Malaria cases in the environmental context

The distribution pattern of reported malaria cases can also be viewed to advantage in the context of the environmental background. Two methods of data presentation are given for this purpose in relation to elevation. In Figure 10 large concentrations of malaria cases are depicted: this map underscores the case clustering that occurs. In Figure 11 small case concentrations are shown in dot density format: these are entered in the corresponding administrative unit areas but are randomly distributed within each unit area.

International borders are marked here (white), however for reasons of spatial crowding internal boundaries are not given. The malaria macro-clusters accurately reflect unit area locations which can be identified by reference back the details of Figure 2, since the coordinates are identical. The micro case concentrations are also unit area based in location; their random distribution within a given unit area makes precise localization somewhat more difficult but conveys a clearer idea of case numbers.

The two maps together confirm the distribution pattern found in the simpler two dimensional maps (Figures 7, 8, 9) but allow visualization in the more instructive environmental milieu. In terms of elevation would seem that malaria occurs in elevated areas even though case numbers are not high in the lower mountainous parts of Yunnan; in the high mountainous regions of that province malaria is absent. Of course, mountains are interspersed with valleys of lower elevation: resolution thereof in this context requires micro mapping. It is evident that the foothills and lower mountains in northern Myanmar, northern Lao PDR, central Viet Nam, northwestern Thailand, southwestern Hainan do not represent a barrier to transmission of malaria. On the other hand the plains of central and northeastern Thailand and Guangxi are relatively malaria free. In contrast the plains of Cambodia and central Myanmar tend to have high malaria case numbers.

Detailed mapping of malaria case numbers in relation to the watershed might also yield useful environmental information but this is beyond the scope of this monograph.

The overlaying of the same malaria data depicted in Figure 10 on the satellite remote-sensing map of forest cover (Figure 12) also provides an integral picture of considerable importance to malaria epidemiology. Here large case clusters show a marked tendency to be associated with densely

forested areas, while denuded areas such as northeastern Thailand and parts of Myanmar, for example, have relatively fewer cases. Cultivated field areas in Thailand appear to be relatively malaria free, as do the Mekong and Chaopraya river deltas. But the striking feature is the strong association between forested areas and malaria case numbers; this could be better analyzed with the introduction of time-series and micro level remote-sensing data.

Together these sets of maps (Figures 7-12) help to define the pattern of malaria in the region as a whole, a dimension not easily inferred from national statistics alone. This distribution pattern is depicted at macro level only. For detailed planning blow-ups of micro areal data are essential: the regional map software allows for this local magnification, limited in practice only by the administrative level at which the disease data are recorded and entered into the program. The present level of resolution is intended to provide a first step to regional analysis of malaria patterns.

