

# **Mosquito monitoring 2023**

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## **Summary.**

1. Monitoring was carried out along the same lines as in the last few years: adult trapping, marsh pool dipping, bite reporting and biting nuisance forecasting, all weekly.
2. The number of adult mosquitoes caught in the traps reached record levels from August till mid-October, explainable by the weather in late June and July, the high spring tide on 1<sup>st</sup> September and the very warm September. Total numbers were 17 times higher than in last three years, and peak counts at the site monitored since 2011 were 14 times higher than previous record. There was a corresponding very high mosquito biting nuisance, both anecdotally and from though bite report data for 2023 (more than twice previous record).
3. Research continued, partly in collaboration with university academics.

## **Methods**

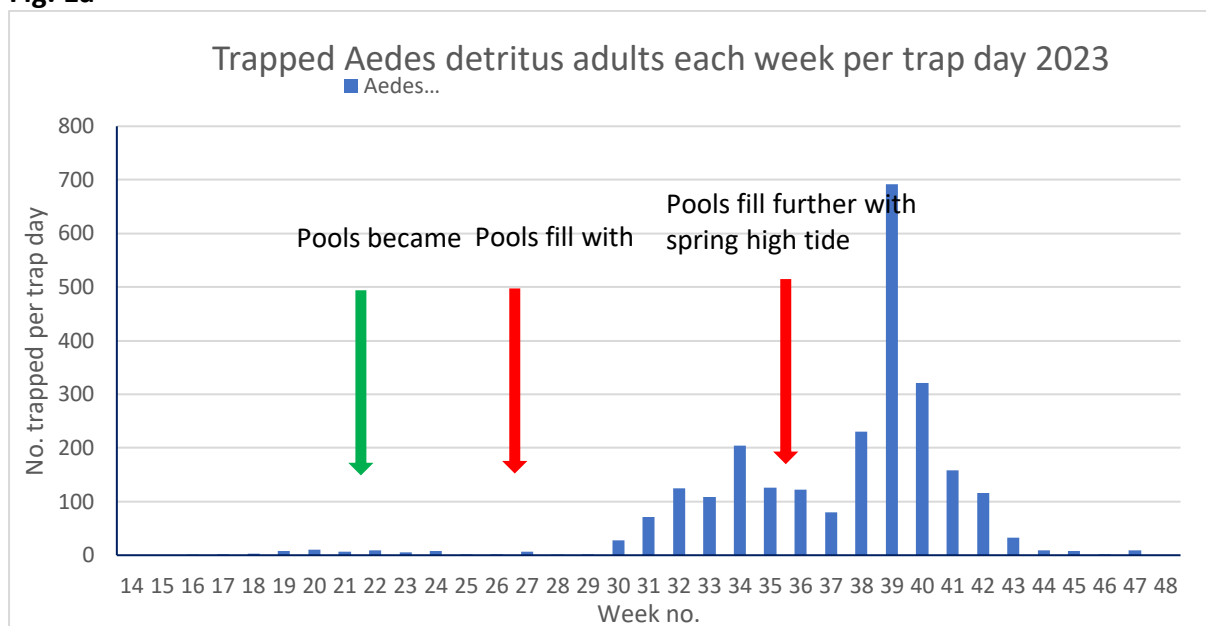
1. Traps (which capture adult female mosquitoes attracted to carbon dioxide and octenol, and so those species of mosquitoes that may bite humans, as well as other mammals and sometimes birds)
  - a. Weekly from 6th April (week 14), and will continue till end of November
  - b. 2 days a week
  - c. Four traps, two very near marsh, two 1 – 2km from marsh, Little Neston and Parkgate/Neston
2. Weekly surveillance of study pools at Quayside, similar to last 13 years
3. Wider surveillance of other marsh pools, mainly near Quayside, roughly weekly and year round
4. Wider surveillance of some known freshwater mosquito breeding sites over radius of about 3 miles. For a few weeks, trapping at RSPB reserve at Burton Mere.

**Trap Results** Fig 1a with Fig 1b showing 2022 for comparison, same vertical scale

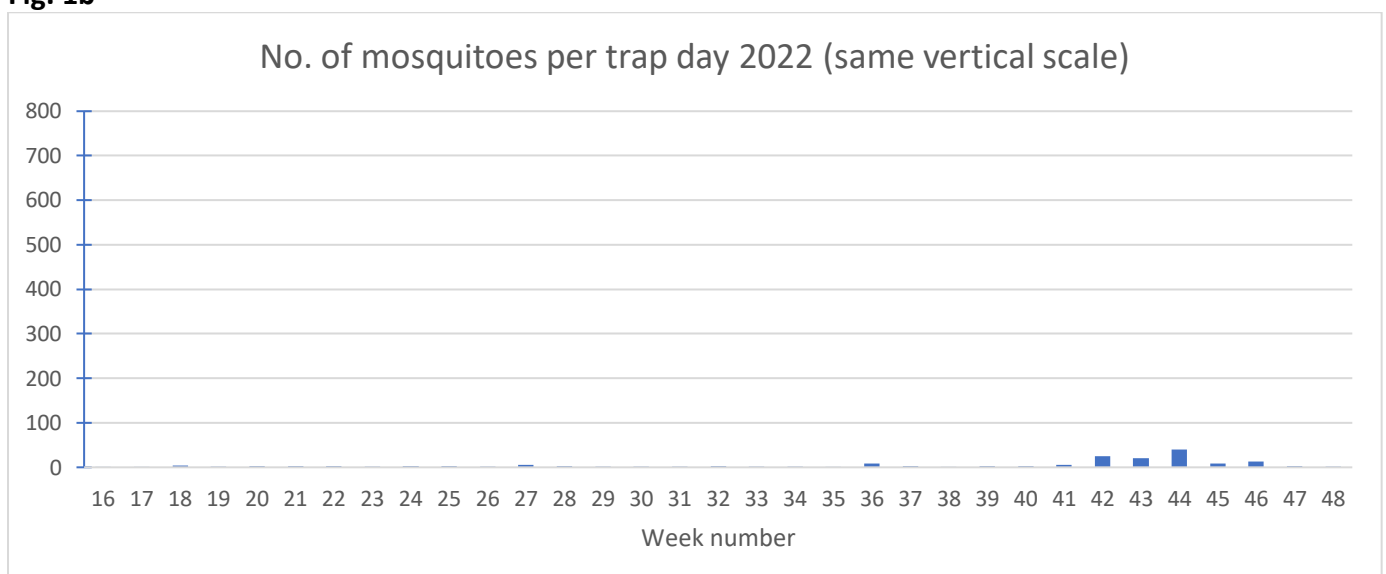
1. As usual, *Aedes detritus* remains the by far the most numerous and widespread trapped species, also occurring in more weeks than any other species.
2. There was a large surge starting in late July/early August (weeks 30/31) which was caused by a mass synchronised hatching of eggs in the breeding pools on the marsh which were previously dry but filled between 5/7/23 and 13/7/23 (weeks 27/28), in turn due to the very wet June and early July. Record numbers of adults were trapped in August. The high spring tide replenished the breeding pools with sea water on September 1<sup>st</sup>, leading to another mass hatching of eggs. The exceptionally warm September permitted rapid development of larvae in the pools and probably prolonged survival of adults that emerged. This resulted in astoundingly high numbers of adults in late September. The numbers far exceeded even the record numbers trapped in August. This surge faded by late October but numbers were still raised in November.
3. Though the numbers were very small in comparison, there was also an unprecedented peak in another species in this time, *Culiseta annulata*, which may breed either on the marshes or in freshwater sources (Fig. 5). There were surprisingly few *Aedes caspius*, another common marsh species.

