

RESEARCH  
PAPER



**U.S. Immigration  
and the Environment:  
Scientific Research and Analytic Issues**

**Ellen Percy Kraly**

U.S. COMMISSION ON IMMIGRATION REFORM

**THE U.S. COMMISSION ON IMMIGRATION REFORM IS A BIPARTISAN COMMISSION AUTHORIZED BY THE IMMIGRATION ACT OF 1990 AND CHARGED WITH EXAMINING IMMIGRATION POLICY AND ITS IMPACT ON SOCIAL, ECONOMIC, AND COMMUNITY RELATIONS, ON POPULATION SIZE AND CHARACTERISTICS, AND ON THE ENVIRONMENT.**

RICHARD ESTRADA  
ASSOCIATE EDITOR, EDITORIAL PAGE, DALLAS MORNING NEWS  
*APPOINTED BY SENATE REPUBLICAN LEADERSHIP*

HAROLD EZELL  
PRESIDENT, THE EZELL GROUP, INC.  
*APPOINTED BY HOUSE REPUBLICAN LEADERSHIP*

LAWRENCE H. FUCHS  
JAFFEE PROFESSOR OF AMERICAN CIVILIZATION AND POLITICS  
BRANDEIS UNIVERSITY  
*APPOINTED BY SENATE DEMOCRATIC LEADERSHIP*  
*ELECTED BY COMMISSIONERS TO BE VICE CHAIR*

ROBERT CHARLES HILL  
PARTNER, VENABLE BAETJER HOWARD & CIVILLETTI  
*APPOINTED BY HOUSE REPUBLICAN LEADERSHIP*

SHIRLEY MOUNT HUFSTEDLER  
FORMER JUDGE, U.S. COURT OF APPEALS, NINTH CIRCUIT  
FORMER SECRETARY OF DEPARTMENT OF EDUCATION  
*APPOINTED BY PRESIDENT CLINTON AS COMMISSION CHAIR*

WARREN R. LEIDEN  
BERRY, APPLEMAN & LEIDEN LLP  
*APPOINTED BY HOUSE DEMOCRATIC LEADERSHIP*

NELSON MERCED  
SENIOR ASSOCIATE  
COMMUNITY TRAINING & ASSISTANCE CENTER  
*APPOINTED BY SENATE DEMOCRATIC LEADERSHIP*

BRUCE A. MORRISON  
CHAIRMAN, FEDERAL HOUSING FINANCE BOARD  
*APPOINTED BY HOUSE DEMOCRATIC LEADERSHIP*

MICHAEL S. TEITELBAUM  
ALFRED P. SLOAN FOUNDATION  
*APPOINTED BY SENATE REPUBLICAN LEADERSHIP*  
*ELECTED BY COMMISSIONERS TO BE VICE CHAIR*

---

SUSAN MARTIN, EXECUTIVE DIRECTOR

**U.S. Immigration  
and the Environment:  
Scientific Research and Analytic Issues**

ELLEN PERCY KRALY, PH.D.

DEPARTMENT OF GEOGRAPHY  
COLGATE UNIVERSITY

FEBRUARY 1995

I AM GRATEFUL TO  
DEBORAH FEDER FOR PREPARATION OF FIGURES  
AND  
ALEX McNICOLL FOR BIBLIOGRAPHIC RESEARCH.

