Reply

Dwight W. Read and Steven LeBlanc

Los Agneles, Calif., U.S.A. 9 X 02

We are pleased with the broad range of perspectives and interesting directions for future consideration expressed in the comments. We do feel somewhat caught in the middle, though, as these are avenues to be explored were we writing a book rather than a paper. As it is, we had to delete sections of our original text because of page limitations and relegate other parts to the online version -- not, as Cowgill's implies, because of their secondary importance but on the basis of what we thought would be of greater interest to most readers. We will restrict our comments to a few areas of disagreement and to areas where elaboration is needed.

The concerns raised by van Dokkum about carrying capacity highlight the reason that *K* (which can be expressed in terms of density, or in terms of the maximal number of persons sustainable in a fixed region) may be a less useful parameter (except as a way to identify an upper bound) than *K** (equilibrium population size in a fixed region). His comment that a population can continue to grow even with a declining growth rate points out the dependency of the logistic growth model on an assumed rate of decline in the growth rate. Similarly, his observation that stasis only means that the death rate equals the birth rate (ignoring migration) underscores the problem with using *K* as a predicted equilibrium value for a population.

Ziker and Ray identify another problem with *K* -- that it does not take into account the effect of sharing resources over appropriate geographical and temporal scales. The importance of the pattern of sharing can be seen in the transition from a primate form of social organization (ini which a troop tends to practice territorial exclusion) to a hunter-gatherer form of social organization (in which individuals have access to resources throughout the region used by the set of individuals who recognize one another as kin). As one of us has argued (Read 1987), two factors are critical for this transition. One is whether sharing of resources over a larger catchment area will lead to a qualitative change in the carrying capacity of that area in comparison with the carrying capacity associated with small groups practicing territorial exclusion as in model 3. The second is the centrality of culturally constructed kin relations expressed through a kinship terminology (Read 2001) that provide the basis for cooperation among individuals even without the face-to-face interaction that appears to be important for maintaining troop cohesiveness in primate species.

The importance of a culturally constructed basis for sharing is underscored by examples such as *hxaro* exchange among the !Kung San and the sealing partnerships of the Netsilik Eskimo (Van de Velde 1956, Balikci 1970). In both cases exchange partners are deliberately selected from individuals without a close (cultural) kin connection (Wiessner 1977; Balikci 1970:137). Biological brothers may share for reasons relating to altruism and kin selection, but biological strangers share parts of a seal for nonaltruistic reasons that arise through culturally formulated sealing partnerships in conjunction with other dyadic relations that served to minimize serious outbreaks of conflict in winter sealing camps. The degree to which this kind of sharing would continue to take place under conditions of significant intragroup competition or when resources were critically short (i.e., they were starving) is, however, less evident. The !Kung San have been below carrying capacity as hunter-gatherers for the reasons discussed in the text, and the ethnographic present for the Netsilik is a time period when the population is not undergoing the periodic starvation that occurred when caribou herds could not be found in the fall.

While we find the issues raised by Ziker with regard to group selection of considerable interest and our work may be relevant to them, we did not use the terms "selection" or "group selection." In fact, the evidence available about conflict arising at any level of social complexity would seem to provide stronger support for cultural group selection (see below) than for biological group selection. To extend our thoughts beyond what we wrote, we note that although some proponents of group selection have made unwarranted claims, as Ziker indicates, group selection can occur if three conditions are met: (1) variation in traits expressed at the group level occurs between groups, (2) intergenerational inheritance of traits occurs at the group level, and (3) there is differential survivability of groups according to group traits (Wilson 2002). That there can be turnover of groups under competition is not problematic, and so the competition argument establishes the equivalent of individual fitness at the group level. More problematic for group selection, though, is the mechanism by which group-level traits are expressed and inherited. This problem is reduced when we note that neither the group traits nor the inheritance need have a biological basis. In human societies social institutions and cultural constructs provide a means for traits both to be expressed at a group level (such as through an ideology of sharing) and to be maintained through time (via cultural reproduction), thus the first two conditions for group selection are met with cultural traits. Even more, the ability of a human group to assess and evaluate its conditions and then to act upon and change the characteristics of the group (Read 1990:54-55, 1996) provides a fitness mechanism for cultural traits that transcends group extinction as the basis of a fitness measure. This ability also circumvents the unrealistic multigenerational time scale for change in cultural traits that would obtain if differential fitness arose only out of group extinction and replacement. We can call this process *cultural group selection* in contrast to biological group selection arising from biologically based traits and differential survivability of groups.

