Incidence of Vector-borne Disease and Climate Change: a Case Study in Semi-Arid Algeria

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ABSTRACT

Since the first reported case of zoonotic cutaneous leishmaniasis (ZCL) in 1991, 1,275 cases have been recorded in Saida with the vast majority of study-area cases (99%) reported between the years of 2000 and 2009. An investigation of potential climatic indicators for the apparent shift in disease prevalence was conducted by evaluating anomalies in the climate data. It was determined that long term climate trends have resulted in conditions that promote the prevalence of ZCL. Increased precipitation has resulted in greater vegetation and promoted host and vector population growth through a trophic cascade. Increased minimum temperatures have lengthened the annual duration of sandfly activity. Short term variations in maximum temperatures, however, show a correlation with disease suppression.

VECTOR-BORNE DISEASE

Reservoir: Rodents (P. boscus & M. shawi)
Recipient: Human (H. sapiens)
Vector: Sandfly (P. papatasi)
Zoonotic cutaneous leishmaniasis (ZCL) is a zoonotic vector-borne disease that is spread by the vector P. papatasi.

RESULTS

Climate conditions affect pathogen prevalence through host and vector populations

Data exhibits a trophic cascade

Decadal Precipitation and NDVI Anomaly

Adult and larval sandfly are sensitive to extreme temperatures and low relative humidity

Period of sandfly activity is longer in P2

Table 1: Definition of Sandfly Physiology

<table>
<thead>
<tr>
<th>Period</th>
<th>T_max (°C)</th>
<th>T_min (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active</td>
<td>10 &lt; 40</td>
<td></td>
</tr>
<tr>
<td>Reproductive</td>
<td>15 &lt; 40</td>
<td></td>
</tr>
</tbody>
</table>

Table 2: Comparison of Sandfly Physiologic Period Durations

<table>
<thead>
<tr>
<th>Period</th>
<th>Decade</th>
<th>Active</th>
<th>Reproductive</th>
<th>Diapause</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (90-99)</td>
<td>6 mo</td>
<td>4 mo</td>
<td>6 mo</td>
<td></td>
</tr>
<tr>
<td>2 (00-09)</td>
<td>8 mo</td>
<td>5 mo</td>
<td>4 mo</td>
<td></td>
</tr>
<tr>
<td>% Change</td>
<td>+33%</td>
<td>+25%</td>
<td>-33%</td>
<td></td>
</tr>
</tbody>
</table>

High Temps are linked to ZCL declines in P2

Conclusions

The incidence of ZCL in Saida shows an important shift one decade after the introduction of the pathogen. Climate and NDVI trends indicate that a warmer and wetter environment promoted endemism of ZCL, although there is the potential for these trends to suppress incidence in the future.

Information on the physiology of host and vector species is useful in interpreting the pathogen cycle for vector borne diseases

STUDY SITE AND DATA

Climate data from weather stations and NDVI values from AVHRR were evaluated.

Saida's climate is semi-arid and Mediterranean, having a mild winter and hot dry summer with winter precipitation.

The twenty years of data was grouped into two decades:
- P1 (1990 to 1999): low rates of incidence
- P2 (2000 to 2009): greater rates of infection

Impacts of climate on the local trophic cascade and pathogen cycle was conducted through examination of anomalies in the record.

INCIDENCE OF ZCL IN SAIDA

Has a wetting and warming of the climate in Saida over at least the last twenty years influenced the prevalence of ZCL?

Annual pathogen cycle demonstrates expected sandfly density

CONCLUSIONS

REFERENCES AND ACKNOWLEDGEMENTS


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