## CONTENTS

### EXECUTIVE SUMMARY I

PERSPECTIVES ON THE ROLE OF MIGRATION IN POPULATION-  
ENVIRONMENT DYNAMICS II

EMPIRICAL RESEARCH CONCERNING MIGRATION AND THE ENVIRONMENT  
IV

METHODOLOGIES FOR ASSESSING THE ENVIRONMENTAL CONSEQUENCES  
OF U.S. IMMIGRATION V

INFORMATION REQUIREMENTS FOR STUDYING THE ENVIRONMENTAL  
CONSEQUENCES OF U.S. IMMIGRATION VI

CONCLUSIONS VIII

A FINAL OBSERVATION X

### INTRODUCTION 1

A FURTHER RATIONALE 2

### PERSPECTIVES ON THE ROLE OF MIGRATION IN POPULATION- ENVIRONMENT DYNAMICS 6

INTRODUCTION 6

POPULATION-ENVIRONMENT MODELS AND MIGRATION 8

MIGRATION AND GLOBAL ENVIRONMENTAL CHANGE 11

PERSPECTIVES ON U.S. IMMIGRATION AND THE ENVIRONMENT 12

CONCEPTUAL ISSUES EMERGING FROM MODELS OF POPULATION-  
ENVIRONMENTAL CHANGE 13

IMMIGRATION AS A COMPONENT OF POPULATION GROWTH 13

GEOGRAPHIC SCALE AND TEMPORAL SPECIFICATION 15

SPATIAL, SECTORAL, AND TEMPORAL LINKAGES 18

---

RESEARCH  
PAPER

---

IMPLICATIONS FOR THEORETICAL RESEARCH ON U.S. IMMIGRATION AND  
THE ENVIRONMENT 20

RECOMMENDATIONS FOR THEORETICAL RESEARCH 20

**EMPIRICAL RESEARCH CONCERNING MIGRATION AND ENVIRON-  
MENTAL PROCESSES AND CHANGE 21**

INTRODUCTION 21

RESEARCH ON REGIONAL AND LOCAL POPULATION-ENVIRONMENTAL  
DYNAMICS 23

RESEARCH ON ENVIRONMENTAL OUTCOMES 27

URBANIZATION AND ENVIRONMENTAL ISSUES 28

RESEARCH ON IMMIGRATION AND THE ENVIRONMENT IN AUSTRALIA 30

IMPLICATIONS FOR EMPIRICAL RESEARCH ON THE RELATIONSHIP  
BETWEEN U.S. IMMIGRATION AND THE ENVIRONMENT 32

RECOMMENDATIONS FOR EMPIRICAL RESEARCH 33

**METHODOLOGIES FOR ASSESSING THE ENVIRONMENTAL CONSE-  
QUENCES OF U.S. IMMIGRATION 34**

INTRODUCTION 34

ENVIRONMENTAL IMPACT ASSESSMENT 35

POPULATION-ENVIRONMENT MONITORING SYSTEMS 41

RELEVANCE OF METHODOLOGIES FOR ANALYSIS OF IMMIGRATION AND  
ENVIRONMENT 41

RECOMMENDATIONS FOR RESEARCH ON METHODOLOGIES 44

**INFORMATION REQUIREMENTS FOR STUDYING THE ENVIRONMEN-  
TAL CONSEQUENCES OF U.S. IMMIGRATION 45**

INTRODUCTION 45

CONCEPTUAL ISSUES 47

CLOSURE IN DEMOGRAPHIC ACCOUNTS 49

AVAILABILITY OF DATA FOR REGIONAL AND LOCAL ANALYSIS 50

IMPLICATIONS FOR RESEARCH ON U.S. STATISTICAL INFORMATION  
CONCERNING POPULATION IMMIGRATION AND THE ENVIRONMENT 52  
RECOMMENDATIONS FOR IMPROVEMENTS IN DATA 54

**CONCLUSIONS 55**

A FINAL OBSERVATION 57

**REFERENCES 58**



## EXECUTIVE SUMMARY

Each of the most recent major amendments to the Immigration and Nationality Act includes a requirement for the federal government to assess the environmental impact of alien immigration on the United States. Specifically, the Immigration Reform and Control Act of 1986 [IRCA] specifies that the Triennial Report to Congress shall provide a “. . . description of the impact of immigration on environmental quality and resources . . .” (Sec.401(b)(3)). The Immigration Act of 1990 gives the Commission on Legal Immigration Reform the mandate to consider the “. . . social, demographic and natural resources impact of immigration . . .” (Sec.141(c)(1)(C)).

The goal of this report is to contribute to this area of policy analysis by reviewing existing scientific literature concerning immigration and environment, to identify research issues emerging from extant scholarship, and to develop recommendations for areas of needed research that will benefit the immigration policy process. It is important to note at the outset that remarkably little hard evidence exists about the environmental effects of alien migration on the United States. A great deal of speculation exists about the nature of the relationship and there is

increasing popular commentary about the degree to which immigration is associated with environmental problems in local areas as well as in the nation as a whole. The direct or causal effects of U.S. immigration on the environment have not been established, however, through scientific study. Moreover, there are significant limitations in U.S. statistics on immigration and population for the study of environmental impacts.

The report is organized around four dimensions of the research process that are relevant for examining the relationship between U.S. immigration and environmental issues. First, the section, *Perspectives on the Role of Migration in Population-Environment Dynamics*, considers the relevance of theories of population and environmental change for the study of immigration and its effects. Second, the section, *Empirical Research Concerning Migration and the Environment*, reviews the results of research relevant for the study of immigration and environment. Third, the section, *Methodologies for Assessing the Environmental Consequences of U.S. Immigration*, briefly reviews selected approaches to measuring environmental impact. Fourth, the section, *Information Requirements for Studying the Environmental Consequences of U.S. Immigration*, outlines strengths and weaknesses of the federal statistical system for

analyses of the role of immigration in population and environmental change. Recommendations for needed research are presented at the end of each section. The *Conclusions* section reviews research issues and priorities within the context of a national program of research on U.S. immigration and environment.

## **Perspectives on the Role of Migration in Population- Environment Dynamics**

The general model of environmental impact identifies three broad sets of factors influencing environmental change: *Environmental impact* [I] is conceptualized as a function of *population* characteristics [P], patterns of *consumption* [A, for affluence] and *technology* [T], the use and manipulation of energy and other natural resources. While this model has provided an organizing framework for much of the debate concerning population and the environment, it has also been criticized for incomplete conceptualization of the components and lack of grounding in social scientific theory. The degree to which the population concept is well specified or connected to theory is also

contested: uses of the model focus primarily on the increase in population size without specification of the different sources of population growth, for example natural increase (births minus deaths) relative to net migration.

Theories on population and environment vary in assumptions about the relative importance and direction of the effect of each of the factors (P,A,T) as well as the significance of interrelationships among the factors. Neo-Malthusian perspectives emphasize the significant influence of population growth for environmental impact and conceptualize a negative relationship between population growth and the availability and, increasingly, the quality of environmental resources. In contrast, more “optimistic” perspectives emphasize the enhanced potential inherent in positive population growth for social, economic, and technological progress, and hence, the means to solve environmental problems. Primary importance is given to changes in technology and social and economic organization in mitigating the effects of the other two factors. A third approach conceptualizes population pressure and short-run negative effects as a stimulus to technological innovation and more effective use of resources.

Perspectives thus vary in the degree to which population is proportional to envi-

ronmental change. According to the demographer Keyfitz:

If all else is equal, action damaging the environment is directly proportional to the number of people. That at least seems the most appropriate initial hypothesis. . . . The burden of proof is one anyone who argues against the proportionality hypothesis in either way. (Keyfitz 1993: 547)

In thinking about the impact of alien immigration on the U.S. environment, relevant questions center on the degree to which the impact of alien migration is proportionally less than, greater than, or equal to the number of immigrants.

Not surprisingly, different theoretical perspectives lead to different conclusions about the national and regional environmental impacts of U.S. immigration. Some economists have emphasized the potential contributions to human capital and the potential for technological innovation deriving from positive population growth in the United States and from alien immigration. Many ecologists, in contrast, highlight the role of alien immigration in U.S. population growth with its negative environmental consequences and often focus on the contribution to future growth resulting from the descendants of current immigrant streams.

In addition to the need to specify more clearly the role of migration in theories of population and environment, several additional issues emerge from the review of theory. Both geographic level and temporal frame of analysis must be specified in theoretical models and ultimately in empirical research. The effects of immigration on environmental processes may be expected to be significantly different for metropolitan areas, rural communities, states, and in the short-term versus the long-term. A third issue is the importance of understanding linkages or connections among geographic areas, economic sectors, and through time. For example, the concentration of immigration in certain metropolitan areas in the United States may have environmental consequences for areas and natural resources geographically removed from the cities.

The most fundamental recommendation for theory development is to revise models of population and environment to break population growth into its component parts in order to consider more clearly the effects of migration. Of particular relevance for the United States, moreover, is the specification of effects for different types of international population movements, including permanent resettlement, refugee migration, tempo-

rary labor migration, and tourism, within theories of environmental impact.