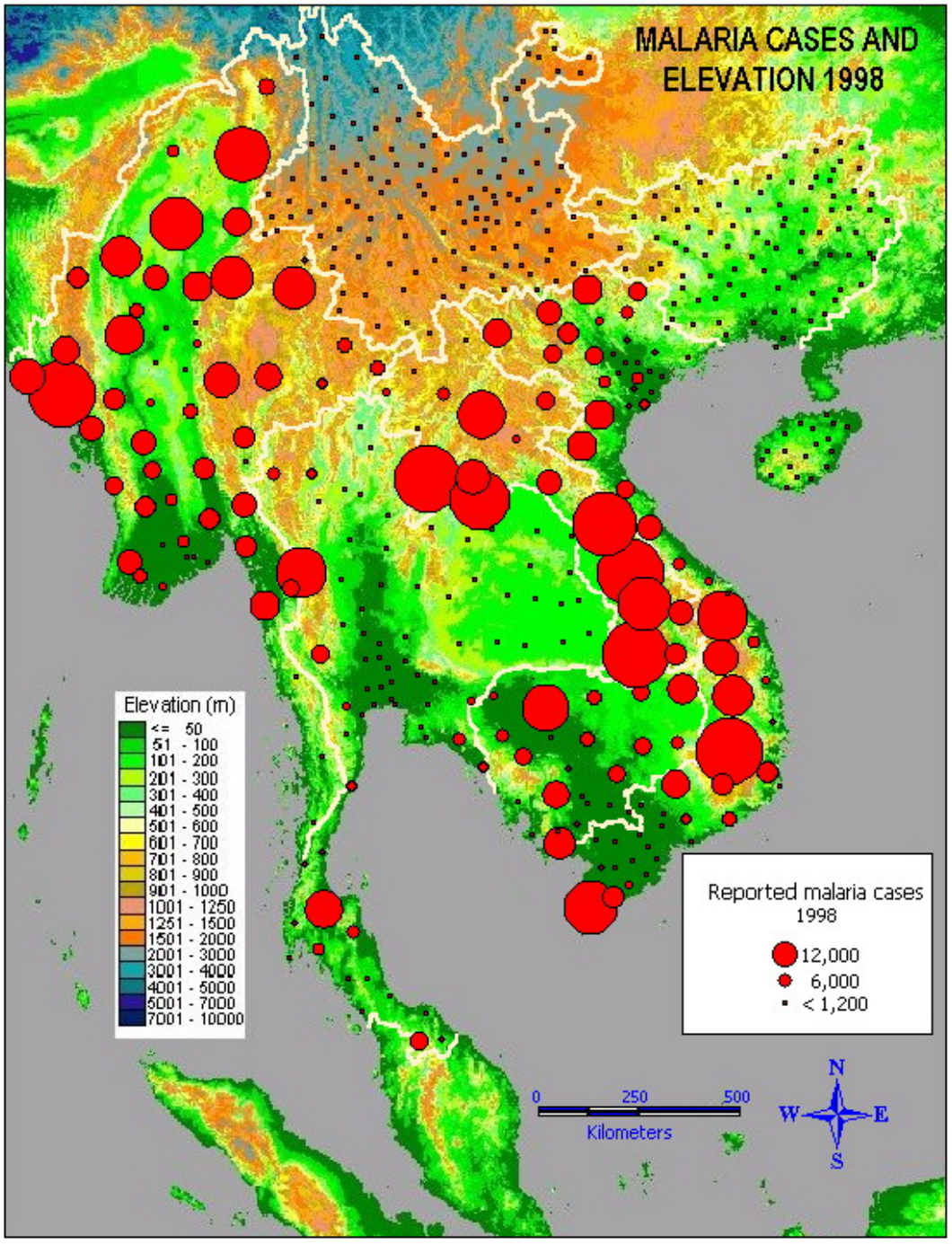
MALARIA CASES AND ELEVATION 1998
Elevation (m)
<= 50
51 - 100
101 - 200
201 - 300
301 - 400
401 - 500
501 - 600
601 - 700
701 - 800
801 - 900
901 - 1000
1001 - 1250
1251 - 1500
1501 - 2000
2001 - 3000
3001 - 4000
4001 - 5000
5001 - 7000
7001 - 10000
Reported malaria cases
1998
12,000
6,000
< 1,200
0
250
500
Kilometers
N
W
E
S

Figure 10.