4. The high trap numbers were very largely observed in the traps in Little Neston (top of Bendee Road and Quayside) (Fig 2). Lesser peaks were seen at these times in Parkgate traps (top of Earle Drive and near the Parade), again higher than in previous years. The reasons for this distribution are a matter for conjecture.
5. We can compare numbers to previous years reliably in two ways:
  - a. We have data from one trap site since 2013, and the results emphasise how exceptional this year has been (Fig. 3a).
  - b. The annual totals of trapped mosquitoes (all species) and *Aedes detritus* (only breeds on the marsh) are shown in Fig 3b for all four present traps for the last 4 years.
6. The range of species trapped locally was similar to previous years (Fig. 4), though with very different proportions of the lesser species, especially fewer *Anopheles plumbeus*.

**Fig. 1a**

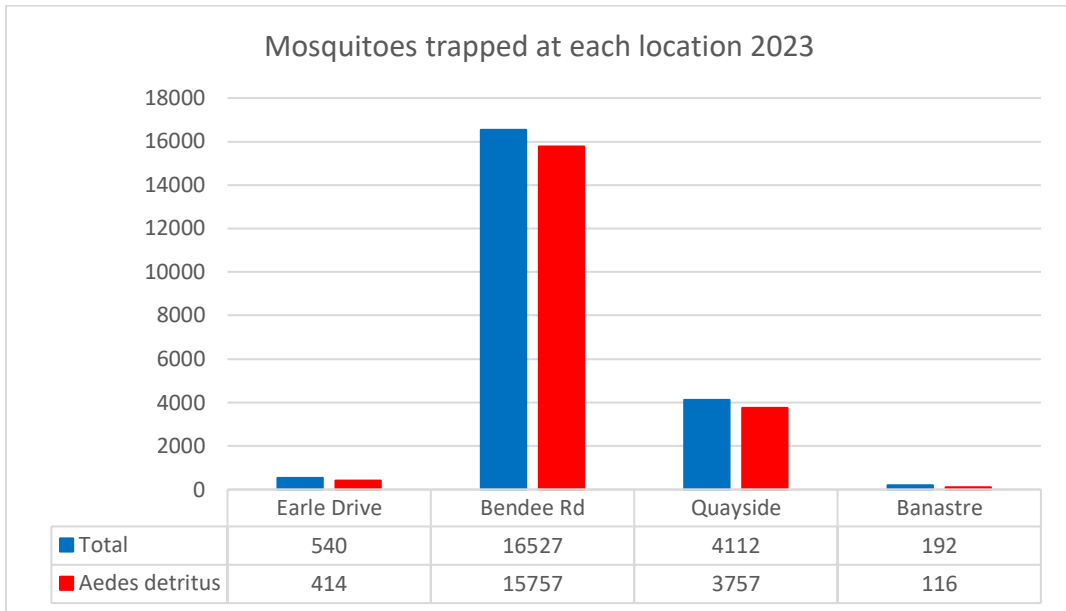


**Fig. 1b**

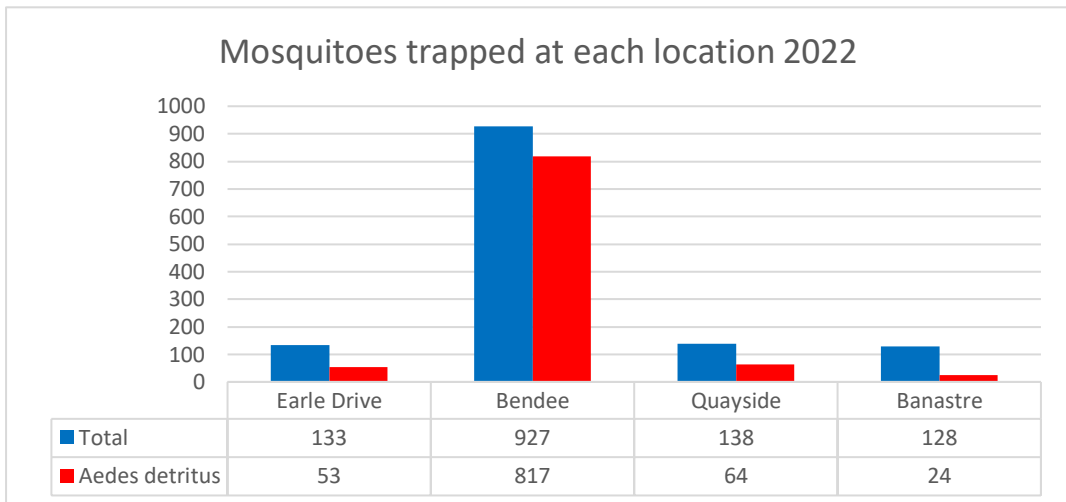


**Fig. 2 Mosquitoes trapped at different trap sites, 2023 (Fig 2a), 2022 (fig 2b) and 2021 (fig 2c). (Note vertical scales are very different!)**