## **Empirical Research Concerning Migration and the Environment**

There is a strong and long tradition of research on the consequences of immigration for U.S. society, economy, and polity. Scholarly interest in the environmental consequences of U.S. immigration has a relatively more recent history, originating in the late 1960s with environmental concern over national population growth and the role of annual alien immigration in the path to population stabilization.

There is increasing interest among scientists and policymakers in the environmental implications of immigration for states, metropolitan areas, and local communities in the United States. Most research to date, however, tends to focus either on population growth and trends in alien immigration, viewed as the causes of environmental change and problems, or on the environmental outcomes of interest, such as land use patterns and urban sprawl, water supplies and quality. Social demographic research is being con-

ducted concerning the role of alien immigration in metropolitan and regional growth patterns in the United States. Inferences about environmental impacts resulting from alien migration are often drawn without direct measurement of the relationships between the two sets of factors: patterns of population growth and immigration are observed to co-vary with environmental outcomes, while data on causal relationships are not presented. Similarly, environmental research often focuses on direct measurement of environmental processes and quality with only cursory measurement of population and social processes that are set out in the introductory statements as direct causes of environmental change.

In short, there exists very little direct causal analysis of relationships among population, immigration, and environment in the United States. Virtually no research has been conducted on the role of immigration status or nativity in the analysis of consumption and production, such as differential patterns of energy consumption, commuting and land use patterns, and water conservation practices.

Probably the best research on migration and environmental outcome has been conducted in areas of the developing world. Very often these are case studies of the complex relationships among migration,

social, economic and technological change and environmental processes. These studies may serve to inform conceptual models, research design, and measurement in empirical studies of population, migration, and the environment in the United States.

The general observation concerning the status of empirical research on U.S. immigration and the environment is the need for more of it. There is critical need for the initiation of well-designed studies that will yield both descriptive information concerning trends and patterns of demographic and environmental processes in U.S. states and local areas, as well as causal analyses of the relationships between types of alien immigration and environmental impacts. It is particularly important that research on the environmental effects of immigration identify different sources of alien migration, for example, permanent resident aliens, foreign students and workers, and tourists. This significance of subsequent internal migration among immigrants should also be studied.

## **Methodologies for Assessing the Environmental Consequences of U.S. Immigration**

Two frameworks that have been developed to study environmental change are relevant for the study of U.S. immigration and the environment: environmental impact assessment [EIA] and population-environment monitoring systems [PEMS]. Environmental impact assessment most often attempts to forecast the impacts of development projects or structural or engineering initiatives, generally new activities within a geographic area. Monitoring systems represent ongoing social and environmental accounting frameworks for the collection and analysis of data over time for specific geographic areas.

The goal of the EIA process is the provision of objective, typically quantifiable, information for policymakers and program administrators concerning the range of environmental consequences of some proposal, often a building project, for a region or place. Inherent in the EIA process are theoretical models of the nature

of causes of environmental change. It is important to place the proposed source of environmental change, i.e., the project or policy initiative, within a multivariate framework in which all exogenous influences on environmental outcomes are documented. The process of EIA involves predictive and, thus, causal analysis. The approach may be useful in assessing various immigration policy options, for example, changes in overall levels of annual alien immigration to the United States, as well as changes in the structure of immigrant admissions in terms of individual and family characteristics.

Population-environment monitoring systems measure changes in these factors over time and are useful in providing an empirical foundation for evaluation of existing policies and collecting baseline data for identifying subsequent environmental impacts. If the approaches to monitoring are standardized across administrative units, results of PEMS can be compared among local areas and also aggregated for analysis of regional dimensions of national policies. This characteristic of PEMS is critically salient for purposes of U.S. immigration policy evaluation.

A critical issue in exploring the use of EIA or PEMS for the study of immigration and environment is the degree to

which the assessment or monitoring system documents all significant dimensions of environmental impact for the regions. Beyond the contribution of alien immigration to population growth for a region or area are issues concerning patterns of resource consumption, technological innovation, conservation behaviors, land use patterns, and how these vary between immigrants and U.S. residents, and among types of immigrants. Moreover, the methodologies must be open to document other sources of environmental impact for the study area, such as in- and out-migration of U.S. residents and economic change. Finally, the relevance of any EIA, monitoring system, or other more appropriate research design for determining the effect of U.S. immigration on the environment will rest, finally, in the degree to which *national*, *state*, and *local* data collection systems can support multivariate analysis of complex dimensions—demographic, economic, institutional, behavioral—of environment change.

## **Information Requirements for Studying the Environmental Consequences of U.S. Immigration**

The specification of data needs should be guided both by theory and by the important policy questions concerning U.S. immigration and the environment. While the emphasis of this report is generally on the relevant research concerning immigration, it is important to note the serious concern among environmental scientists about the status of environmental data for the United States and the capacity for monitoring environmental quality and resources for different geographic areas.

Fundamental to the analysis of immigration and the environment, however, is statistical information on the contribution of alien immigration to population growth for states, regions, cities, and local communities in the United States. Further, because the present policy debate concerns the impact of *alien* migration, disaggregation of the components of population growth—fertility, mortality, and migration—by immigration status is also a necessary characteristic of statistical information. Accordingly, the report focuses on the adequacy of U.S. data on population processes for measuring the role of alien immigration in population dynamics on national, regional, and local scales of analysis.

Problems in the adequacy of national demographic accounts for the comprehen-

sive measurement of trends and components of population change have been well documented. Three sets of issues pose particular problems for the empirical evaluation of the role of alien immigration in population growth and generally in environmental processes. First, conceptual problems exist in official data on alien immigration. U.S. statistics on immigration collected by the U.S. Immigration and Naturalization Service [INS] represent legal and administrative categories, including permanent resident alien, nonimmigrant, refugee, asylee, and parolee. As a result these data are less than ideal measures of demographic concepts of long and short-term immigration that use criteria such as length of stay and activity in the country. Work has been done to manipulate INS administrative data better to represent demographic concepts of alien immigration. Comparison of demographic measures with official INS data on admissions yields important differences in the national origins characteristics of annual alien immigration to regions and states in the United States.

