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# POPULATION DENSITY AND WARFARE: A RECONSIDERATION

(addendum to the preprint… additional findings)

As we can see, both for Han China and the Roman Empire the relationship between the population density in each observed moment of time and the rate of change in internal warfare in subsequent periods is positive (and quite strong). Both for Han China and the Roman Empire population density turns out to be a really strong and positive determinant of internal warfare.

On the other hand, our first model predicts that in the preindustrial world a qualitative social transformation involving the technological change (leading to the rise of the carrying capacity of land), the rise of the population density and the political complexity should be accompanied by the rise of warfare frequency. Indeed, they suggest that the higher level of population density will be reached within a "secular cycle", the higher will be also the maximum level of warfare frequency within this cycle. However, to test this hypothesis we should change the unit of analysis, and to compare not just individual cultures, but types of cultures.

Major preindustrial technological shifts which were accompanied by enormous rises in population density were transition to agriculture, and transition from extensive to intensive agriculture. Our first model predicted that cultures having subsistence technology that supports a significantly higher population density would also tend to have in average a significantly higher warfare frequency.

Our prediction has been entirely supported by the respective cross-cultural test (Fig. 21):

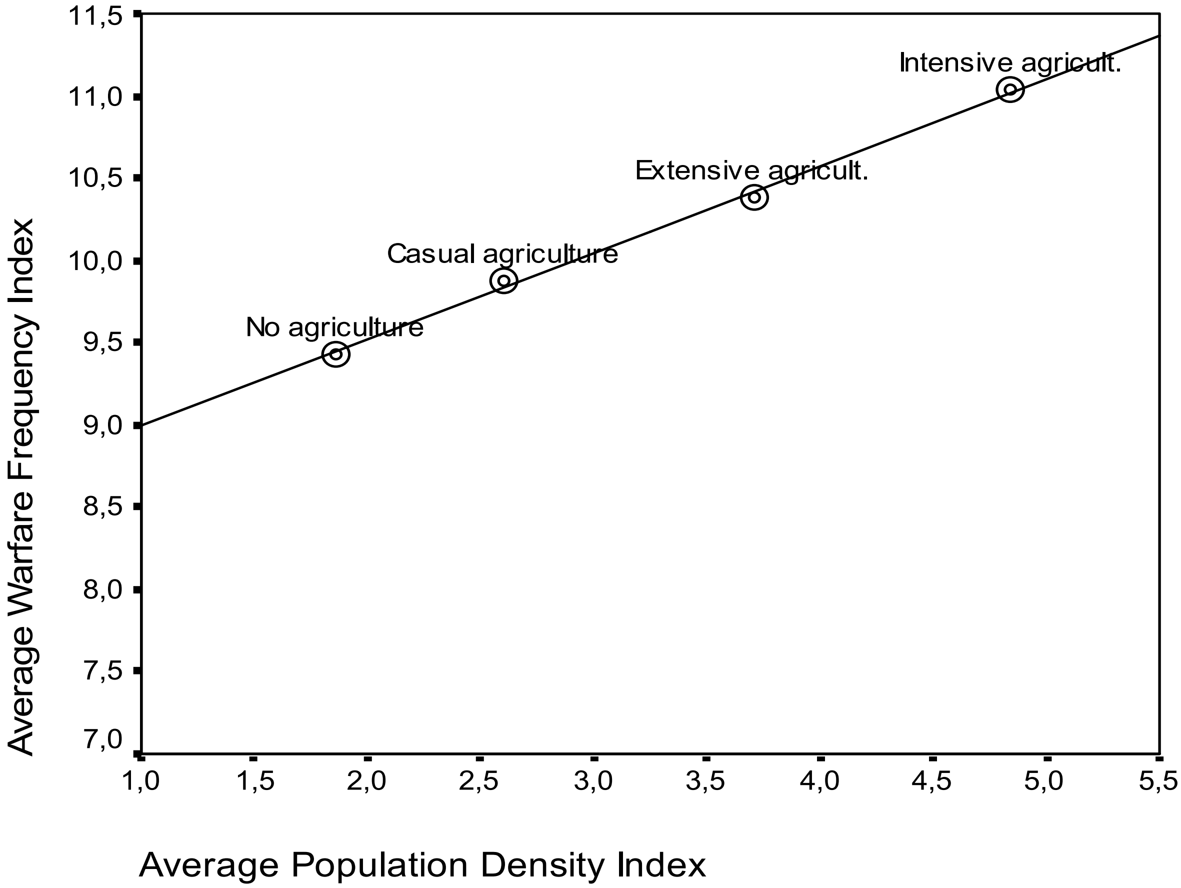


FIG. 21. *Population Density X Warfare Frequency. Scatterplot with linear regression line. For the Standard Cross-Cultural Sample, averages for cultures with different basic economic types.*[1] *For sources and codes see Figure 1.*

**NOTE: *r* = + 0.999, *p* = 0.001 (1-tailed)**

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[1] Cultures based on different economy types were selected using the variable INTENSITY OF CULTIVATION (Murdock 1967, 1985; Murdock *et al.* 1999–2000; STDS 2002: file STDS10.SAV [v232]).