We implicitly use cultural group selection with our model 3 when we argue that if a coalition of groups leads to a marked increase in population density then there is a built-in "pressure" at the individual level for maintaining the larger group despite its costs. Under these conditions fission will eventually translate into individuals' discovering that they have insufficient resources for survival, since most groups resulting from fission will have a population density that cannot be maintained without access to resources throughout the larger catchment area of the coalesced group. Thus individuals or groups will see it as in their interest to maintain a society organized at a larger scale despite its costs. That kind of assessment and restructuring can occur on a time scale that precludes either individual fitness or group fitness (in the sense of group turnover) as necessary properties for the change to occur.

We are not sure what Cowgill means when he says that our "central omission" is "the anticipated material benefits of children once the children have grown past infancy," since our propositions are stated in terms of general processes rather than specific instances of those processes. "Material benefits of children" would be subsumed under proposition 6: "Individual choices are triggered by individual experience and made in terms of individual self-interest," where the experience and choices in this instance would relate to the material benefits obtained from offspring. We do not object to including material benefits obtained from children as part of fertility decisions so long as their inclusion is justified by the ethnographic context. In the case of foragers, however, young and even adolescent children contribute negatively to the caloric needs of families (Kaplan et al. 2000). There is more evidence for a positive contribution by children among farmers by ca. 10 years of age, but the literature is rather thin and vague on the subject (see Caldwell 1983, Mueller 1976, and Nag, White and Peet 1978).

Inclusion of material benefits obtained from children would require modification of the form of our decision model, in keeping with our comment: "We do not claim that these three assumptions [of the model] are or can be expected to be universally true." Our intent in focusing on a single relatively simple decision model was, as Fischer observes, to determine the model's consequences when we take into account the following: (1) the relationship between the ideational and the material in decisions made by individuals or groups, (2) the implications of interaction among groups for the dynamics of any group or society, (3) the implications of social organization for the relationship between decision making (which may be through individuals, an individual consulting others, consensus in minimal social units, and so on) and the material conditions that have an impact on decisions, and (4) the implications of the scale of temporal and spatial variability in resources for short -- and long -- term stability and instability of different modes of social organization.

If we simply focused on the material benefits obtained from children we would capture only the local decision making by a family, not the implications of the decoupling of fertility decisions from their societywide population consequences. How can the high fertility rates implied by the material-benefits model in a labor-intensive agricultural context be maintained over long periods of time without leading to a disastrously large population? Egypt provides an illustrative example (see Jankowski 2000), since local decision making plays itself out in a rural environment in hwich child labor and "old age insurance" have had significant impact on family-level fertility decisions but there is also an urban environment of population centers linked to the rural hinterlands that are integrally tied to population growth.

Prior to the 1800s the population size of Egypt varied from around 2 to 6 million persons (Jankowski 2000) with no particular long-term trend. In the 1800s sewer systems and other sanitation measures were introduced that decreased the mortality rate substantially. This, in conjunction with economic expansion, initiated the high growth rate that continues to the present

(Jankowski 2000:103). Rural family sizes have averaged about 4-5 living offspring per family, a growth rate that doubles the population each generation. While census data on family sizes in rural families before the 20th century are lacking, it is likely that the pattern of women's having a total number of living offspring well above replacement rates is applicable for the past several hundred years. Peasant farming has changed very little during this period and has always been labor-intensive.

The basis for long-term stability in population size despite a high rural fertility rate is suggested by a graph of the rural population size versus crop area (see fig. 10) (crop area takes into account the multiplicative effect of double and triple cropping on the cultivated area). From 1887 (the first date for which census data are available) to the 19e0s, growth in rural population size matched growth in the crop area, and thus the population size in rural areas stayed in balance with agricultural production. The rural areas achieved this balance by shedding excess population into the urban areas. From the 1940s onward the rural population growth appears to have exceeded the ability of the urban areas to absorb migration form the rural hinterlands and so rural population growth began to exceed growth in crop area. It appears that urban areas have acted as population sinks, allowing the rural areas to have high fertility rates without directly experiencing the consequences of a growing population.