Second, U.S. statistics on international migration lack closure: it is not possible to assess the impact of alien immigration on population growth in an area if not all sources of population change are known. For example, no systematic source of data exists on the process of out-migration of

---

RESEARCH  
P A P E R

- viii -

---

aliens or citizens from the United States; measurement of levels and patterns of undocumented migration relies on demographic estimation. Very useful work has been conducted by the U.S. Census Bureau to estimate emigration using census and survey data. There has also been consideration of other federal sources of administrative data as a basis for estimating emigration. As with alien emigration, estimates of undocumented migration have been developed using methods of demographic estimation for U.S. census data, immigrant data records, and assumptions about mortality levels, emigration, and census undercount. Demographers at INS have also estimated the size of the undocumented alien population by state of residence.

Third, the role of alien migration in annual population growth for states and local areas is not easily measured. Decennial census data are extremely valuable for measuring components of population change for small geographic areas at ten-year intervals. Currently, however, annual measures of the immigrant population at the subnational level are available for large states and metropolitan areas through the Current Population Survey. The lack of data on internal migration patterns of immigrants is particularly frustrating for comprehensive study of the effect of immigration on states and local areas.

Longitudinal survey design holds strong potential as a means more effectively to collect data on the social demographic behavior and experiences of immigrants and U.S. citizens relevant for the study of immigration and environment. The research community has recognized the value of a survey of immigrants to directly study patterns of settlement and internal mobility among immigrants, as well as social characteristics and economic behavior among immigrant cohorts and how these change over time. To yield results appropriate to environmental research, survey design must address, first, the need for reliable data at different geographic scales, and, second, the critical need to compare environmental relevant behaviors and characteristics among different groups of immigrants and with U.S. citizens over time.

## Conclusions

Four broad areas of recommendations for scientific research concerning U.S. immigration and environment emerge from this review:

**First**, research on the environmental consequences of U.S. immigration will benefit from the revision of models of the population-environment to specify the role of migration and, specifically, types of

international migration, in processes of environmental change. Theoretical development concerning migration and the environment needs to occur to derive relevant and testable hypotheses about causal relationships and effects.

**Second**, research on U.S. immigration and the environment should provide both descriptive results concerning trends in demographic and environmental change at different geographic scales and for specific places, as well as causal insights about the nature of relationships between levels and types of alien immigration and environmental outcomes. Studies should be undertaken on the national, regional, and local levels to compare the effects of immigration at different geographic levels, adding to our understanding of geographic variation of impacts.

**Third**, it is critical that attention be given to developing the necessary research designs for ongoing study of the interrelationships among population, immigration, and environmental processes for the nation, states, and local areas in the United States. Survey methodology has been shown to hold useful potential for studies of the social and economic consequences of migration and should be explored for studying environmental impacts.

**Fourth**, the statistical foundation for the analysis of the environmental consequences of U.S. immigration must be strengthened. Migration statistics—data on alien immigration, internal migration, and emigration—must be improved to accommodate local and regional analysis for intercensal periods. As relevant in these times of fiscal restraint in federal spending is the critical need to advocate the continuation and maintenance of current statistical programs: INS statistics on the admission of aliens to the United States must continue to be collected and made accessible for public use; questions concerning nativity, citizenship, and geographic mobility must continue to be asked on the decennial census and the Current Population Survey. Finally, an assessment of the status of indicators of environmental quality and resource availability is a critical component of developing an agenda of policy relevant scientific research.

These broad recommendations beg the question of strategy for stimulating and organizing research efforts to address the important analytic issues concerning U.S. immigration and the environment. Interdisciplinary collaboration is essential for the development of a research program on U.S. immigration and the environment. Interaction among environmental and

---

RESEARCH  
P A P E R

- x -

---

social scientists in government agencies and planning offices, as well as in universities and research institutes, must be encouraged to initiate theoretical development, to reflect on research design, to document the status of available data, and, ultimately, to establish a framework for interpretation of research results in connection to the policy process.

Given the need for both baseline documentation and exploratory analytic research, it seems highly appropriate to initiate a coordinated research program on immigration and environment for specific regions, metropolitan areas, and local communities in the United States. Selected places should be identified as research sites in which an integrated program of population and environmental research would be implemented. Interdisciplinary collaboration among scientists must be organized within research sites and coordinated with relevant planning and scientific agencies at the federal, state, and local areas.

## **A Final Observation**

Barry Commoner once stated that he knew “. . . of no scientific principle which can tell us how much to rely on population

control and how much on technological change (and the required economic controls) in order to reduce environmental impact. The choice between these alternative paths is clearly a political one, not a matter of science.” A somewhat contrasting perspective is evident in this report. Research on relationships between U.S. immigration and the environment is an essential component of rational and responsible decisionmaking concerning U.S. immigration. Whether environmental criteria are appropriate grounds for revising immigration policy encompasses questions that are within the grasp of social and environmental research.

## INTRODUCTION

Each of the most recent major amendments to the Immigration and Nationality Act includes a requirement for the federal government to assess the environmental impact of alien immigration on the United States. Specifically, the Immigration Reform and Control Act of 1986 [IRCA] specifies that the Triennial Report to Congress shall provide a “. . . description of the impact of immigration on environmental quality and resources . . .” (Sec.401(b)(3)). The Immigration Act of 1990, which focused on legal immigration, gives the Commission on Legal Immigration Reform the mandate to consider the “. . . social, demographic and natural resources impact of immigration . . .” (Sec.141(c)(1)(C)), and also requires the government to provide statistical information that is “. . . useful in evaluating the social, economic, environmental, and demographic impact of immigration laws . . .” (Sec.142(c)(1)).

These statutory mandates to consider the relationship between U.S. immigration and environmental processes and issues provide an opportunity for social and environmental scientists to expand theoretical and empirical knowledge concerning population-environment dynamics by giving specific attention to processes of international migration, mobility, and

circulation. The goal of this report is to contribute to this area of policy analysis by reviewing existing scientific literature concerning immigration and environment, to identify research issues emerging from extant scholarship, and to develop recommendations for areas of needed research that will benefit the immigration policy process. It is important to note at the outset that remarkably little hard evidence exists about the environmental effects of alien migration to the United States. A great deal of speculation exists about the nature of the relationship and there is increasing popular commentary about the degree to which immigration is associated with environmental problems in local areas as well as the nation as a whole. The direct or causal effects of U.S. immigration on the environment have not been established, however, through scientific study. Moreover, there are significant limitations in U.S. statistics on immigration and population for the study of environmental impacts.