It seems also necessary to note that the above-mentioned shifts in subsistence technology correlate rather strongly with shifts in political complexity (see Table 1):

T A B L E 1

*Intensity of Cultivation X Political Complexity*

| | | Intensity of Cultivation | | | | Total |
|---|---|---|---|---|---|---|
| | | No agriculture | Casual agriculture | Extensive agriculture | Intensive agriculture | |
| Political Complexity Index = # of Political Integration Levels over Community | No levels = Independent Communities | 34<br>81,0% | 5<br>50,0% | 20<br>37,0% | 8<br>25,8% | 67<br>48,9% |
| | One level = Simple Chiefdoms | 8<br>19,0% | 3<br>30,0% | 21<br>38,9% | 5<br>16,1% | 37<br>27,0% |
| | Two levels = Complex Chiefdoms | | | 11<br>20,4% | 5<br>16,1% | 16<br>11,7% |
| | Three levels = States | | 2<br>20,0% | 2<br>3,7% | 9<br>29,0% | 13<br>9,5% |
| | Four levels = Large States / Empires | | | | 4<br>12,9% | 4<br>2,9% |
| Total | | 42<br>100,0% | 10<br>100,0% | 54<br>100,0% | 31<br>100,0% | 137<br>100,0% |

**NOTE:** **Rho = + 0.51, *p* = 0.0000000002 (1-tailed)**

**Gamma = + 0.64, *p* = 0.00000000001 (1-tailed)**

This, of course, suggests that we should obtain similar results if we choose as units of comparison independent communities (no levels of political integration over community), simple chiefdoms[2] (1 level of political integration over community), complex chiefdoms[3] (2 levels of political integration over community), states (3 levels over community), and large states / empires (≥ 4 levels).[4]

And this indeed turned out to be the case (see Fig. 22):

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[2] And socio-political systems alternative to simple chiefdoms, *e.g.*, federations of communities.

[3] And socio-political systems alternative to complex chiefdoms, *e.g.*, tribal confederations of the Iroquois type.

[4] To select them we used the variable JURISDICTIONAL HIERARCHY BEYOND LOCAL COMMUNITY (Murdock 1967, 1985; Murdock *et al.* 1999–2000; STDS 2002: file STDS10.SAV [v237]).