Prior to modern systems of sanitation and medical care, urban centers also had high rates of mortality through periodic plagues that wiped out large portions of the urban population (Sayyid-Marsot 1985, Petry 1998). This suggests that the long-term stability of Egypt's population, even with high fertility rates in rural families, was due to urban centers' having population boom-and-bust cycles as they grew in response to migration from the hinterlands. At the same time, the rural areas tended to be shielded from the effects of a growing population through migration to urban areas and so could continue with high fertility rates driven (as many have suggested) by the need for agricultural labor and for care in one's old age.

In pharaonic Egypt the situation may have been different, as there was proportionally a much smaller urban population. Pharaonic Egypt had 300-400-year intervals (the so-called Old, Intermediate, and New Kingdoms) of social stability punctuated by societal crises often accompanied by widespread famine and starvation (see Bell 1971). Malthusian checks may have affected the entire population, whereas under conditions of peasant agriculture in combination with urban centers such checks seem to be affecting urban more than rural populations.

The material-benefits argument, it should be noted, is subsumed within Becker's (1976) economic model of the family as a firm. We did not deal explicitly with Becker's model or with yet another prominent demographic model -- Caldwell's model of intergenerational wealth flows (Caldwell 1976, 1982; but see critique by Kaplan 1994) -- because our interest lies in the interplay between population dynamics, on the one hand, and their broader cultural, social, and ecological context, on the other. This goal is increasingly shared by many demographers (see discussion by Pollak and Watkins 1993, Fricke 1997, Kertzer 1997, among others), though it is hardly a new perspective for anthropological demographers such as Bledsoe (1990), Greenhalgh (1988), Hammel (1990), Handwerker (1986), Kertzer (1995), Kreager (1985), and Townsend (1997). Demographers have made this shift because it has become increasingly evident that standard demographic theorizing (for example, demographic transition theory) has failed in not taking into account the impact of cultural setting:"The new era … is marked by a self-conscious search for methodologies that will allow demographers to incorporate cultural meanings into their explanation of demographic processes" (Fricke 1997:825). As noted by Caldwell and Caldwell in a study of high fertility in sub-Saharan Africa, that region "may well offer greater resistance to fertility decline than any other world region. The reasons are cultural" (1987:409).

The implications of cultural setting for fertility behavior and its effects on population size become more complex when the consequences of fertility decisions affect a woman's position with respect to both her natal group and the group of her husband (and possibly other social units). Cowgill's comment about the interest of others in her fertility is only one aspect of the multidimensional social aspect of fertility decisions. Another aspect is highlighted by Ziker's comment that "property has at least as much to do with relations between people as with control over resources" -- though we find it difficult to imagine that it might be any other way since one person's having control over a resource means that another does not and a relationship between them is inevitably involved. Nor need there be consistency among the individuals or groups involved in the various dimensions that bear on fertility decisions, as van Dokkum notes with regard to Mae Enga women's disagreeing with Mae Enga men about the need for warfare. It should be noted that the men did not like warfare, but their survival was at stake and they had no choice but to fight.

At a detailed level we need to incorporate all of this complexity into our modeling of human processes, and for this we agree with Fischer that "there is still a lot of work to be done." One of the promising methodologies for this work is multiagent simulation; "agent-based models support a *model-centered social science* that rests on strongly legitimated connectionist, autonomous, heterogeneous agent-based ontology and epistemology" and "agent-based modeling should emerge as the preferred modeling approach [because] social behavior results from the interactions of *heterogeneous agents*" (Henrickson and McKelvey 2002:7295).

References

ANONYMOUS. 1978. *Population and development: A study on the population increase and its challenge to development in Egypt*. CAPMAS: Cairo.

BALIKCI, ASEN. 1970. *The Netsilik Eskimo*. New York: The Natural History Press.

BECKER, G. S. 1975. *Human capital*, 2nd edn. New York: National Bureau of Economic Research.

BECKER, G. S. 1976. *The economic approach to human behavior*. Chicago: University of Chicago Press

BELL, B. 1971. The Dark Ages in Ancient History: The First Dark Age in Egypt. *American Journal of Archaeology* 75:1-26.