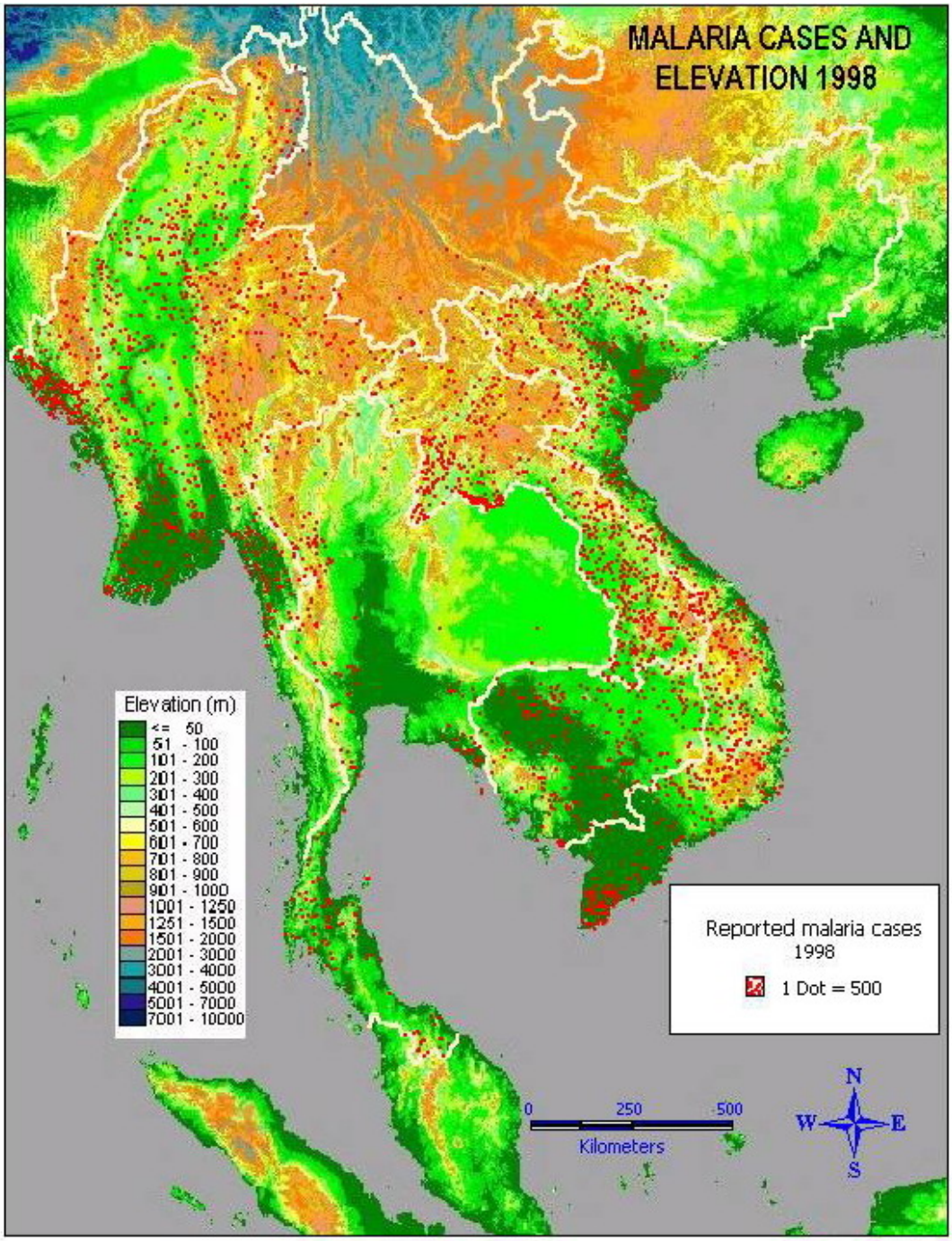
MALARIA CASES AND ELEVATION 1998
Elevation (m)
<= 50
51 - 100
101 - 200
201 - 300
301 - 400
401 - 500
501 - 600
601 - 700
701 - 800
801 - 900
901 - 1000
1001 - 1250
1251 - 1500
1501 - 2000
2001 - 3000
3001 - 4000
4001 - 5000
5001 - 7000
7001 - 10000
Reported malaria cases 1998
1 Dot = 500
0
250
500
Kilometers
N
W
E
S

Figure 11.