The report serves as an initial review of four salient dimensions of a policy relevant research agenda concerning the relationship between U.S. immigration and environmental issues. First, we consider the relevance of contemporary theoretical perspectives on the relationships among population change, migration, and environmental processes and problems. Sec-

ond, we review the extant scientific literature concerning these relationships. While primary attention is directed to studies pertaining to the United States, the review seeks to be comprehensive by considering relevant research concerning migration and the environment in other countries and regions; particular attention is given to research concerning immigration and the environment in Australia. Third, we consider the relevance of existing methodological approaches to studying environmental change for the analysis of the environmental consequences of alien immigration and international population movements to and from the United States. Environmental impact assessment and population-environment monitoring systems are considered specifically. Fourth, given existing theory and methods, we reflect on the information requirements for analysis of immigration-environmental relationships at various geographic scales in the United States. The degree to which federal statistics can support analyses of the role of immigration in national, regional, and local population dynamics is considered a critical issue for policy research concerning immigration and the U.S. environment.

Throughout the review, we draw on scientific literature specific to the United States as well as studies and perspectives on human environmental impact specific

to other countries and regions, including areas within the developing world. We thus attempt to glean from this array of scholarship insights about theory, methods, and empirical research that are relevant for developing a research agenda for the U.S. context. The paper concludes with an outline of research priorities concerning the consequences of immigration for environmental processes and trends in the United States.

## **A Further Rationale**

As implied above, the legislative mandate for information on the environmental consequences of U.S. immigration provides an important opportunity for policy relevant research and also for the expansion of scientific literature concerning population-environmental dynamics. In short, there is an opportunity for both basic and applied research concerning human-environmental interactions. There is also a need for such research because conclusions or inferences about the environmental consequences of immigration may be preceding systematic study of the issues (for example, Mann 1990; Population-Environment Balance, Inc. 1992; Simcox 1992; Federation for American Immigration Reform 1991). It is relevant to note that

the premature use of environmental arguments in debates over immigration was anticipated in Canada a few years ago. The Canada Employment and Immigration Advisory Council observed that given evidence about the positive economic impacts of immigration, the Canadian public might be expected to shift its attention to another rationale to restrict immigration, and that argument could likely settle on environmental issues (see Canada Employment and Immigration Advisory Council 1991:30-31).

It is also interesting to note that the discussions about environmental effects are somewhat reminiscent of the tone of statements made in the early decades of this century concerning the social and cultural effects of immigration, e.g. in such statements as the one below made in 1926 by George Cutten, President of Colgate University concerning the effects of immigration for the quality of the U.S. population and society. [Currently on display in the exhibit on immigration restrictionism at the Ellis Island Museum, perhaps it is not the most appropriate illustration, but it holds intrinsic interest for this writer.]

The melting pot is destructive to our race. . . . We must either build up from own resources and conserve our race power, or else we must admit only such immigrants as shall strengthen and not weaken

our race, or both. The danger the 'melting pot' brings to the nation is the breeding out of the higher divisions of the white race and the breeding in of the lower divisions. (Wood 1923)

A recent statement by the Federation for American Immigration Reform concerning the environmental effects of current alien immigration to the United States directs attention to the relationships among immigrant fertility and population growth within the context of declining environmental quality and resources:

**WHY A LIMIT?  
Our Natural Environment  
Says There Must Be Limits  
on Increasing Numbers  
of Immigrants**

We are plagued by water shortages, overflowing landfills, crowded transportation systems, deteriorating wilderness and recreation areas and toxic pollution, ailments that point very clearly to the fact that the U.S. is overpopulated. . . .

Some experts point to the increasing number of immigrants and refugees admitted to this country during the last ten years as one reason for the rising

fertility rate. Most of the recent entrants to the U.S. have come from countries with high fertility rates, and many who come are in their childbearing years. . . . (Federation for American Immigration Reform 1991:41-42)

Even somewhat more scientific accounts of U.S. immigration draw illusions to ecological concepts. Note, for example, the reference to limits on the absorptive capacity in a recent publication of RAND-Ford Foundation Program for Research on Immigration Policy:

**Policy Questions Regarding the Flow of Immigrants**

Policies of the last decade leave three central issues regarding new immigration unresolved.

**Aggregate Total Numbers.** Each of the three significant immigration measures passed by Congress during the 1980s has been considered independently, and each has had an expansionary and compounding effect on the size of legal immigration. For the most part, each has been considered without a unifying debate on the overarching question of how much total immigration . . . the nation can

productively absorb. Of particular note, policy makers have not examined the **absorptive capacity** of the major metropolitan receiving centers.

. . . The policy question will be how to respond to the growing pressures [for immigration to the United States]: Is there a **limit** to the nation's **absorptive capacity**, and, if so, what is the **limit**? [emphasis added] (Rolph 1992:50-51)

These are appropriate questions reflecting ecological perspectives concerning the human environment. While Rolph does not define explicitly absorptive capacity, we can infer the concept to refer to the capacity of societal institutions to receive and integrate alien migrants (as opposed to the addition of native births) into local communities, regions, labor markets, and, ultimately, national society. Absorptive capacity is thus related to an area's carrying capacity [see pages 24-25 below] but encompassing the availability of social, economic, and political resources effectively to accommodate newcomers.

Increasingly, however, there are popular interpretations of the effect of immigration on both the social and physical environment. While questions concerning absorptive capacity are similar to the

above statements, definitive answers are being forwarded identifying immigration as the cause of a range of social and environmental problems. Excerpts from the *San Francisco Examiner-Chronicle* are illustrative:

**Bursting at the Seams**

. . . It is time to consider a moratorium on immigration until we have provided a lamentably lacking element in our governance system—a population policy. We need to determine the carrying capacity of the state.