BLEDSOE, C. 1990. "The politics of children: Fosterage and the social management of fertility among the Mende of Sierra Leone," in *Births and Power: The Politics of Reproduction*, edited by W. P. Handwerker, pp. 81-100. Boulder: Westview Press.

CALDWELL, JOHN C.1976. Toward a restatement of demographic transition theory. *Population and Development Review* 2: 321-366.

CALDWELL, JOHN C.1982. *Theory of fertility decline*. London: Academic Press.

__________. 1983. "Direct Costs and benefits of children," in *Determinants of fertility in developing countires, vol. 1. Supply and Demand for children*, edited by R. Bulatao and R. Lee, pp. 458-493. New York: Academic Press.

CALDWELL, JOHN C. AND PAT CALDWELL. 1987. The Cultural Context of High Fertility in sub-Saharan Africa. *Population and Development Review* 13: 409-437.

FRICKE, TOM. 1997. The uses of culture in demographic research: A continuing place for community studies. *Population and Development Review* 25: 823-832.

GRENNHALGH, S. 1988. Fertility as mobility: Sinic transitions. *Population and Development Review* 14: 629-674.

HAMMEL, GENE. 1990. A theory of culture for demography. *Population and Development Review* 16:455-85.

HANDWERKER, W. P. 1986. "Culture and reproduction: Exploring micro/macro linkages," in *Culture and reproduction*, edited by W. P. Handwerker. Boulder: Westview Press.

HENRICKSON, LESLIE AND WILLIAM McKELVEY. 2002. Foundations of ‘‘new’’ social science: Institutional legitimacy from philosophy, complexity science, postmodernism, and agent-based modeling. *PNAS* 99 (suppl. 3):7298-7295.

JANKOWSKI, JAMES. 2000. *A short history of Egypt*. Oxford: Oneworld Publications.

KAPLAN, H. 1994. Evolutionary and wealth flows theories of fertility: Empirical tests and new models. *Population and Development Review* 20:753-91.

KAPLAN, H., K. HILL, J. LANCASTER AND A. M. HURTALDO 2000. A theory of human life history evolution: diet, intelligence, and longevity. *Evolutionary Anthropology* 9(4):156-185.

KERTZER, DAVID I. 1997. "The proper role of culture in demographic explanation," in *The continuing demographic transition*, edited by G. W. Jones, R. M. Douglas, J. C. Caldwell, and R. M. D'Souza, pp. 137-157. Oxford: Clarendon Press.

KREAGER, P. 1985. "Demographic regimes as cultural systems," in *The state of population theory*. Edited by D. Coleman and R. Schofield. Oxford: Basil Blackwell.

MUELLER, E. 1976. "The economic value of children in peasant agriculture," in *Population development: A search for selective interventions*, edited by R. Ridker, pp. 98-153. Baltimore: Johns Hopkins University Press.

NAG, M., B. N. F. WHITE AND R. C. PEET. 1978. An anthropological approach to the study of the economic value of children in Java and Nepal. *Current Anthropology* 19:292-306.

PETRY, CARL F. (editor) 1998. *The Cambridge history of Egypt. Vol. 1*. Cambridge: Cambridge University Press.

POLLAK, ROBERT A. AND SUSAN COTTS WATKINS. 1993. Cultural and economic approaches to fertility: Proper marriage or mesalliance? *Population and Development Review* 19: 467-496

READ, DWIGHT W. 1987. Foraging society organization: A simple model of a complex transition. *European Journal of Operational Research* 30:320-326.

___________ 1990. "The utility of mathematical constructs in building archaeological theory," in *Mathematics and information science in archaeology: a flexible framework*. Edited by A. Voorrips, pp. 29-60. Studies in Modern Archaeology. Bonn: Helos.

___________ 1996. "Mathematical models," in *Encyclopedia of cultural anthropology, Vol. 3*. Edited by D. Levinson and M. Ember, pp. 752-57. New York: Henry Holt.

___________2001. "What is kinship?," in *The cultural analysis of kinship: The legacy of David Schneider and its implications for anthropological relativism*. Edited by R. Feinberg and M. Ottenheimer, pp. 78-117. Urbana: University of Illinois Press.