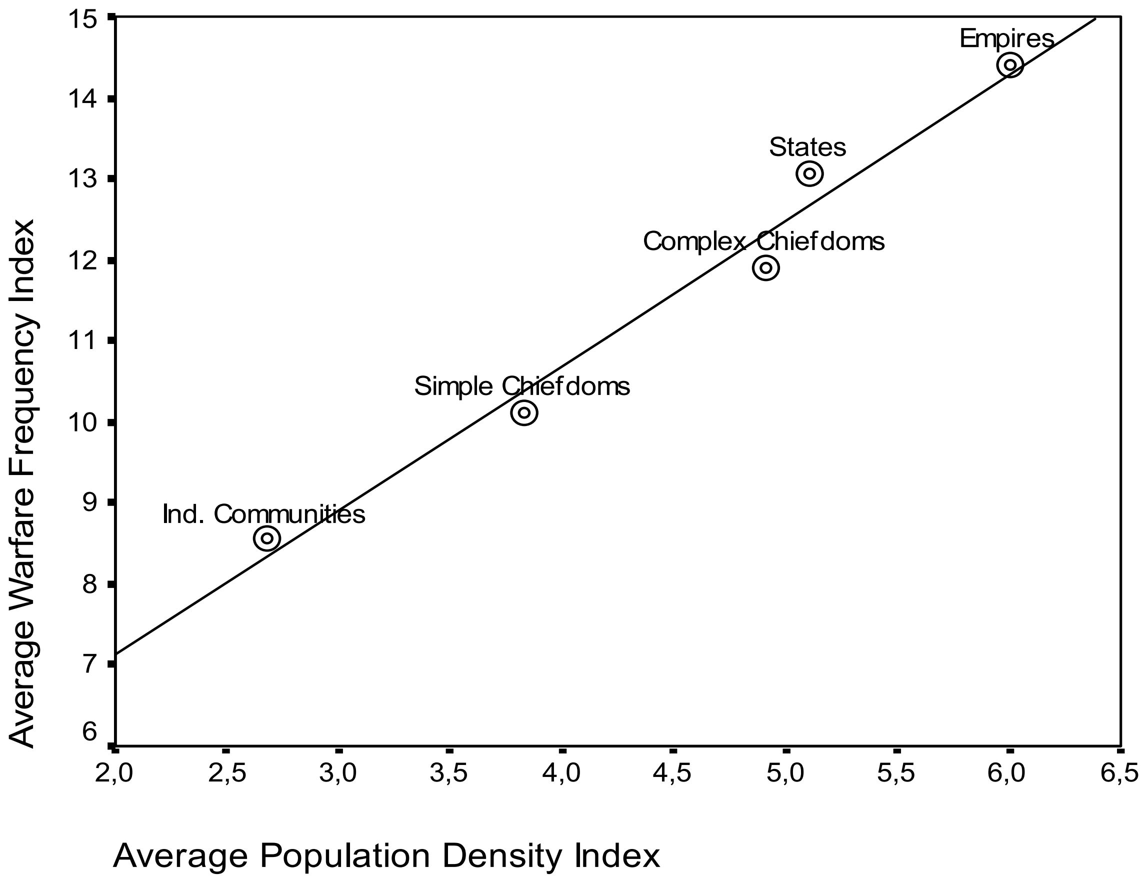


FIG. 22. *Population Density X Warfare Frequency. Scatterplot with linear regression line. For the Standard Cross-Cultural Sample, averages for cultures with different political complexity types.*[5] *For sources and codes see Figure 1.*

**NOTE: $r = +0.99$, $p = 0.001$ (1-tailed)**

Thus, our hypothesis has been supported: indeed, in the preindustrial world qualitative social transformations involving the technological change (leading to the rise of the carrying capacity of land), the rise of the population density and the political complexity appear to have been accompanied by the rise of warfare frequency.

[5] Cultures based on different economy types were selected using the variable INTENSITY OF CULTIVATION (Murdock 1967, 1985; Murdock *et al.* 1999–2000; STDS 2002: file STDS10.SAV [v232]).

# APPENDIX 1

## ADDITIONAL NOTE (TO FIG. 13–14):

It might be revealing to compare these figures with the ones illustrating a classical prey-predator relationship. The data document population oscillations of prey, a caterpillar that eats the needles of larch trees in the Swiss Alps, and its predators, parasitic wasps. The caterpillar population goes through very regular population oscillations with the period of 8-9 years. Predators (here measured by the mortality rate that they inflict on the caterpillars) also go through oscillations of the same period, but shifted in phase by 2 years with respect to the prey (Figure 14Aa). Almost 95% of variation in caterpillar numbers is explained by wasp predation [Turchin, 2003], but when we plot the two variables against each other we see only a weak, and negative correlation (Figure 14Ab). If we plot predators against the lagged prey numbers, then we clearly see the positive correlation