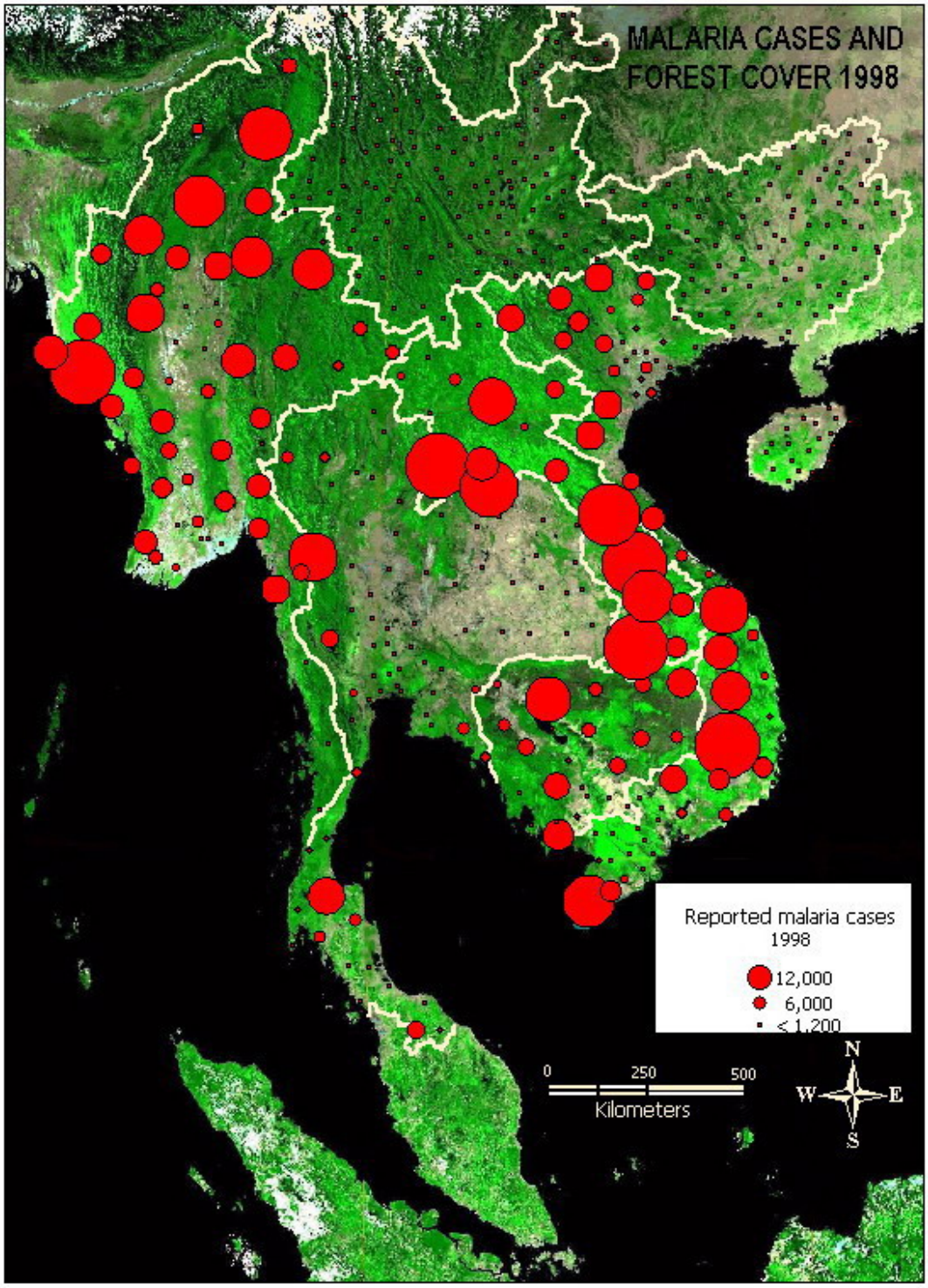
MALARIA CASES AND
FOREST COVER 1998
Reported malaria cases
1998
12,000
6,000
< 1,200
0
250
500
Kilometers
N
W
E
S

Figure 12.