Climatology of Mosquito Activity Within Summer Ranges of North Slope Caribou Herds in Alaska

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Introduction:

- Insect harassment is spatially and temporally dynamic, both within and between years (Dau, 1986). Our current knowledge is limited to estimates of harassment for certain herds in certain years (White et al 1975, Russell et al 1993), and these estimates have not been localized within the summer range of a herd.
- A comparative estimation of potential effects of mosquitoes on caribou herds is warranted. For maximum utility and to make broad inferences such a study should involve the spatial and temporal components of mosquito activity.
- Long-term climatology datasets provide the potential to derive abiotic drivers of mosquito activity.

Hypotheses:

The positive trend in spring and summer temperatures and regional differences in temperature reported for Arctic Alaska (Shulski and Wendler, 2008), is hypothesized to affect mosquito activity, through time and space. We tested the hypotheses –

- Intensity and duration of mosquito activity seasons have increased during the period 1979-2009.
- The MAI estimated from NARR data will show regional differences in patterns and magnitude, across Alaska north of the Brooks Range.

Data & Analysis:

A three-decade period, 1979 to 2009, was abstracted from the long-term climate dataset to study the patterns in conditions conducive for mosquito activity over space and time.

- DATA: North American Regional Reanalysis (NARR) data is a long-term climatology dataset, available at 3-hourly temporal resolution, and 0.33° spatial resolution (Mesinger et al 2004).
- Following Russell et al (1993), we quantified "Mosquito Activity Index (MAI)" for each time step (8 times every day) for the duration 1-Jun to 31-Aug, for each year.
- Spatial and temporal trends were generated for the regions within summer ranges of Western Arctic herd (WAH), Teshekpuk lake caribou herd (TCH), Central Arctic herd (CAH), and Porcupine caribou herd (PCH).

Results & Discussion

Figure 1 (a-d): Temporal Trends in Daily MAI from day 1 (1-Jun) through day 92 (31-Aug) for four herds, for the period 1979-2009.

Finding 1: Trends (1 Jun-31 Aug) within years show similar patterns in peak MAI for all herds, although different magnitude. Patterns between years (1979-2009) show a trend towards early start of mosquito activity season.

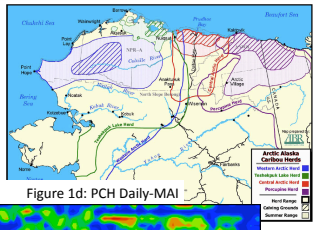


Figure 1a: WAH Daily-MAI

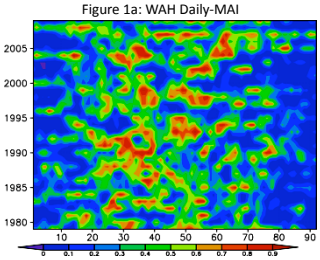


Figure 1b: TCH Daily-MAI

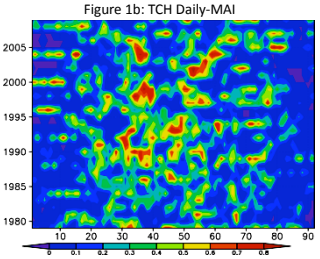


Figure 1c: CAH Daily-MAI

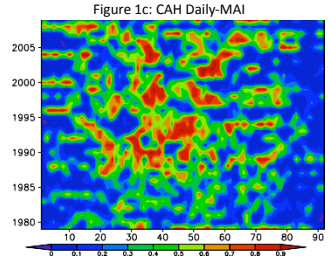


Figure 1d: PCH Daily-MAI

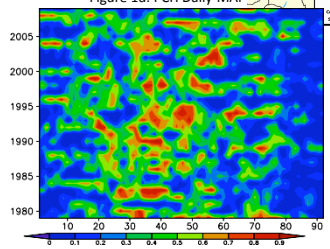
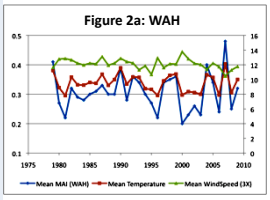
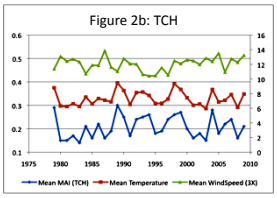


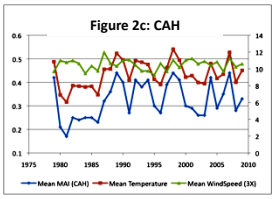
Figure 2: Temporal trends in seasonal mean MAI for four herds plotted on Y1 axis with seasonal mean temperature and mean wind speed (3X) on Y2 axis.

Finding 2: Similar patterns for the four herds but differences in levels of MAI.

Temperature shows high variability over time, therefore temperature changes contribute more to the temporal patterns in MAI. Wind shows variability over space and thus contributes to the differences in magnitudes of MAI.







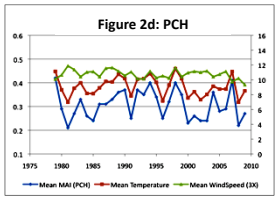
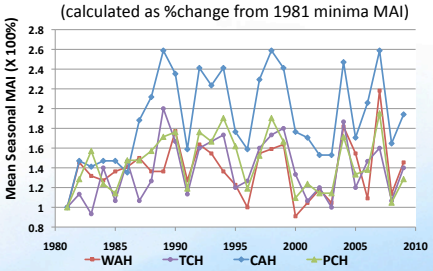
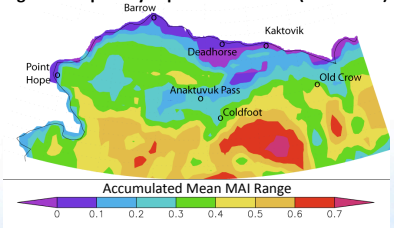


Figure 3: Normalized Trends in Mean MAI
(calculated as %change from 1981 minima MAI)



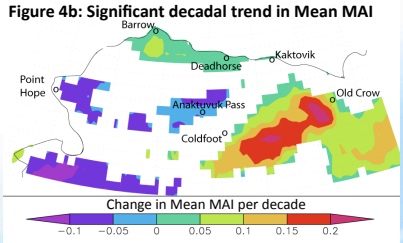
Finding 3: Peaks in MAI follow same pattern for all herds following the peaks in mean temperature. Highest range of variability observed for CAH. Lowest 31-year accumulated MAI for TCH (6.43); followed by WAH (9.49) and PCH (9.53); and CAH (10.04).

Figure 4a: Spatially explicit Mean MAIs (1979-2009)



Finding 4(a): Accumulated mean MAI over 31 years show regions of high and low potential mosquito activity. MAIs are consistently lower on summer ranges north of the Brooks Range for most years.

Figure 4b: Significant decadal trend in Mean MAI



Finding 4(b): There is a consistent, albeit very light increase in mean MAI along the low coastal sedge meadows (0-0.05), and a 0.05-0.1 increase south of Pt Barrow. For rest of the areas, there is high variability over time, and no significant trend.

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