Fiscal problems aside, how many people can our dwindling natural resources support at a reasonable standard of living?

Consider water, for example. As we have learned recently, the filling of the reservoirs by this year's rains will not solve the long-term water shortage.

Even with reservoirs at capacity there is not enough water to satisfy present demands, much less an unending demand for more. The population grows; the water supply does not. . . .

Water conservation can extend existing supplies, but you can only tighten the belt up to a point. A continually growing population will overtake all efforts at conservation.

Another declining resources is topsoil. . . .

. . . Where once there were miles of orange groves beneath snowy mountains, there are now miles of besmogged suburbs, and the mountains are seldom visible. . . .

Half of the state's population increase comes from net births . . . [net increase]. But most of the births that increase the population are attributable to immigration. (Gilliam 1993:7,12)

The point is that statements currently are being presented about the relationships among population, immigration, and the environment in the United States. It is critical that scientific evidence concerning these relationships enter into the policy arena both to inform the immigration policy process and to clarify the multiple causes and correlates of environmental issues. As Preston (1993:601) observes, "[d]iscussions of appropriate levels of im-

migration inevitably will become heated, and it is important to begin now to establish a sound basis for any revisions.”

## **PERSPECTIVES ON THE ROLE OF MIGRATION IN POPULATION- ENVIRONMENT DYNAMICS**

### **Introduction**

Theoretical perspectives on the relationship between population and the environment generally fall into three broad camps, each with different implications for policies concerning population regulation and migration. These perspectives have been critically presented by Hogan (1992), Lowe and Bowlby (1992), Fincher (1991:9-16), and Lowenthal (1992, 1990) among others, and will be described only briefly here. Neo-Malthusian perspectives conceptualize a negative relationship between population growth and the availability, and, increasingly, the quality of environmental resources (see, for example, Ehrlich & Ehrlich 1992; Grant 1992). More optimistic perspectives emphasize the enhanced potential inherent in positive population growth for social, economic, and technological progress and, hence, the

means to solve environmental problems (see for example, Simon 1990, 1992; Repetto 1987); Boserup conceptualizes population pressure as a stimulus to technological innovation and more effective use of resources (Boserup 1981). A third perspective, less associated with proscriptions concerning population control policies, identifies population growth as a factor that retards efforts at social and economic development and exacerbates social inequality within poor societies (see Mink 1992; Caldwell 1985; cf. National Research Council 1986; United Nations Secretariat 1991).

The general model of environmental impact has been presented and applied by Ehrlich & Ehrlich (1990) among others (see Marden & Hodgson 1975). Environmental impact [I] is conceptualized as a function of population characteristics [P], patterns of consumption [A, for affluence] and technology [T], the use and manipulation of energy and other natural resources. This model has provided an organizing framework for much of the debate concerning population and the environment. Neo-Malthusians emphasize the significant influence of population growth for environmental impact, while “optimistic” perspectives give primary importance to changes in technology and social and economic organization in mitigating the effects of the other two factors.

The model has been criticized for the incomplete conceptualization of the causal components and the lack of grounding in social scientific theory. Meyer and Turner (1992:52) note that the model “. . . suffers from the handicap of a mismatch between its categories of driving forces (apart from population) and the categories customarily used in the social sciences. Neither “affluence” nor “technology” as defined is associated with a substantial body of social science theory; any bridges between the IPAT and other approaches would have to be built between these categories and those better-conceptualized aspects of behavior and social structure that may drive and limit changes in production and consumption.” Demeny (1991:410-12) comments on the implication of independence among the three components of environmental impact and hence the lack of conceptual attention to the ways in which changes in population, consumption and technology are interrelated.

The degree to which the population concept is well specified or connected to social theory can also be contested: uses of the model focus primarily on the increase in population size without conceptualization of the different sources of population growth, for example, natural increase relative to net migration. For example, critical attention to the interrelationships among migration, patterns of consumption, and shifts in technology is

not accommodated in the model; in general, testable hypotheses about the effect of population movements on social and technological change are not derived from the model. Relatedly, the model frustrates a dynamic perspective concerning the consequences of changes in the factors over time. Pragmatic considerations of short-term versus long-term relationships are not prominent in the theoretical discussions.

In spite of these conceptual deficiencies, however, the IPAT model has become an important conceptual construct influencing general thinking about population-environment relations. Keyfitz (1993:547) clarifies the strengths and weaknesses of the general model and states the hypothesis clearly:

If all else is equal, action damaging the environment is directly proportional to the number of people. That at least seems the most appropriate initial hypothesis.

Keyfitz provides examples of circumstances in which population has a more than proportional effect on environmental change, that is, a 1 percent increase in population results in more than 1 percent change in some environmental characteristic, for example, the stock of some natural resource; similarly, one can illustrate

circumstances in which population growth is associated with a less than proportional environmental impact. According to Keyfitz, however, "(t)he burden of proof is on anyone who argues against the proportionality hypothesis in either way" (1993: 547).

## **Population- Environment Models and Migration**

This discussion of general perspectives on population and environment suggest that an appropriate modification of theory is the improvement of the ways in which population processes and concepts are specified. For example, the effect of immigration on environmental change is likely to be different from the effect of above replacement fertility or of mortality decline, thus, using the vocabulary of Keyfitz, immigration may have a different level of proportionality than other demographic processes. Hence, results specific to demographic behaviors (mortality, fertility, and geographic mobility and migration) will be relevant to different policy responses.

Theoretical discussions of population-environment relationships vary in the de-

gree to which migration is critically considered. For example, neo-Malthusian perspectives give greater conceptual prominence to the negative effects of aggregate (positive) population growth and hypothesize that any source of growth, such as positive net migration, has negative consequences for the environment. The application of these perspectives to the United States, for example, leads to conclusions about the negative effects of alien immigration for preservation of resources and environmental quality. Not surprisingly, more optimistic conceptualizations draw the converse hypothesis about the role of migration on technological and environmental change (see Simon 1990). Fundamentally, however, the role of migration in environmental change derives directly from the underlying conceptual model of population-environment dynamics: the effect of migration is specified on the basis of its (positive) contribution to population growth.