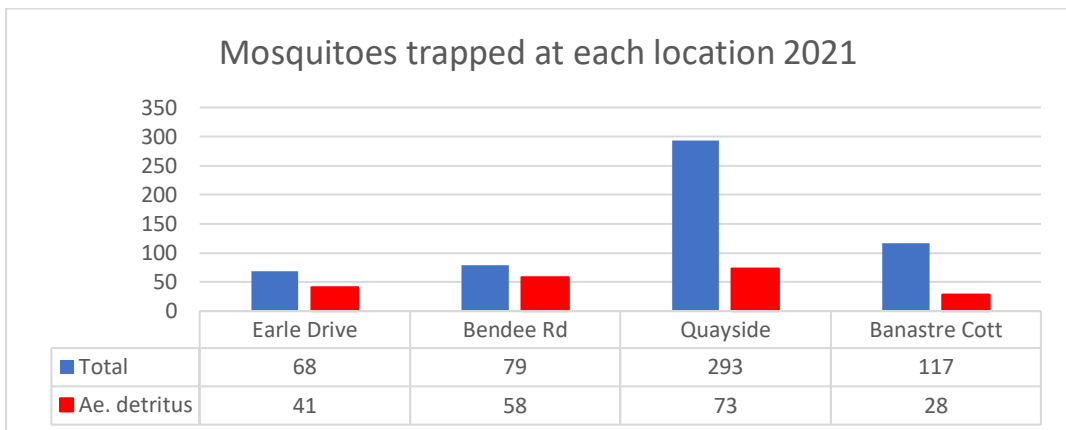
**A 2023**



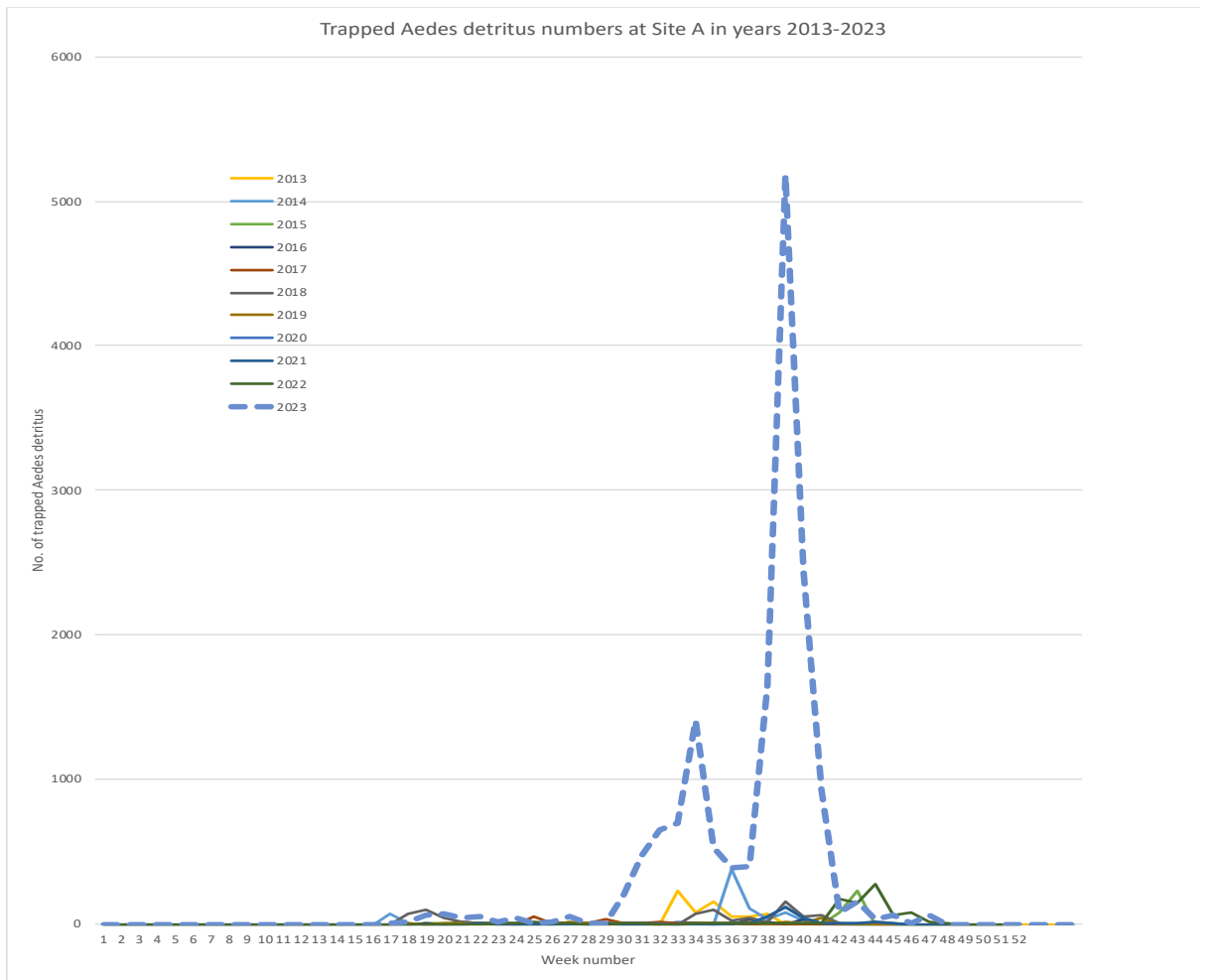
**B 2022**



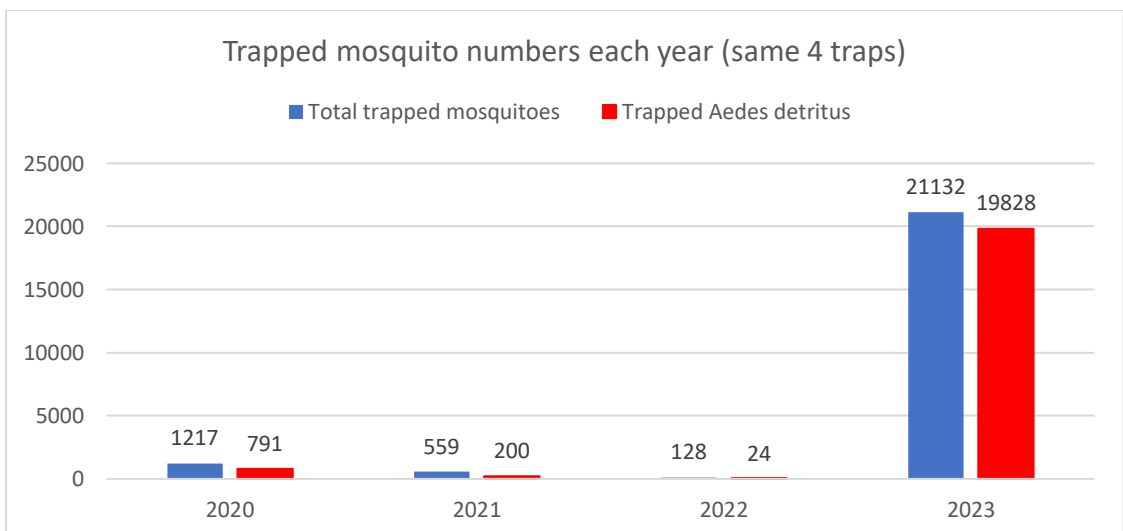
**C**

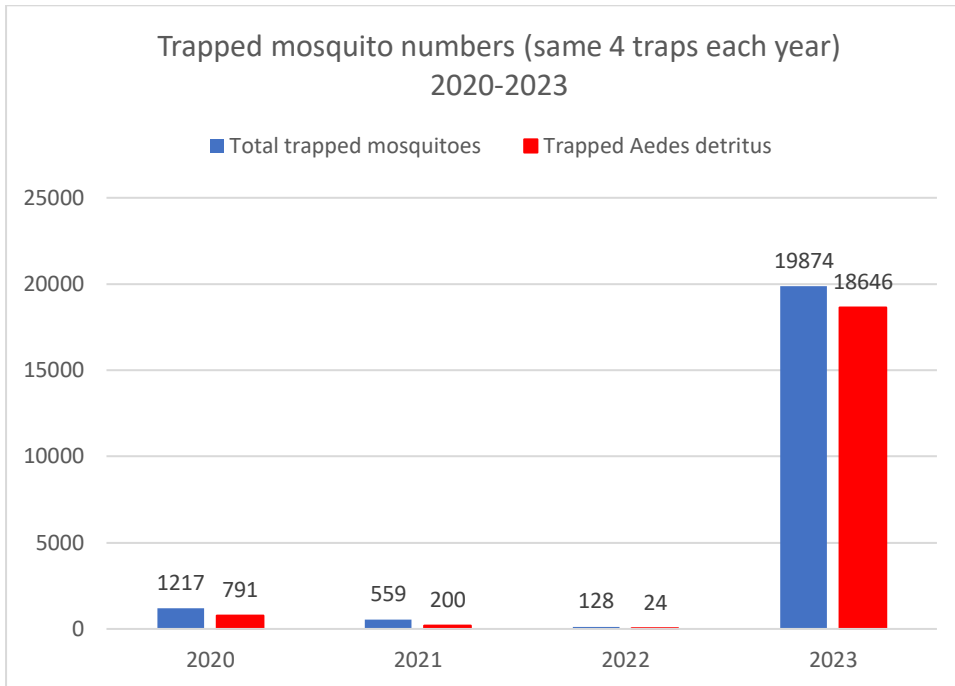


**Fig. 3a**

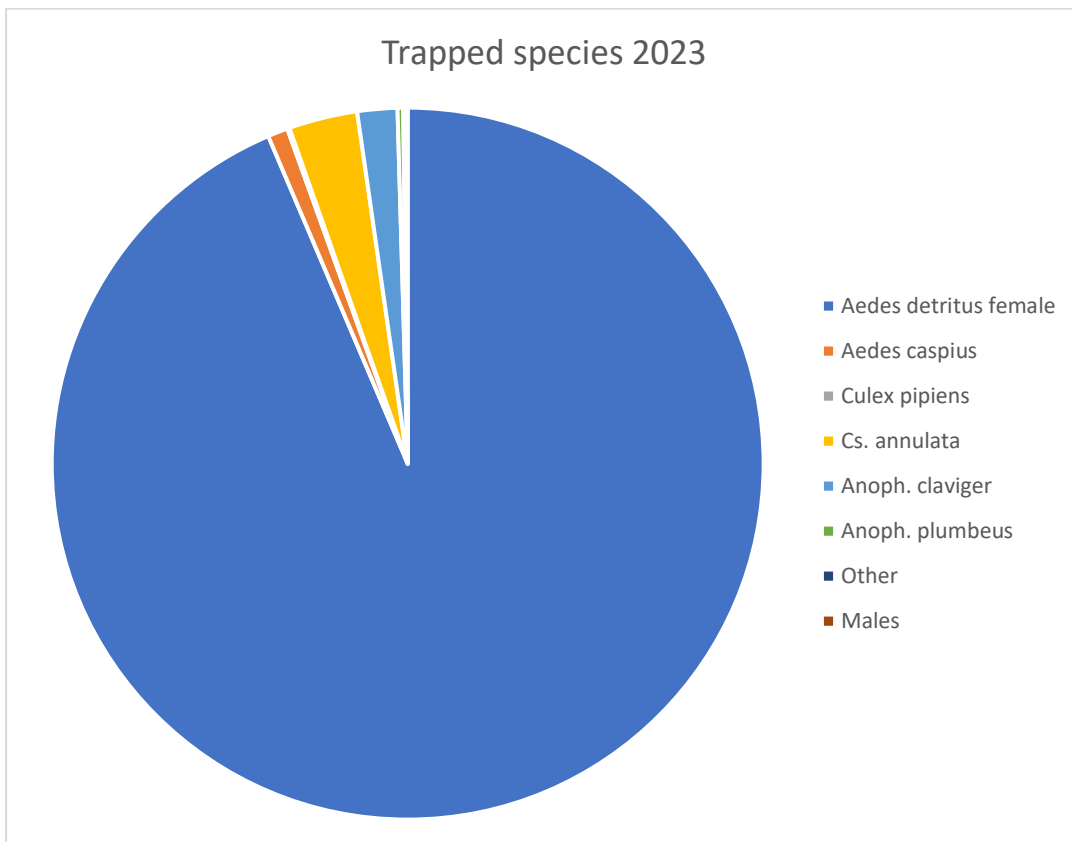


**Fig 3b**

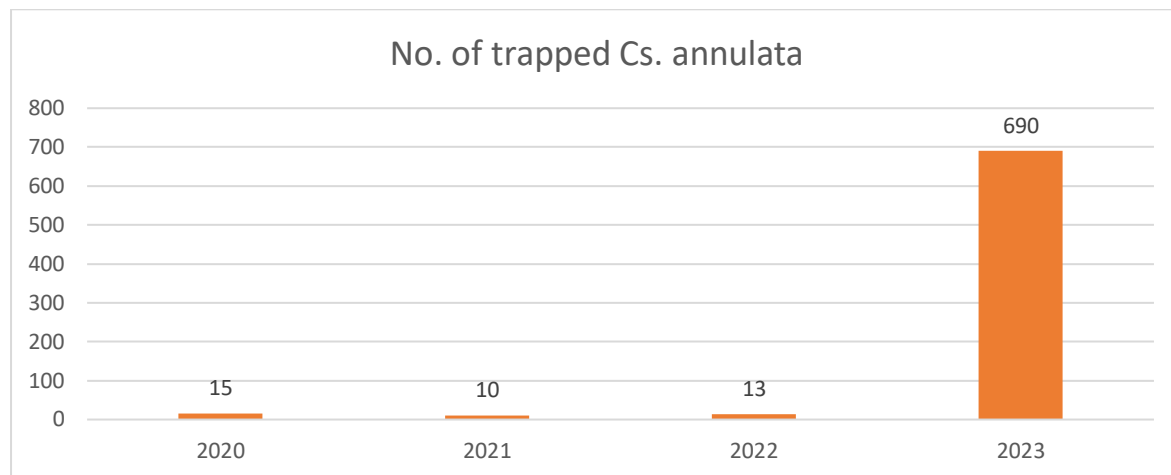




**Fig. 4**



**Fig 5 Culiseta annulata caught in traps 2020-2023 (breed on marshes and in freshwater)**



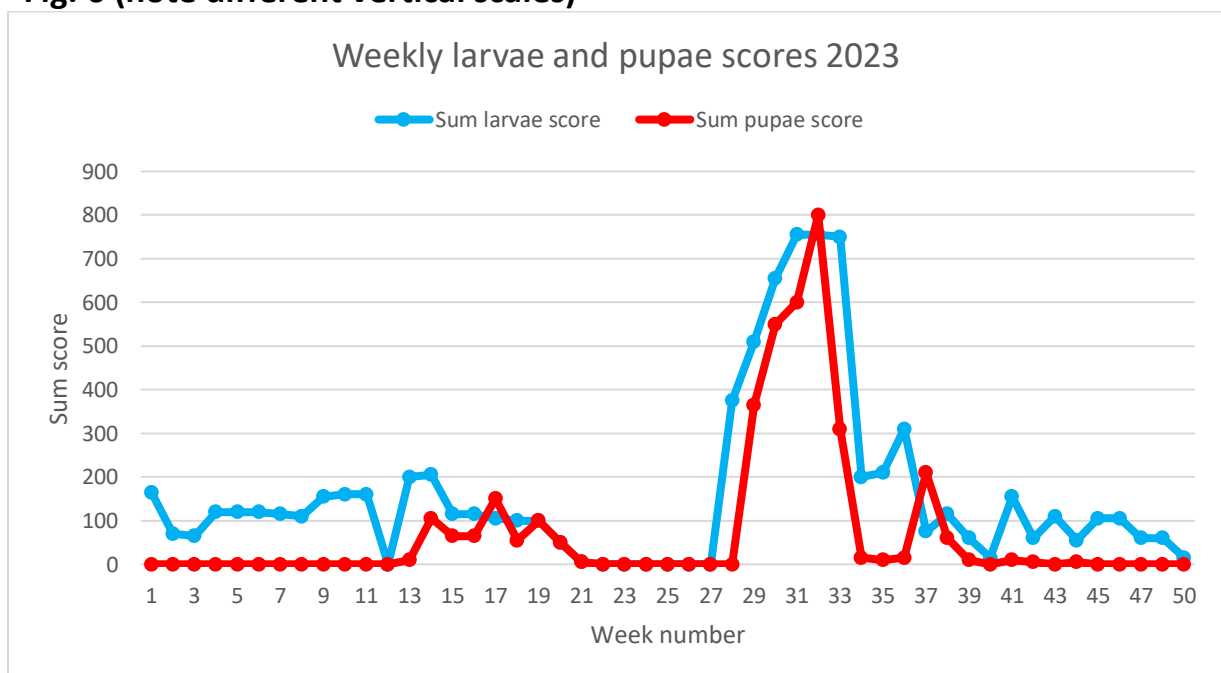
### **Pool dipping results**

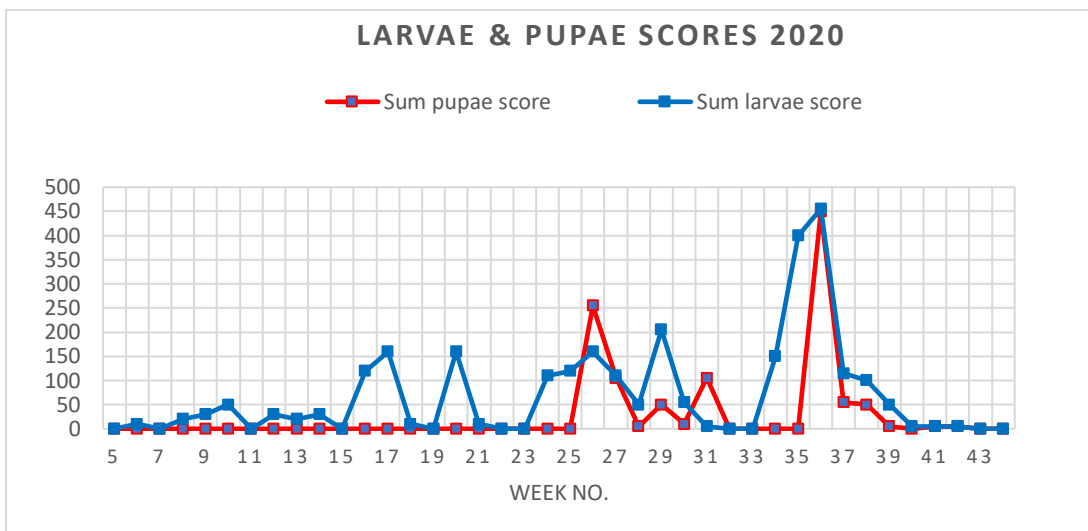
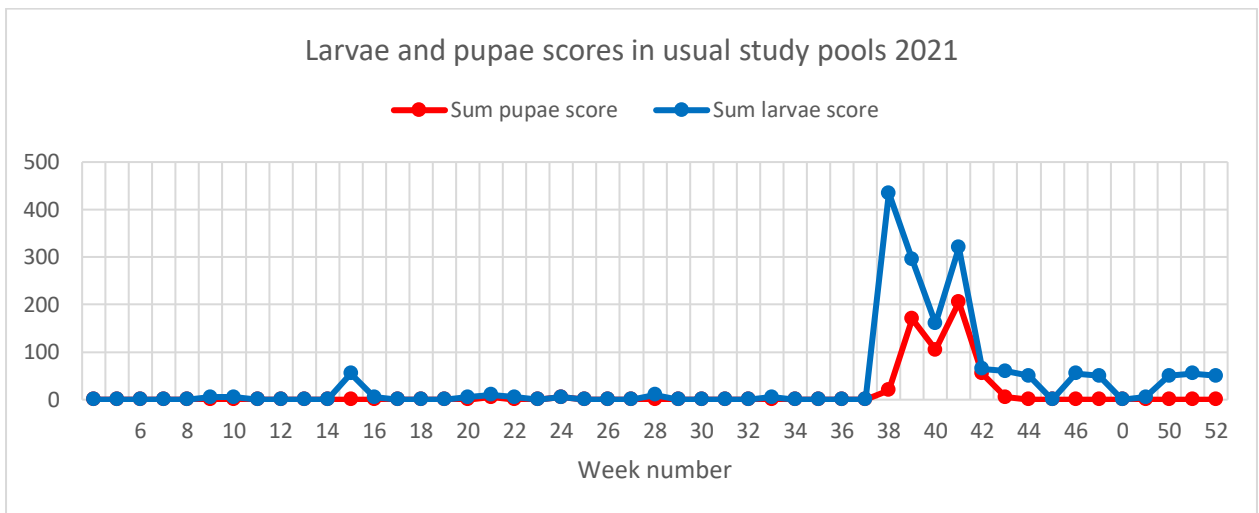
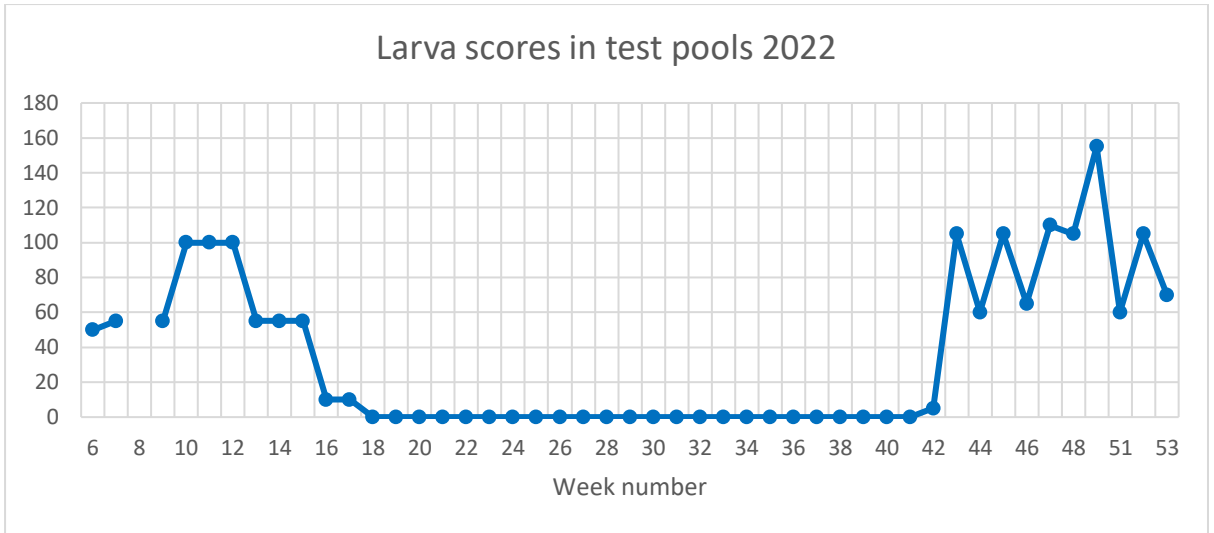
- 1 Prof. Clarkson started collecting data from dipping pools at Quayside in Little Neston in about 2012. Pretty well the same pools have been surveyed ever since. For the last 4-5 years this has been done weekly and extended to include all weeks of the year. For the sake of consistency, this report has confined its quantitative results to the data arising from these numbered "Clarkson pools". However, over the last 4-5 years, pools from a much wider area have been dipped in addition to the "Clarkson pools". Generally the results have been broadly similar and there has been no conflict in terms of using the results for the purposes of the mosquito forecast. However, some