

The effect of contrasting water management regimes on mosquito populations in a wetland habitat in the United Kingdom

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Introduction

Information on the current distribution and abundance of mosquitoes (Diptera: *Culicidae*) in Great Britain is patchy or non-existent. The UK is therefore presently ill-equipped to monitor, predict and mitigate the impacts of climate, socioeconomic and land use change on the occurrence and incidence of mosquitoes and mosquito-borne pathogens (MBPs).

Furthermore, in England plans are afoot to increase the area covered by wetland habitat for biodiversity enhancement and conservation as well as flood management.

(<http://www.wetlandvision.org.uk>).

Wetlands are likely foci for the maintenance and introduction of MBPs since such habitats support abundant populations of mosquitoes (putative vectors) and migratory birds (potential reservoir hosts).

We are undertaking a three-year study at the largest wet grassland in the UK, the Somerset Levels and Moors (SLMs). Here, water levels of the coastal grazing marsh fields are managed under a government-funded scheme at one of three tiers.

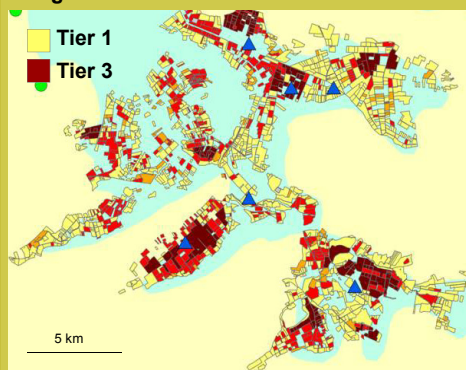
Tier 1 (T1) is highly drained permanent grassland.



At **Tier 3 (T3)** water levels in drains surrounding the grassland is kept nearly at field level leading to conditions not dissimilar to the natural wetland.



Map of the hydrological regimes patterns of wet grassland of the Somerset Levels



Our study aims to

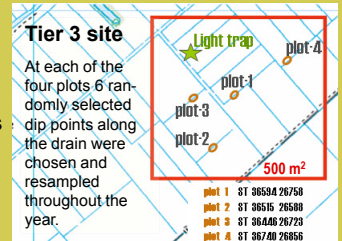
- 1) contribute baseline data on culicid distribution,
- 2) to identify significant biotic and abiotic factors related to mosquito population dynamics, and
- 3) to assess the effect of contrasting hydrological management regimes on these factors.

Methods

Eighteen sites maintained under the two different water management regimes, T1 (n=9) and T3 (n=9), were selected by random stratification using GIS data supplied by Natural England and sampled for adult mosquitoes using CDC CO₂ black light traps.

Within each site, four randomly selected drain plots were surveyed for aquatic mosquito life stages following a standardised dipping methodology. Details of emergent and submergent vegetation, potential predator taxa, as well as a range of physicochemical factors were recorded. GPS coordinates were taken to allow ground based and remotely sensed climate and vegetation measurements to be related, and to enable identical localities to be sampled repeatedly.

All 18 sites were visited three times, in mid-May, at the end of June and late August of 2009. Mosquito specimens were identified using standard morphological keys.

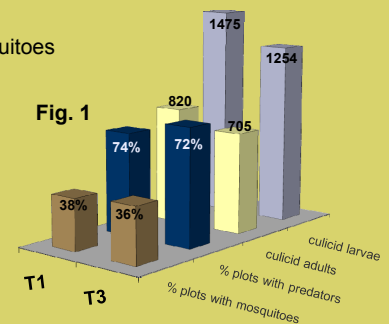


Results and discussion

During the first field season over 4700 immature and adult mosquitoes were collected from the SLM and identified to species level.

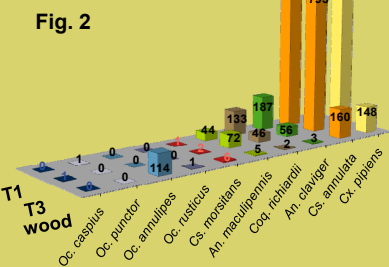
Tier 1 and Tier 3 habitats appear to be similar.

The overall prevalence, species composition and numbers of both adult and immature mosquitoes as well as aquatic mosquito predators on T1 and T3 sites seems similar (see Fig. 1 & 2). This suggests that these two hydrologically different wet grassland types do not represent exclusive ecological niches for particular mosquito species.



Tier 1 and Tier 3 are dominated by *Culex* and *Culiseta*.

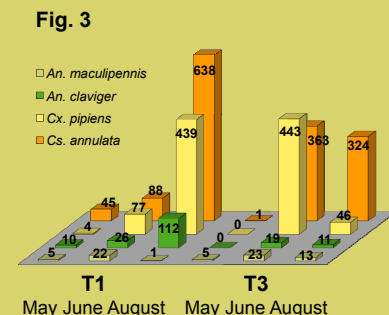
Seven mosquito species were present at the two coastal grazing marsh habitats (see Fig. 2). The most abundant species during all three sampling periods were *Culex pipiens* (46% at T1 and 48.5% at T3) and *Culiseta annulata* (37% & 40%), both involved in MBP transmission in other countries. Other putative vectors found on the SLMs include *Anopheles claviger* (8% & 4%) and *Coquillettidia richiardii* (6% & 2%).



The mosquito fauna in two SLM wet woodlands sampled in May and August for comparative purposes was more diverse: three additional mosquito species, *Ochlerotatus annulipes/cantans*, *Oc. punctator*, and *Oc. rusticus*, were found. Again both *Cx. pipiens* and *Cs. annulata* were most abundant (35% & 38%), followed by *Oc. annulipes/cantans* (27%).

True differences in seasonal peak abundance of larvae?

When broken down by month, variations in the timing of larval *Culicinae* - but not *Anophelinae* - peak abundance, on T1 and T3 sites seems apparent (see Fig. 3). However, in both cases the large seasonal differences in *Culicinae* larval numbers on T1 and T3 plots observed in June and August can be attributed to a very small number of highly productive dipping plots: In June four out of the 16 mosquito-positive T3 plots accounted for nearly 90% of the total number of larvae found on this habitat type. Similarly, in August one single dip at one of the thirty-one T1 plots that were sampled contained 37% of the total number of larvae recovered from this habitat type.



Conclusions and outlook

The Somerset Levels and Moors, the UK's largest wet grassland, are a suitable habitat for 10 mosquito species. First analyses of the first field season's data suggest that the contrasts in hydrological management under which a large proportion of the coastal grazing marsh on the SLM is maintained is not reflected in the observed culicid prevalence, abundance and diversity.

Throughout the upcoming field seasons of 2010 and 2011 all 18 Tier 1/Tier 3 sites will be revisited three times. In order to determine seasonal dynamics of the adult mosquito populations on the SLM six CDC light traps, manned by local volunteers, are now operated on a weekly basis.

Robust multivariate statistical analysis of two years of data and metadata combined with remotely sensed and field measurement of soil moisture content will allow us to identify any associations between abundance of mosquito species and the biotic and abiotic factors we have measured.