Among the recommendations of the National Research Council Committee on the Human Dimensions of Global Change was the need to "... 'unpack' broad concepts, such as technological change, economic growth, and population growth, that are frequently offered as explanations of how human activities cause global change" (Stern, Young & Druckman 1992:97; see

also Ness, Drake & Brechin 1993b:377-406). Such recommendations hold particular relevance for specifying the role of migration in environmental process and change. For example, in a critique of perspectives on population and the environment, Hogan (1992:113-14) identifies, first, the theoretical disadvantages of the concept of aggregate population growth and, second, the advantages of considering more meaningful demographic processes:

But in all of these cases [theoretical perspectives], with a pure or moderated or even inverted Malthusianism, what we see is an emphasis on the volume or growth rate of population. The refrain is always the race between population and resources. The question of the population/resource or population/environment relation is reduced to a unidimensional relation. the ways in which patterns of fertility, morbidity, mortality, migration, nuptiality, and age structure relate to environmental change, have received little attention. What seems to have occurred, on the one hand, is that for the Neo-Malthusians, there is not reason to go beyond this point; the relation is clear, and the solution obvious. On the other hand, the

critics look for the causes of environmental problems in other processes. It is as though population growth causes everything or population is unimportant.

What is needed is an analysis of the relationships of demographic dynamics, in all their complexity, with environmental change. . . .

An important starting point in efforts to go beyond such generalizations is to decompose what we mean by "population pressure" which has been nearly universally understood to mean excess numbers with clear conclusions about policies to reduce fertility rates.

Hogan's observation about the derivation of fertility policy proposals is increasingly applicable to policy recommendations to restrict or to promote immigration. Such proposals similarly derive from inherent conceptualizations of the environmental effects of aggregate population growth.

The theoretical necessity to disaggregate the components of population growth in order to specify the role of migration (or any demographic behavior) in environmental processes is reinforced by Mink

(1992) in his discussion of the interrelationships among population, development, and the environment. In reference to developing countries, Mink identifies the range of effects of migration on environment processes that are conditioned by social and economic factors in both places of origin and destination:

Migration often represents a response to imbalances between population levels and the capacity of local environmental resources to support them. There are also potent environmental impacts in areas receiving the migration, which will differ according to the form the migration takes—whether of individuals or households, seasonal or permanent, to frontiers or established communities—and which can either mitigate or exacerbate the environmental impact of population growth. Some forms of episodic migration, such as flight from political strife, can expose environmental fragile areas to massive population increases . . . (Mink 1992:26-27).

Implicit in Mink's discussion is both an emphasis on the importance of shorter-term effects of migration on developing

areas, particularly refugee migration, as well as the importance of incorporating causes and characteristics of migration processes in studies of environmental change. Finally in their critical analysis of population-environment perspectives, Arizpe, Stone, and Major (1994:340) state:

Population must not be reified as if the simple numbers of human bodies were all that mattered. From the standpoint of population/environment analysis, people are significant in terms of what these humans do in a matrix of social and environmental interactions. This means that population must be understood as a process of biological and social reproduction whose components are principally interactions. Research must focus on these interactions as they relate to the three determinants of population—fertility, mortality and migration.

They emphasize the relevance of study on the relationship between migration and environmental change and the role of gender and income inequality in migration processes and changing environmental processes, such as patterns of consumption, resource extraction, and

waste production (Arizpe, Stone & Major 1994: 339-40).

Perspectives on the relationship between global dimensions of urbanization do focus on the significance of migration as a component of regional population growth and redistribution (see Keyfitz 1991; Berry 1990; Detwyler 1971 ) but generally in the form of regional rural-urban movements and labor circulation. Perspectives on optimum city size, in contrast, grapple with the effect of the aggregate concept, urban population growth, on urban efficiencies in accessibility of services and resources, and urban environmental characteristics, such as residential and industrial density, air and water quality, pollution, waste disposal, and sewage processing. Less attention is given to the nature of the relationships between specific sources of urban growth, for example, alien immigration versus internal migration, and social and environmental outcomes in urban areas and metropolitan regions, although issues of population homogeneity and urban problems have been raised (see for example, Speare & White 1990, 1992; Fincher 1991; Murphy, et al. 1990; cf. Muller 1993:211-13).

## **Migration and Global Environmental Change**

The degree to which migration processes are considered in conceptualizations of population-environmental linkages is a function of both theoretical perspective and geographic scale of analysis. Perspectives on global environmental change generally focus on overall population growth without significant or specific attention to component processes underlying patterns and trends in geographic distribution (see, for example, National Academy of Sciences 1991; Ehrlich & Ehrlich 1990; Stern, Young & Druckman 1992; Barry, Mather & Sdasyuk 1991; Mathews 1991a; also Royal Society of London and National Academy of Sciences 1992). Moreover, models of global population change emphasize the implications of regional variations in population growth but tend to obscure the role of international or inter-regional migration in the global outlook and regional trends (see Keyfitz 1991; Demeny 1990; Goudie 1990; Smil 1990, 1991; Bongaarts 1992; also Coale 1975). In this sense, some contemporary perspectives are reminiscent of earlier consider-

ations of population growth for the environment (see, for example, Turk, Turk & Wittes 1972; Waldron & Ricklefs 1973; Detwyler 1971a; cf. Dubos 1971; see also Goudie 1990).

## **Perspectives on U.S. Immigration and the Environment**

Perspectives on the national and regional environmental impacts of U.S. immigration similarly reflect underlying theoretical frameworks. Simon (1990) has emphasized the potential contributions to human capital and the potential for technological innovation deriving from positive population growth in the United States and alien immigration. Short-run costs of immigration are distinguished from long-term benefits; age composition of immigrants, rather than such characteristics as national origin or education, is considered the important policy issue relevant for questions of immigration impacts. Ehrlich and Ehrlich (1992), in contrast, have used the IPAT model to illustrate the degree to which the United States is over populated and the need to constrain population growth. These authors recognize both the long-term benefit of reducing levels of fertility as well

as the political and sociological difficulties in recommending the cessation of immigration as a route to stationary (zero) population growth (Ehrlich & Ehrlich 1992:130-31).

