

Identification of putative vectors in an arboviral endemic area in Costa Rica

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Introduction

Costa Rica is an endemic country for several arboviruses. Ostional is a coastal district located in northwest Costa Rica (Figure 1) where wet and dry seasons are clearly marked and with a landscape mainly constituted of tropical dry forest and cattle ranches. Recently, human and equine outbreaks of several arboviruses have occurred in Ostional and its surroundings. Dengue, Zika and Chikungunya have been reported in the last two years. Zoonotic arboviruses as West Nile Virus (WNV), Venezuelan Equine Encephalitis Virus (VEEV) and Madariaga (MADV) have been also detected in the area. Besides *Aedes aegypti*, most culicids have been poorly studied in Costa Rica. We did a year long study to describe the mosquito populations in an endemic area of Costa Rica.

Methods

We sampled 8 different properties in Ostional. Each state was divided in 4 different areas (Figure 2). The capture of adult mosquitos was performed from 18:00 to 06:00 h. Encephalitis vector Surveillance Traps (EVS) (Bioquip®), CDC Gravid Traps (GT) (Jonh W. Hock®) and Gravid Aedes Trap (BG-GAT) (Biogents®) were used (Figure 3). The EVS were baited with 1 kg of dry ice and the BG-GAT and GT with hay infusion following manufacturer instructions. Traps were placed at the described sampling points, with the solo exception of), CDC Gravid Traps (GT, that was not present at D point.



Figure 1. Ostional County. Ostional County is a coastal area located in northwestern Costa Rica.

The larvae were collect by in ovi-traps (OV), described elsewhere(1). The OV was placed at the P, A and F pints at 1 m height. They were filed with 250 mL of hay infusion. Larvae was also collected from natural larval habitats.



Figure 2. Sampling areas per properties. A: Domiciliary, B: Animal Pen, C: Forest, D: Peridomiciliary.



Figure 3. Vector traps. A: CDC Gravid Traps (GT) (Jonh W. Hock®). B: Encephalitis vector Surveillance Traps (EVS) (Bioquip®). C: Gravid Aedes Trap (BG-GAT) (Biogents®). D: Ovi-trap

Results

We were able to identify several species considered as vectors of WNV and VEEV among other viruses. We collected approximately 25 different species of mosquitoes. The EVS capture success was significantly lower during the dry season than in the wet season, whereas the CDC Gravid Trap success was greater during the dry season. Overall, the most common species captured with the EVS and CDC Gravid Traps during the wet season were *Culex quinquefasciatus* (36.3%), *Deinocerites pseudes* (22.9%), and *Anopheles albimanus* (12.2%); while during the dry season *De. pseudes* (60.0%) was the most common species found (Figure 4). Larvae of *Aedes aegypti* and *Aedes albopictus* were captured in the ovi-traps during both seasons. Other species such as *Trichoprosopon digitatum* and *Haemagogus* sp. were captured only during the dry season.