discrepancies have been noted in some weeks, and this emphasises what Prof. Clarkson and I had already realised over the last 4 years, namely that the Clarkson pools are not completely representative of the local marsh pools (and a number of reasons may be advanced for this). Sampling of other pools revealed the presence of larvae at times when none were found in the Clarkson pools. In future years, a wider range of pools will be *reported*, hopefully giving a more representative picture, but this year has been so exceptional that I have not done so yet.
- 2 There were more larvae throughout the year in 2023 (Fig 6) compared to 2022 (a very dry year), 2021 (dry summer), 2020 and 2019 (both had wet spells in summer). (note different vertical scales in graphs).
- 3 The pools were essentially dry by week 23 (week 18 last year). There was heavy rain in late June and early July but the pools did not refill till suddenly doing so in week 28. This sparked a mass synchronised hatching of eggs in mid-July and these matured as expected to emerge as adults from mid-August onwards.
- 4 The pools were drying out by late August but were refilled by the high spring tide of September 1<sup>st</sup>, leading to another mass synchronised hatching of eggs. The larvae produced matured noticeably quickly due to the very warm September weather. The graph, which is based on data collected from the "Clarkson" pools does not adequately reflect the numbers of larvae and pupae found *in September* in other ("non-Clarkson") pools.
- 5 Nevertheless, it is noticeable that the numbers of adults trapped in August and September is disproportionately high compared to the number of larvae and pupae in August and

September. This may be indicating longer survival of the adults, perhaps permitted by the warmer weather.

- 6 Other notable results from the dipping are:
  - a. Over the last 3-4 years, larvae have been discovered which have been shown by various methods to be a species called *Culiseta litorea*. This species bites birds but importantly has never been found in the Dee estuary previously and classically was thought only to occur in southern England. More extensive dipping studies have this year identified that this species is only found in certain types of pools: small, highly vegetated and near the edge of the “marsh”.
  - b. In July and August there were very high numbers of larvae and then pupae found in some pools where few had been found in previous years. Samples were taken and reared till adults for identification purposes. Whilst some turned out to be *Aedes detritus*, the vast majority were *Culex pipiens*. This is a very common species (elsewhere in the UK it is the commonest) which bites humans and animals only very rarely (and so it is not attracted to our Mosquito Magnet traps) and typically bites birds. It most commonly breeds in freshwater (e.g. water butts, rain-filled buckets or flood puddles) but can also breed in weak brackish water (as was the case in these pools which had been filled by rainwater). This species will not have added to the mosquito biting nuisance locally or contributed to the reported trap results but its presence in the pools will have distorted the quantitative pool dipping results in July and August. Most importantly, **none of the many reared from the marsh samples or the few caught in the traps in September were of the species *Culex modestus*.**
  - c. To follow up on the last MWG report: in late 2022, with all the pools full, mosquito larvae had been discovered in some pools where none had been found in previous years (i.e. in addition to the usual pools). Samples were taken for rearing to adulthood to permit species identification and as anticipated when the adults emerged in Spring 2023 they turned out to be *Aedes detritus*. One can speculate the reasons for this.

