20%).
- Pre-exposure to PBO did not yield full susceptibility but induced significant increment of mortality in all sites for deltamethrin than alpha-cypermethrin and permethrin.

- The results indicated that *An. gambiae* s.l. was susceptible to chlorfenapyr in five of the ten sites (98–100% mortality) at the dose of 100 µg/bottle; and in seven sites (99–100% mortality) at the dose of 200 µg/bottle, respectively.

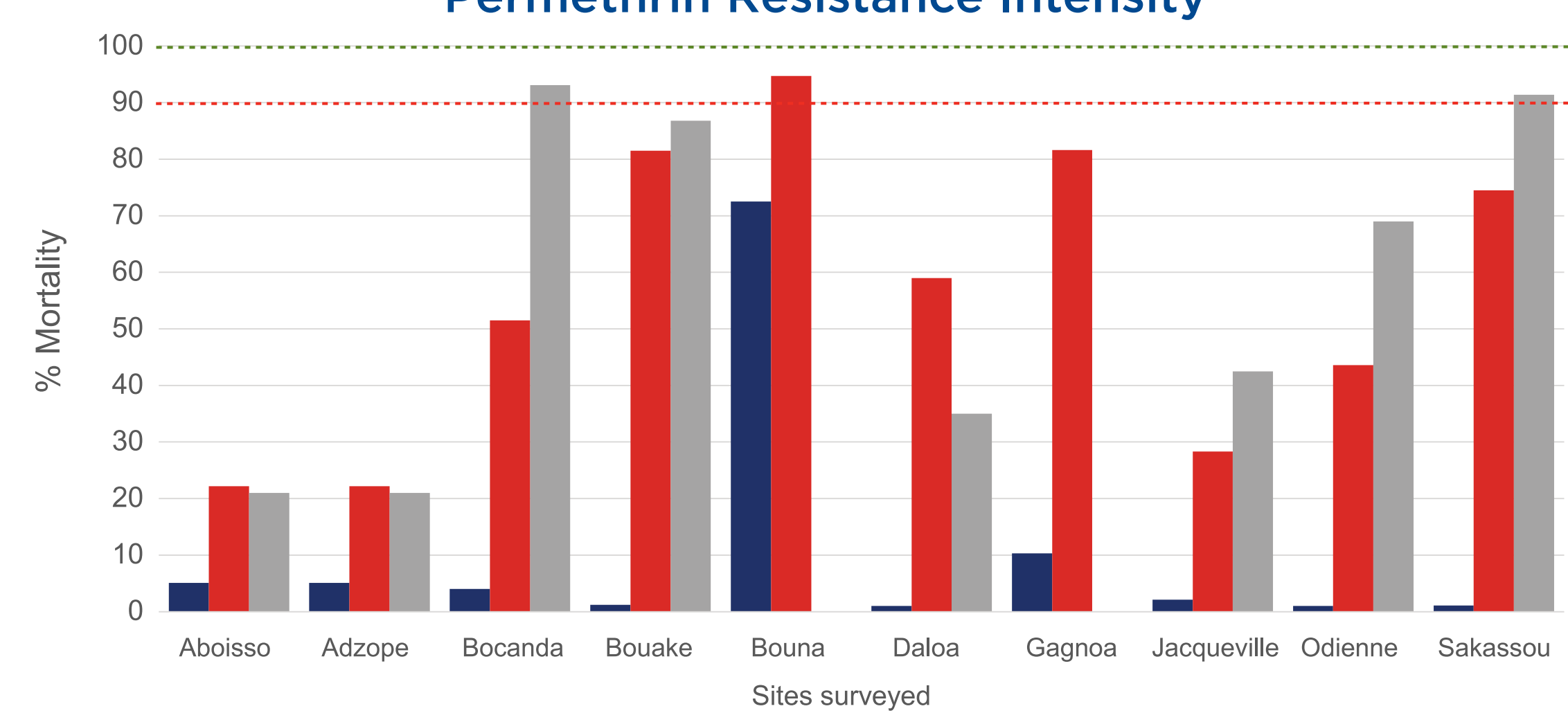
Conclusions

- Enzymes such as P450s are involved in the insecticide resistance of the vectors in some sites and could also support the NMCP in terms of selection of areas that could be considered for PBO nets distribution.
- An. gambiae* s.l. from most sites are susceptible to chlorfenapyr indicating that the Interceptor[®]G2 should be considered as an alternative to pyrethroid only nets and could be recommended in a stratified distribution for malaria vector control and resistance management in Cote d'Ivoire.