Adult mosquitoes captured per season

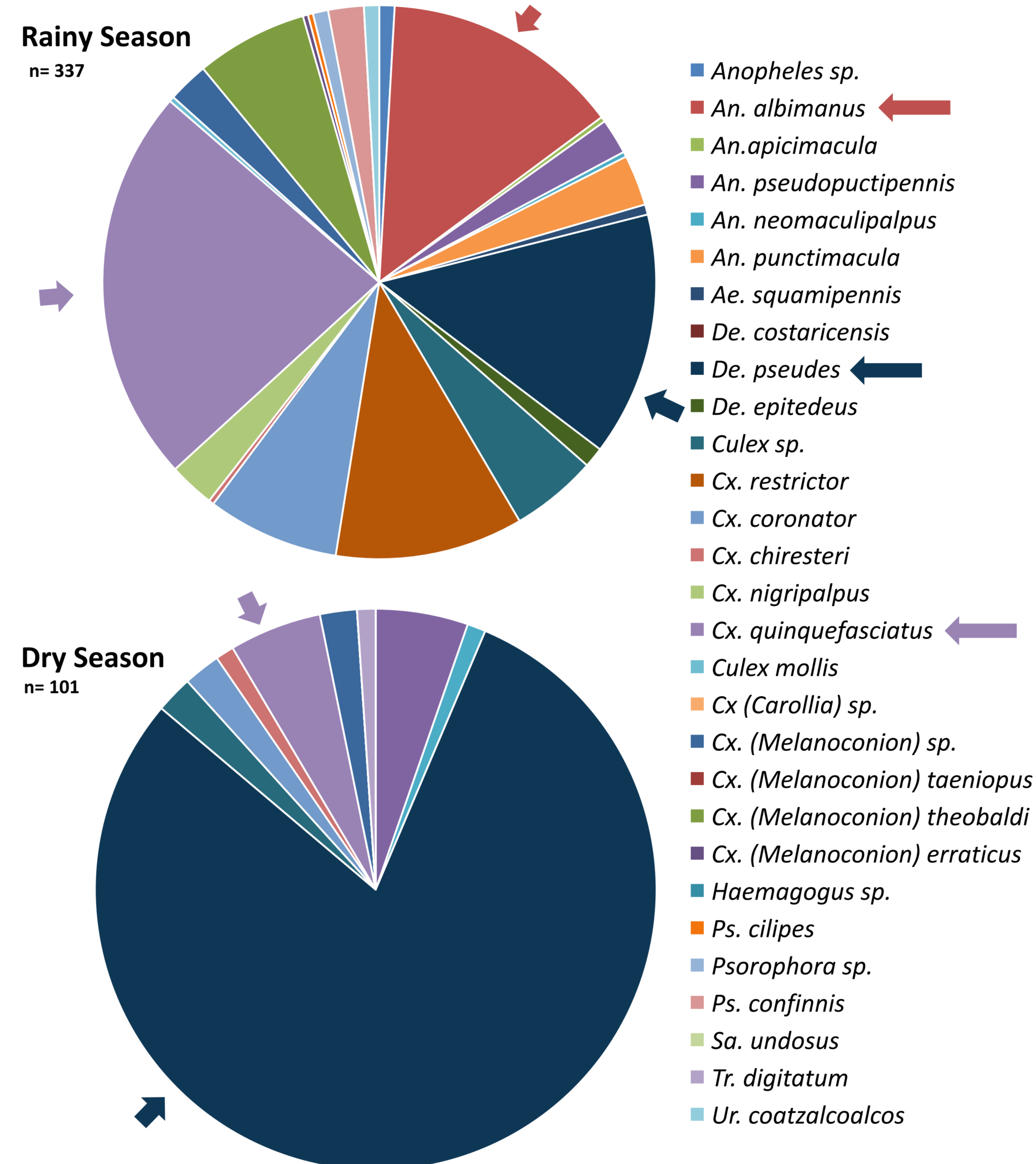


Figure 4. Mosquito species diversity per season. The pie charts represent the percentage of each species of the total number of mosquitoes per season