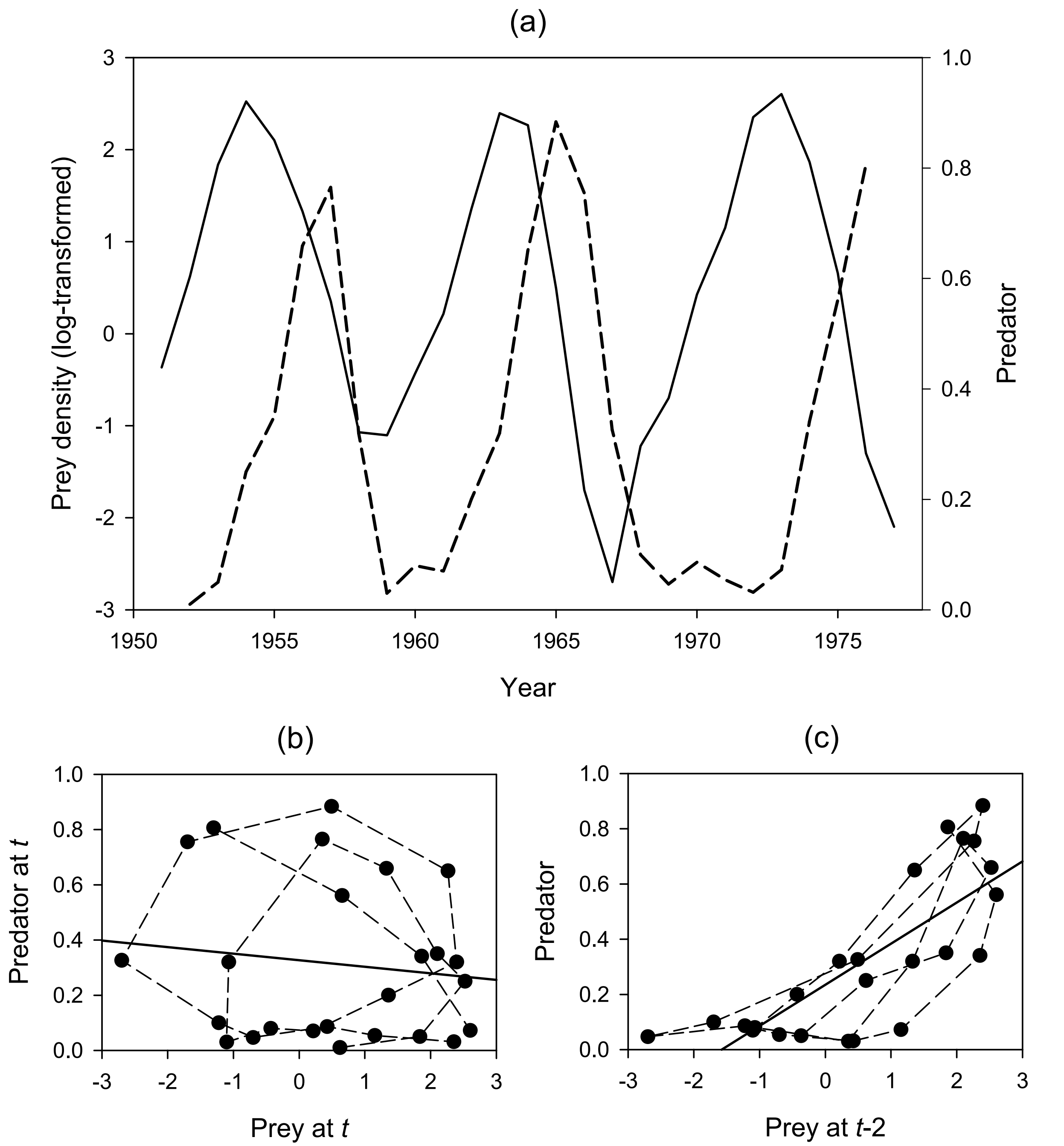


Figure 14A. Population dynamics of the caterpillar (larch budmoth) and its predators (parasitic wasps). (a) Population oscillations of the caterpillar (solid curve) and predators (broken curve). (b) A scatter plot of the predator against the prey. The solid line is the regression. Broken lines connect consecutive data points, revealing the presence of cycles. (b) A scatter plot of the predator against prey lagged by two years.