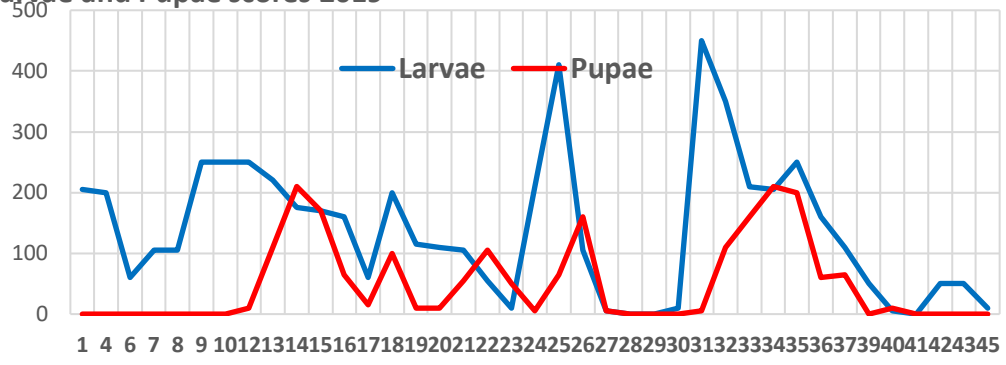
**Fig. 6 (note different vertical scales)**







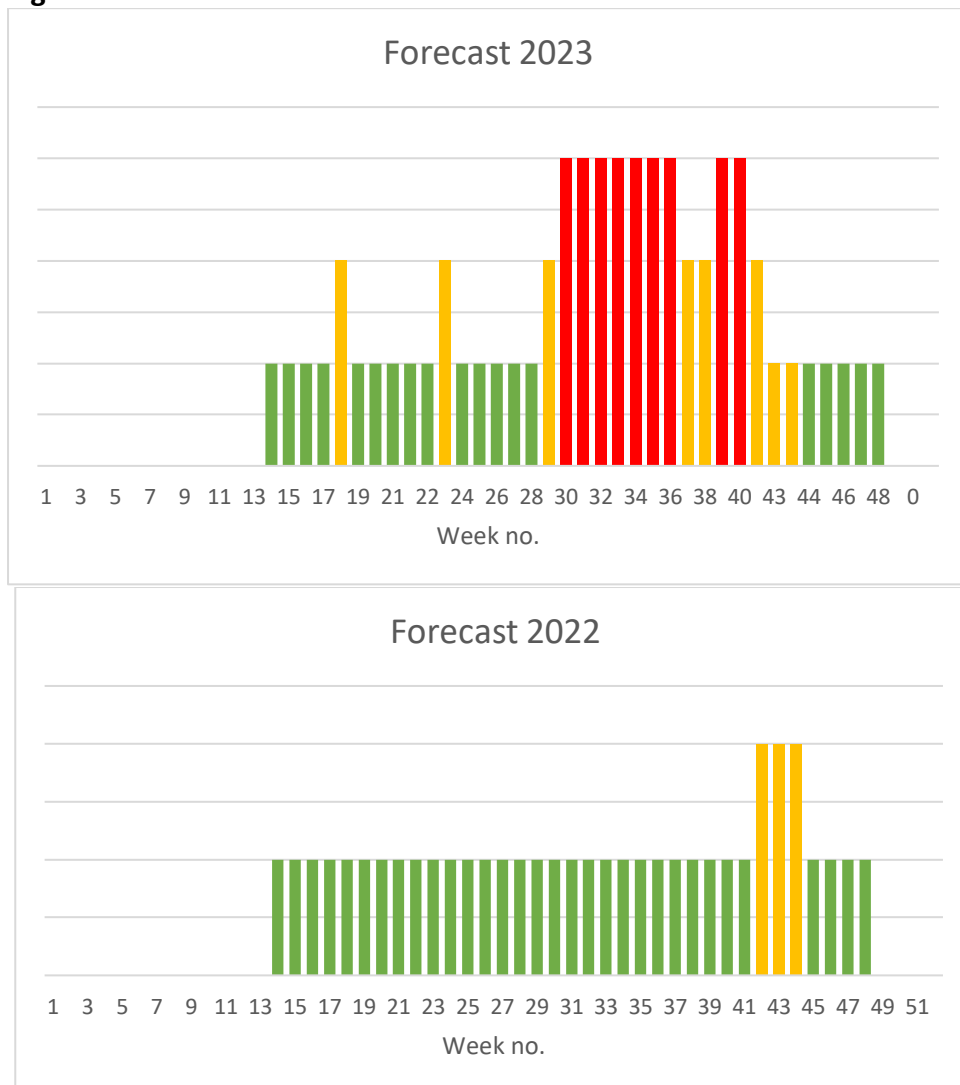
Larvae and Pupae scores 2019



**Forecast results**

- 1 Produced weekly (Friday, looking forward to forthcoming week) from early April to end of October. Published on NTC website and Neston Life, About My Area.
- 2 Traffic light report (Fig. 7)
- 3 Based upon trap results from preceding few days, pool dipping on the previous day, and weather forecast for forthcoming week (the most difficult element)
- 4 Some narrative explanation
- 5 Accompanying encouragement to report any bites online.
- 6 This year, advice was added about preventative measures and treatment of mosquito bites during red and amber forecast weeks

**Fig. 7**



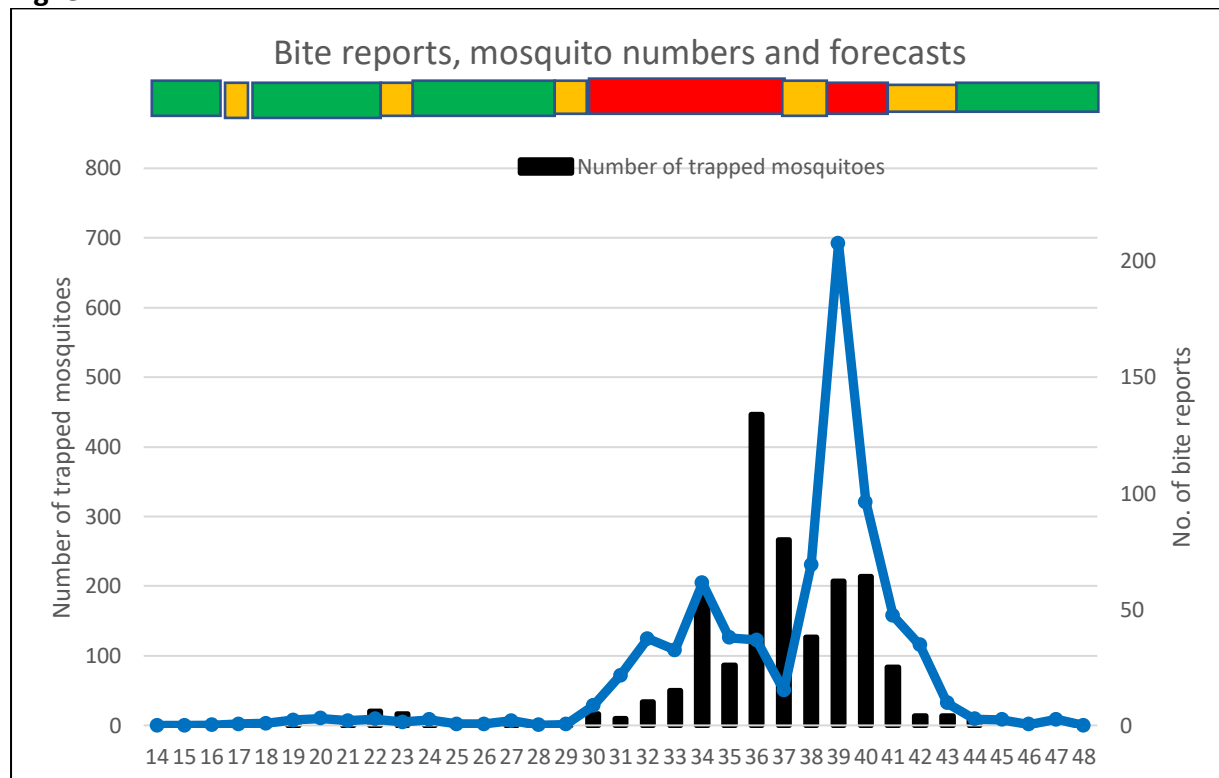
## Bite reports

- 1 Online, now with mapping facility
- 2 Form deliberately kept simple
- 3 553 reports of 690 bites filed (in weeks 19 to week 46), a huge increase over recent years.