Main species capture per sampling area

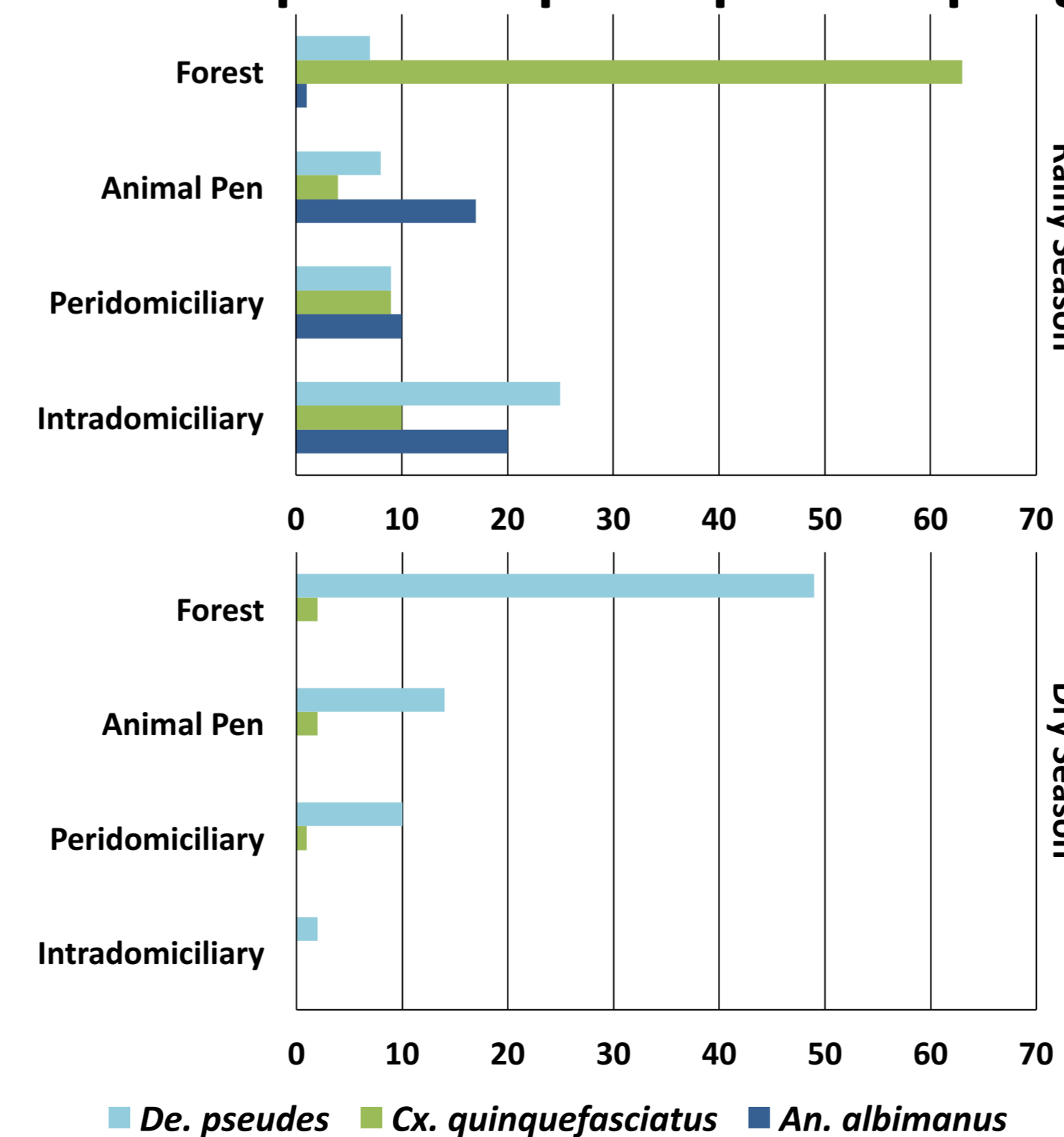


Figure 5. Mosquito species per sampling area. The total number of mosquitoes was significantly different between seasons. T-Test= 0,02.



Figure 6. Graphical evidence of the differences between wet and dry seasons. The floods of the Ostional River are common during the wet season. It completely disappears during dry season.