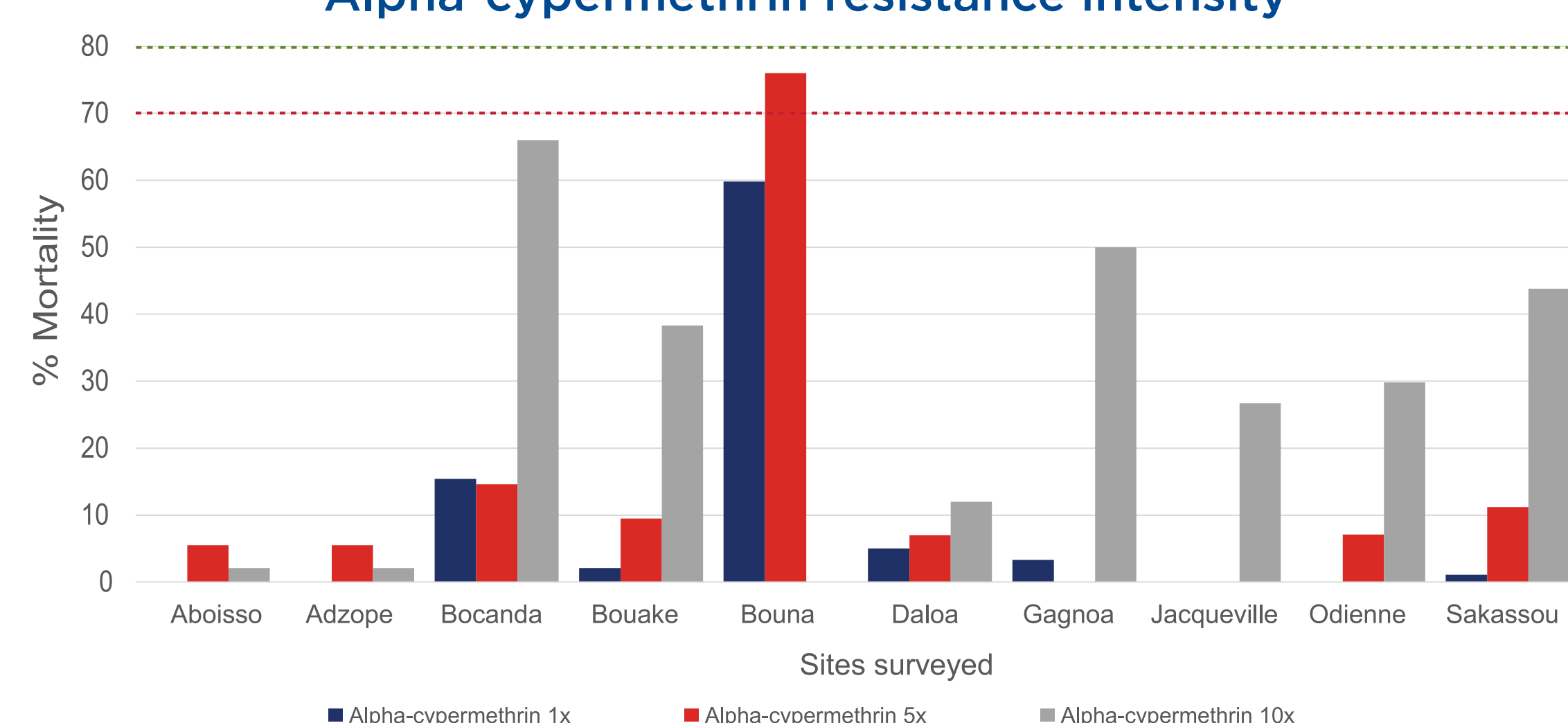
Deltamethrin Resistance Intensity



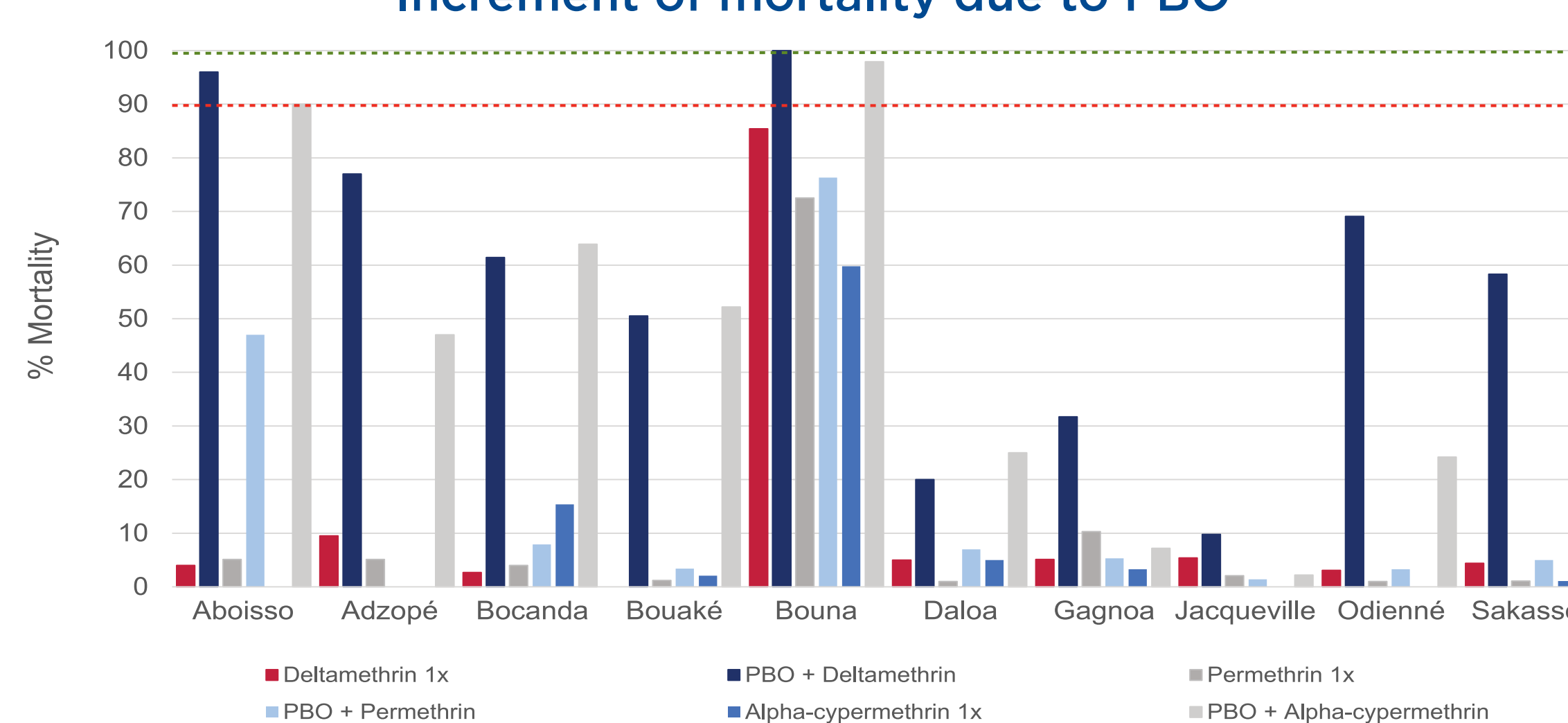
Permethrin Resistance Intensity



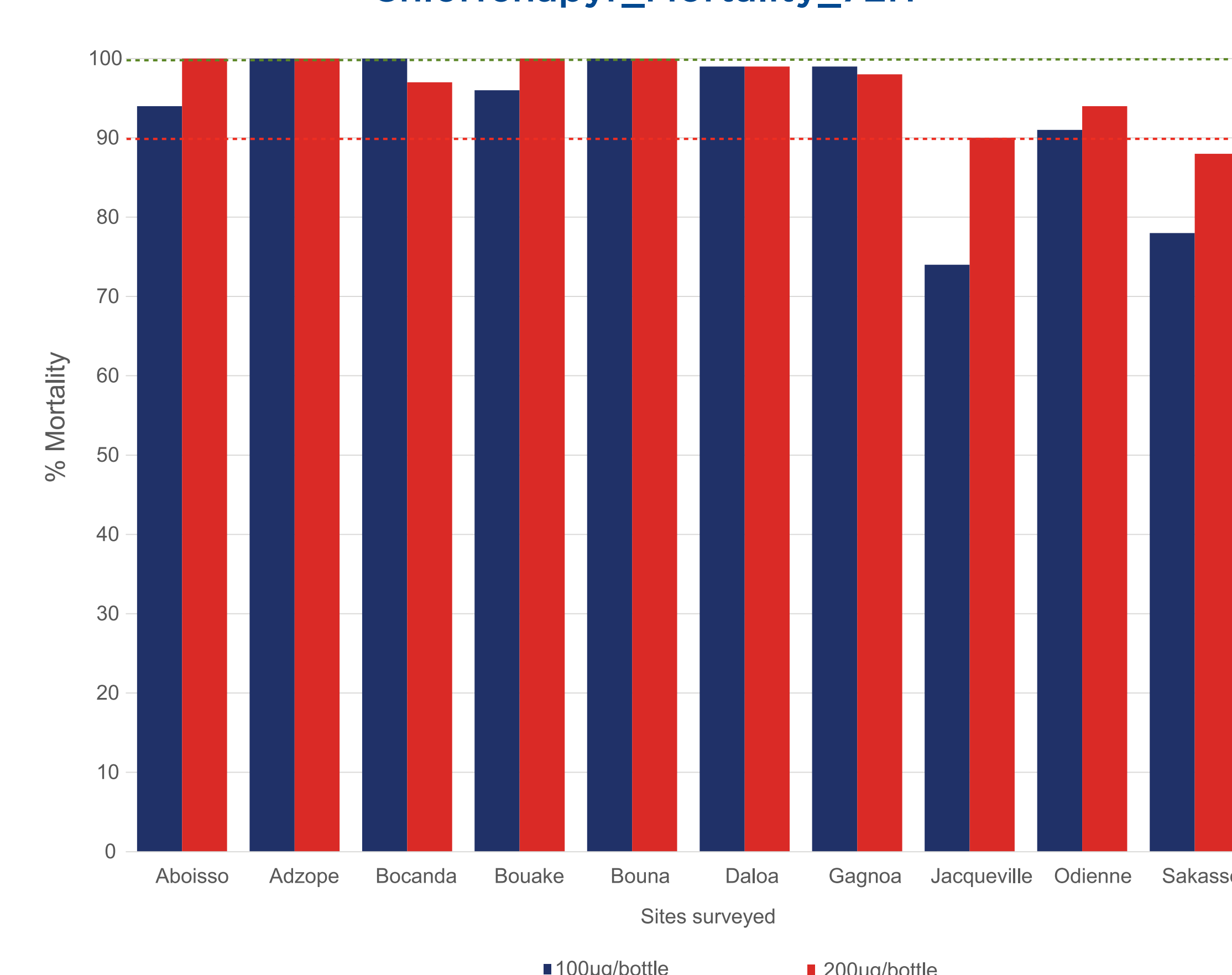
Alpha-cypermethrin resistance intensity



Increment of mortality due to PBO



Chlorfenapyr_Mortality_72H



Key References

Brogdon W, Chan A, 2010. Guidelines for Evaluating Insecticide Resistance in Vectors using the CDC Bottle Bioassay/Methods in anopheles research. Second edition. CDC Atlanta USA: CDC technical report. P 343.
N'Guessan et al., 2016. A Chlorfenapyr Mixture Net Interceptor[®] G2 Shows High Efficacy and Wash Durability against Resistant Mosquitoes in West Africa. PLOS ONE 11(11): e0165925.
WHO 2016: Test procedures for insecticide resistance monitoring in malaria vector mosquitoes – 2nd ed ISBN 978 92 4 151157 5

Acknowledgments

We wish to thank all technicians who participated in the field collection of larvae and provided support during the testing. This work was funded by the U.S. President's Malaria Initiative.

