Malaria mortality

Knowing the parasite species distribution it is appropriate to proceed to look at the pattern of malaria mortality expressed as deaths per 100,000 population per year over the 3-year period (Figure 18), since almost all malaria case fatalities are due to *P.falciparum.* There are clearly areas of high mortality and areas of low mortality, indeed it is the very distribution pattern that permits use of a quantitative bar format, since if most areas had high mortality the map would be too crowded to interpret at the unit area level. There is considerable variation in mortality rate from year to year in some unit areas.

As would be expected, there is a degree of association between high overall malaria concentrations and malaria mortality (Figures 7-9) but this is not absolute. There may be a closer association of mortality with areas of high *P. falciparum* incidence (Figure 17a,b) but the focal high mortality clustering within these broad areas is not necessarily explained by a high *falciparum/vivax* ratio alone.

The clustering of mortality is perhaps visualized more readily by plotting 1998 mortality data against the map of forest cover (Figure 19), particularly by comparison with Figure 12. The mortality concentrations are generally forest-associated in remote areas. They are not identical with all the high total malaria case concentrations but they do occur within the dominantly falciparum areas where these concentrations reside.

This pattern suggests that the underlying cause of mortality is multi-factorial, requiring high overall malaria incidence, high falciparum species prevalence and other biases, being related additionally to logistics of time lapse between onset of fever and seeking treatment, delayed species diagnosis, appropriateness or otherwise of drug treatment, access to adequate disease management in a hospital and related issues. Age (e.g. children) and occupation (e.g. forest environment) are likely to be factors. Heath facility/resources mapping is needed to extend the geographical dimension provided by disease mapping.

Regardless of the detailed explanation of high mortality foci, high *P. falciparum* transmission will be one factor. Genetic variation among isolates of *P. falciparum* is well documented elsewhere and virulent strains may account for some foci of mortality: potentially molecular probing in the context of micro-epidemiological analysis could provide some answers. A more immediately practical avenue for investigation perhaps rests with drug policy application in relation to more rapid parasite species identification, infrastructure evaluation and related factors. GIS provides some guides to research questions but does not provide all the answers.

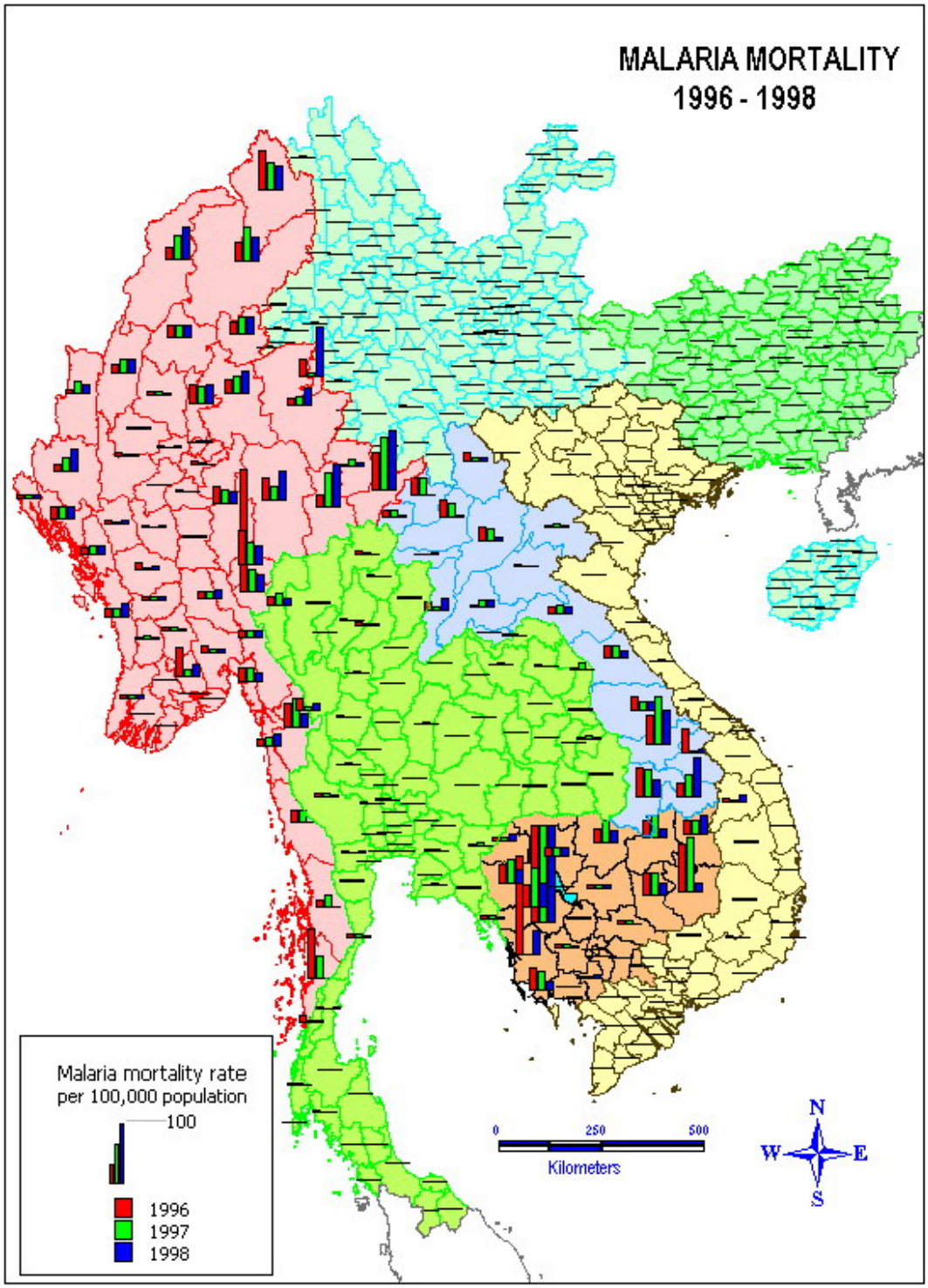
MALARIA MORTALITY
1996 - 1998
Malaria mortality rate
per 100,000 population
100
1996
1997
1998
0
250
500
Kilometers
N
W
E
S