SAYYID-MARSOT, AFAF LUTFI. 1985. *A short history of modern Egypt*. Cambridge: Cambridge University Press.

WILSON, DAVID SLOAN. 2002. Natural selection and complex systems: a complex interaction. Paper given at International workshop on: Self-Organisation and Evolution of Social Behaviour, Monte Verità, Switzerland, September 8-13, 2002.

TOWNSEND, N. 1997. "An anthropological approach to the concept of fertility: Parenthood, fertility, and social reproduction," in *Anthropological demography: Toward a new synthesis.*

Edited by D. Kertzer and T. Fricke, pp. 96-114. Chicago: University of Chicago Press.

VAN DE VELDE, FRANZ. 1956. Les règles du partage des phoques pris par la chasse aux aglus. *Anthropologica* 3:5-15.

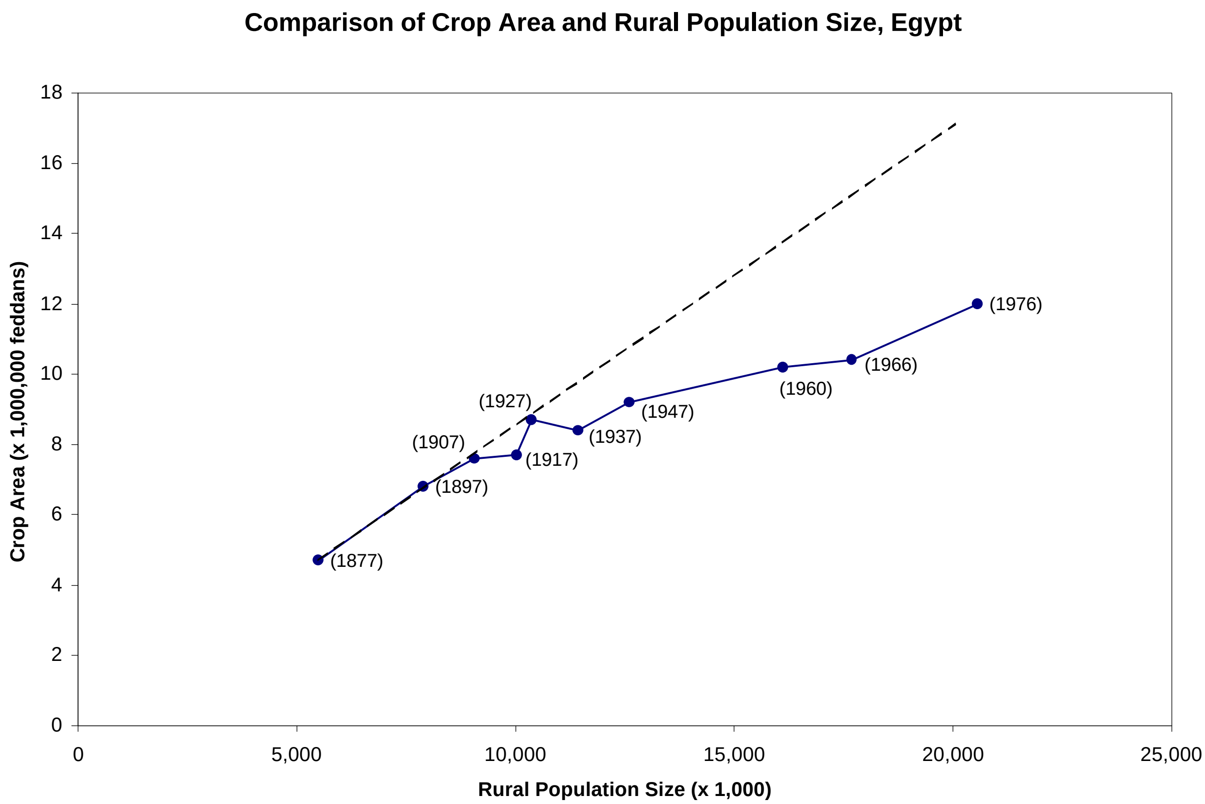

Figure 1: Comparison of rural population growth with increase in crop area. Dashed line: Constant ratio between population size and crop area. Numbers in parentheses: census years. Data from Tables 2.5.1 and 3.1.4 in *Population and development* (1978).