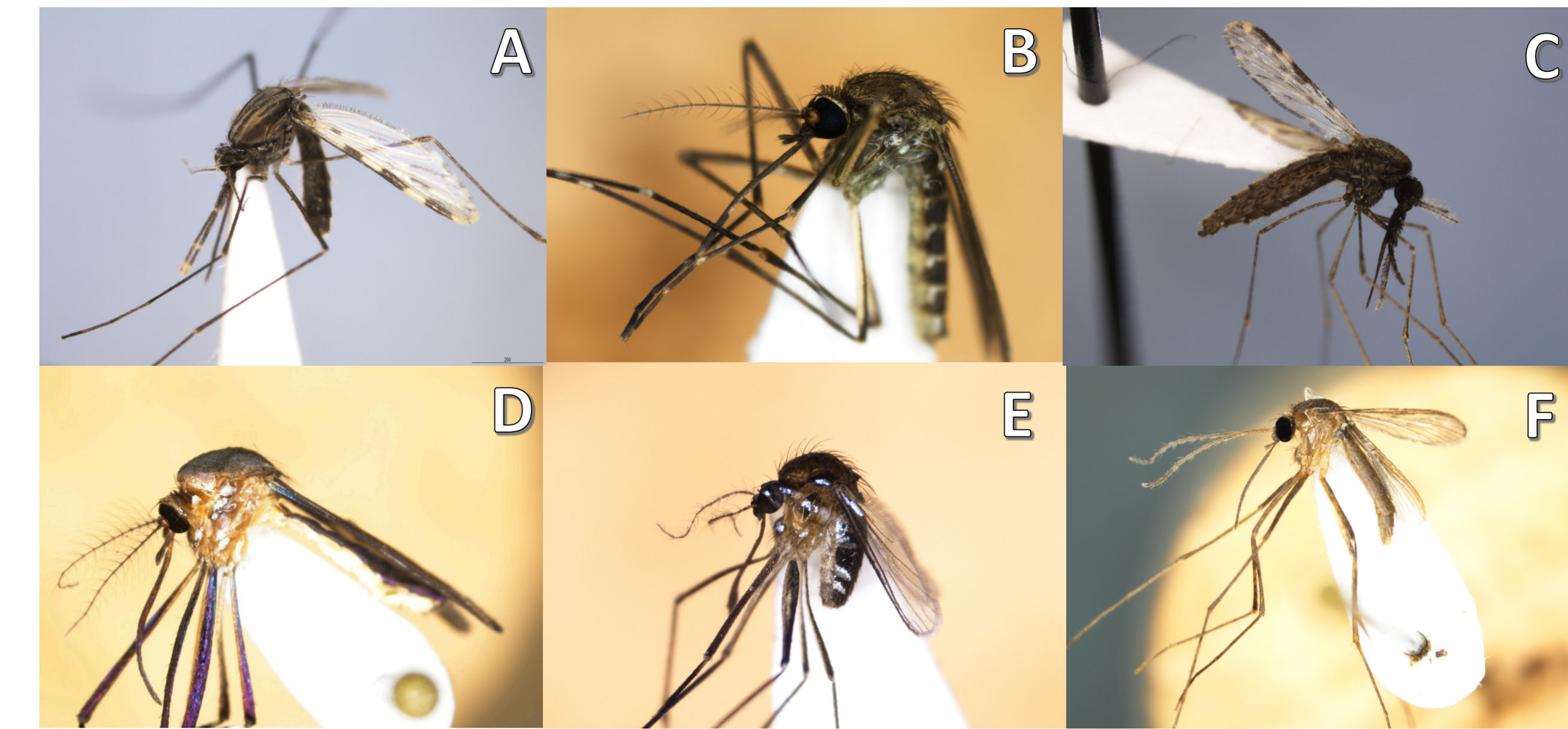


Figure 7. Notable mosquito species captured in Ostional. A: *Anopheles pseudopunctipennis*. B: *Culex coronator*. C: *Anopheles albimanus*. D: *Trichoprosopon digitatum*. E: *Uranotaenia quetzalcoalcos*. F: *Deinocerites pseudes*.

Discussion

The presence of known arboviral vectors such as and *De. pseudes* may indicate the maintenance of enzootic transmission cycles year-round though with sporadic arboviral spillovers, despite an important drop in the number of mosquitoes and species captured during the dry season,. *De. pseudes* oviposits in crab holes in mangroove forests. This breeding pattern might me responsible for its year long presence since it does not relays on the rainfalls for oviposit. The presence of *Tr. digitatum* also states the possibility of other arboviruses such as Mucambo Virus (2). Although *An. albimanus* and *An. pseudopunctipennis* larvae not an important vector of arboviruses, it is important to recall its roll as a *Plasmodium* spp. vector(3). Our larvae habitat sampling gave evidence of the effect of human activities on the mosquito populations in Ostional (Figure 8). Animal sprues, rice fields ,and open dumps were common habitats for species like *Cx. quinquefasciatus*, *An. albimanus* and *Limatus durhamii*. Naturally occurring ponds during the dry season also serve as important breeding habitats. Since the captures of adult mosquitoes are consistent with these larvae findings; we expected a drop in these vector populations if the larvae habitats are controlled. Further sampling and testing of mosquitoes for different arboviruses presence are required to correctly address arbovirus transmission dynamics in this endemic area.



Figure 8. Main larvae habitats sampled in Ostional. A: Naturally occurring ponds, B: Animal sprues, C: Open dumps, D: Rice fields.

References

1. Chaverri et al. *Journal of Medical Entomology*. 55: 646
2. Auguste et al. *Am. J. Trop. Med. Hyg.* 83:1262.
3. Liebman et al. *Malaria Journal* 14:74

Acknowledgments