Figure 18.

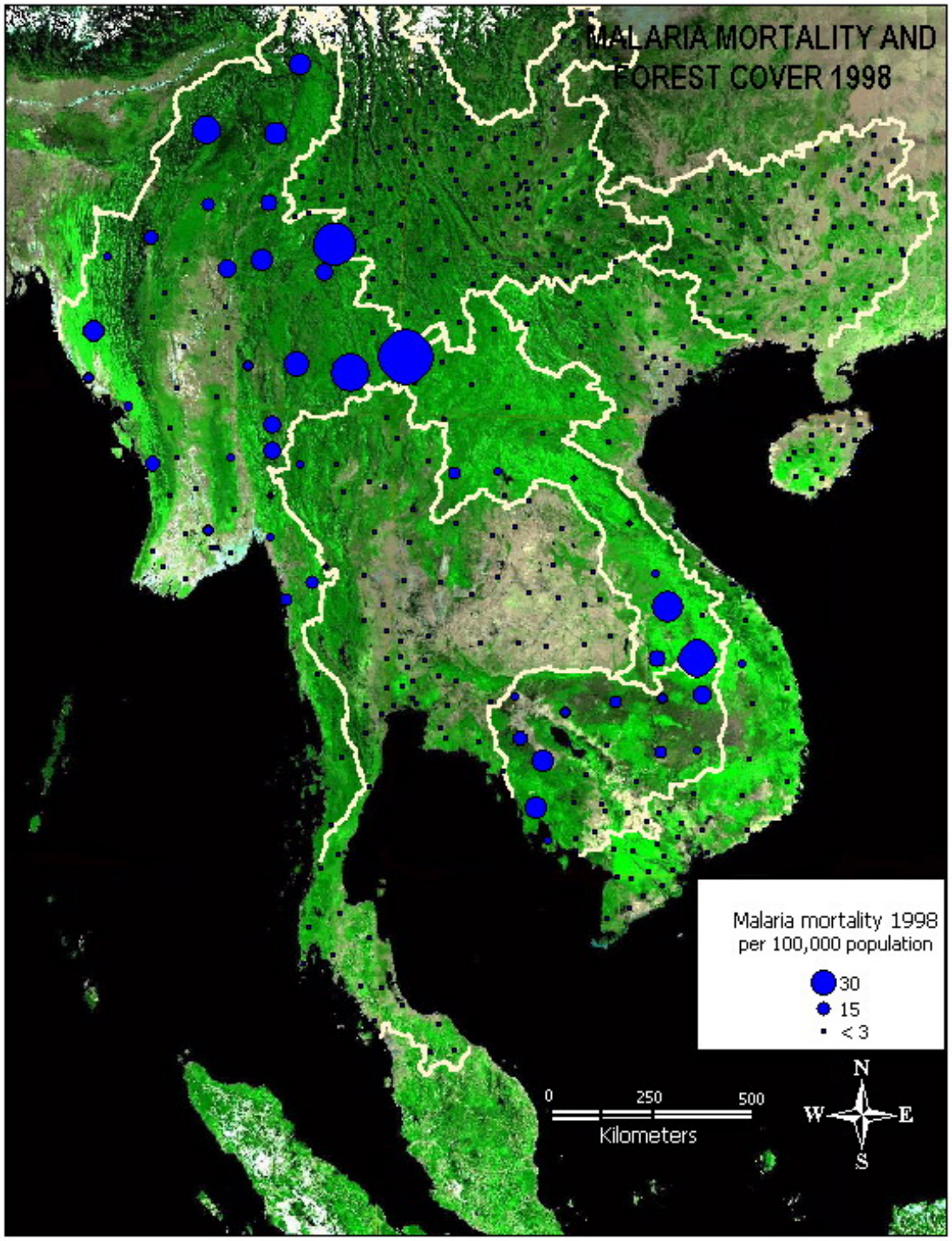
MALARIA MORTALITY AND
FOREST COVER 1998
Malaria mortality 1998
per 100,000 population
30
15
< 3
0
250
500
Kilometers
N
W
E
S

Figure 19.