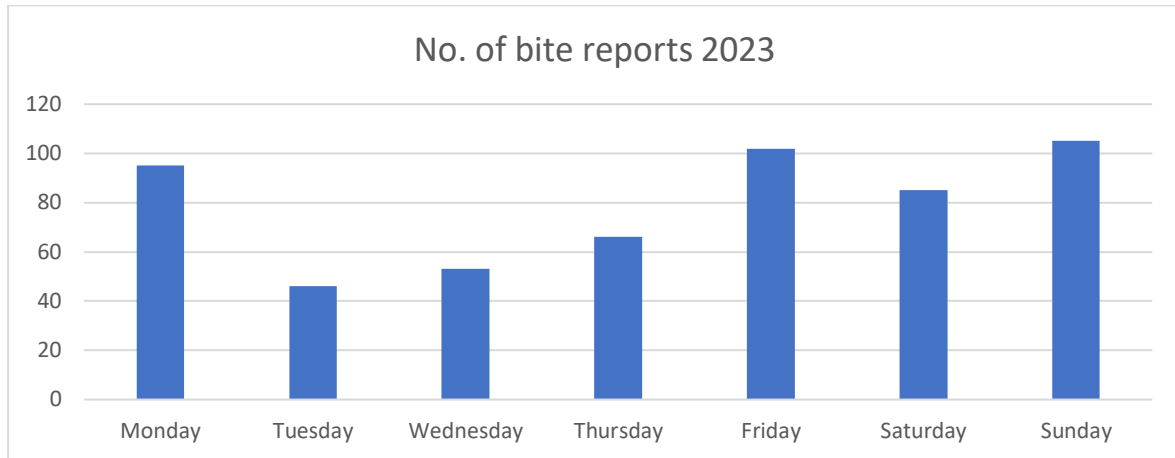
Year	No. of bite reports	First week	Last week	Peak number bite report	Week of peak bite report
2023	553 reports (690 bites)	19	46	134	36
2022	38	18	46	8	43
2021	169	15	46	26	23
2020	293	19	48	45	26
2019	216	16	45	66	35

- 4 Reasonable correlation with trap results and with forecasts (Fig. 8), considering likely daily weather variations affecting trap results and biting nuisance.
- 5 Analysis by
  - a. weekly distribution (Fig. 8),
  - b. day of week (Friday and Sunday most common) Fig. 9,
  - c. time of day (Fig. 10) (again fairly even spread across day, but we await analysis of variation with time of year).
  - d. location (Fig. 11a & 11b, larger scale). Data being stored for future analysis on temporal and spatial correlation each week as we accumulate more data over coming years.

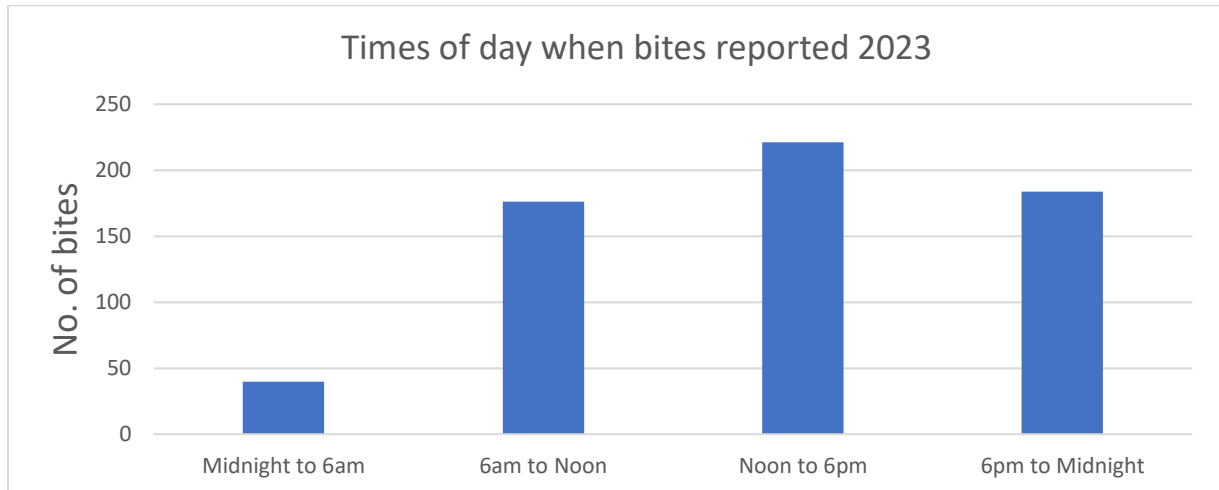
**Fig. 8**



**Fig. 9 Bite reports on different days of the week 2023**



**Fig. 10 Bite reports at different times of the day 2023**





# Research

## Published:

<https://bmcbiol.biomedcentral.com/articles/10.1186/s12915-022-01508-8>

Rapid identification of mosquito species and age by mass spectrometric analysis

Biochemistry, Molecular and Cellular Biology *BMC Biol* **21**, 10 (2023)

Iris Wagner, Linda Grigoraki, Peter Enevoldson, Michael Clarkson, Sam Jones, Jane L Hurst, Robert J Beynon

Dedication: This paper is dedicated to the memory of Professor Michael Clarkson

## As yet unpublished, in preparation:

Studies on the protandry of *Aedes detritus* and other species, survival of viable *Aedes detritus* eggs, over-wintering of *Aedes detritus*, distribution of *Culiseta litorea*.

## Ongoing collaborations: with research scientists at

- Liverpool School of Tropical Medicine (virome studies and adult mosquito dispersion)
- the Veterinary School at Leahurst (virology infectivity), University of Liverpool
- University of Oxford (modelling and possible effects of climate change)
- Liverpool Museum

Results also reported to UK Health Security Agency annually