Most neo-Malthusian perspectives on the environment, however, generally highlight the role of alien immigration in U.S. population growth and often focus on the contribution to future growth resulting from the descendants of current immigrant streams (see for example, Bouvier 1991, 1992). The results from these studies, often population projections, present images of unending population growth deriving from the rising demand for immigration within developing countries and positive annual levels of permanent immigrant additions. Inherent in these perspectives are critical conceptual and analytic issues concerning immigration and population growth. For example, there is contention over appropriate approaches to conceptualizing the source of population growth resulting from international migration in annual measures of population growth as well as in population projections. Interpretations of population projections must also be resolved with results of formal demographic studies of the relationship between annual immigration and the achievement of a national stationary population.

## **Conceptual Issues Emerging from Models of Population- Environmental Change**

Several analytic issues emerge from this review of the conceptualization of migration in population-environment models. Very fundamentally, the conceptualization of immigration as a component of population growth must be revisited. Second, both geographic level of analysis or geographic scale and temporal reference, for example, short-term or long-term, must be specified in theoretical models and, ultimately, in empirical research. The effects of immigration on environmental processes may be expected to be significantly different for metropolitan areas, rural communities, and states. Similarly, the setting of policy goals regarding immigration and the environment and the process of policy evaluation require explicit time frames for analysis and assessment. A third analytic issue is the importance of understanding linkages or connections among geographic areas, economic sectors, and through time. For example, the concentration of immigration in certain metropolitan areas in the United States may have environmental

consequences for areas and natural resources geographically removed from the cities.

### ***Immigration as a Component of Population Growth***

There is not consensus among demographers concerning the most appropriate approach to conceptualizing, and hence measuring, the proportion of population growth due to migration or the role of immigration in future population growth. For example, partitioning annual population growth among demographic components to yield the proportions (in percents) of growth due to immigration ignores the overall level of population growth and also assumes all sources of population change are measurable (see pages 57-59 below). Warren (1994b) suggests the comparison of annual immigration to total additions to the population, that is, immigrants and births is a more appropriate approach to thinking about immigration's contribution to population growth (see also Keely 1974). Weeks (1992) advocates the migration ratio: net migration as a proportion of natural increase, (births minus deaths) for areas. Simon (1990) argues for the use of the ratio between either the flow of immigration (immigration admissions or arrivals) or the stock

of immigrants (such as the foreign-born population) to the residential population in a given year as a gauge of immigration of both demographic and social impact.

Similarly, there are differing approaches to conceptualizing the impact of immigration on future population growth in both the short and long-run. Population projections simulate future patterns of population growth by making assumptions about changes in behavioral patterns of demographic processes (mortality, fertility, and migration), by age and sex, and often by other social demographic characteristics such as race and rural or urban residence. The effect of the demographic components of growth on future population size and structure (age and sex composition) is shown by comparing the results of different projection series in which different assumption are modelled. For example, the U.S. Census Bureau conducts population projections assuming the continuation of current levels of net immigration (see page 59 below) and projections assuming zero net immigration.

Problems in interpreting the results of population projections concerning the contribution of immigration population growth have been discussed by demographers (see, for example, Edmonston & Passel 1992; Keely & Kraly 1978; Kraly 1981). A fundamental issue concerns the

choice of reference data for measuring the demographic impact of immigration: nearly 100 percent of U.S. population growth since 1790 has resulted from immigration and the descendants of immigrants. There are empirical difficulties in developing assumptions about fertility among first and subsequent generations of immigrants. Further, emigration is often not modelled as an age specific propensity, but is subsumed with a concept of net immigration. Given the wide use made of population projections in discussions of U.S. immigration policy issues, it is critical that conceptual issues in both approaches to modelling and in the interpretations of results be clearly set out.

Similarly the results of formal demographic analysis of immigration and population growth should be incorporated into models of population and environment. As mentioned above, there is a solid body of demographic theory that has revealed the relationship between positive immigration and the achievement of population stabilization at zero annual growth, that is, a stationary population (Keyfitz 1971; Coale 1972; Pollard 1973; Espenshade, Bouvier & Arthur 1982; Mitra 1983; Espenshade 1986; Feichtinger & Steinman 1992). A stationary population is consistent with annual immigration given fertility at replacement or below replacement levels. The ultimate size of

the population is a function of the level of fertility and mortality, annual levels of immigration, and the age composition of immigrants. These results suggest the importance of better understanding demographic characteristics of immigrants, specifically fertility and age characteristics, in order to interpret more effectively results of models of immigration, population growth.

***Geographic Scale and Temporal Specification***

Geographic scale is a critical conceptual and analytic dimension of contemporary perspectives on population and environment. The importance of considering the role of demographic processes in environmental change on regional and local scales of analysis is increasingly emphasized in literature on the relationship between economic development and the environment in less developed countries (see, for example, Arizpe, Stone, and Major 1994; Mink 1992; Ogata 1989:48; United Nations Secretariat 1991; Glaser 1980; Milliman 1992; Huguet 1992). Mink (1992:13), for example, calls for both spatial and temporal specification:

The impact of population intervenes along three main dimensions: its scale in relation to

the resource base, its rate of growth, and its redistribution across resources through migration. Population's impact on the environment is critical in some countries or regions within countries, but is less important in others. Moreover, the three dimensions will not be equally important for the environment in different places and points in time. Thus, assessments of population's impact on the environment, and the appropriateness of addressing such impact through direct population interventions, need to take local circumstances into account.

In reflecting on the study of environmental processes among island ecosystems, Glaser (1980:9) offers a very clear statement on the "limitations of global synthesis" in the study of population and the environment:

The population/resource/environment situation differs from country to country and varies even from area to area within most countries, in particular the larger ones. The problems of assessing population/resource ratios, and of defining measures for their beneficial adjustment,

must be tackled on a disaggregated and areal basis. In fact, there seems to be a need for almost every country to develop a population/resources environment model for its particular national situation for its major geographic subdivisions.

Bilsborrow (1992) argues for local and regional studies as opposed to cross-country analysis on the basis of principles of research design and the analytic goal to move beyond descriptive studies of covariation to conclusions concerning causal processes:

While cross-country-level data have the appeal of generalizability, there are important reasons for focusing research efforts at the individual country level. One is the much greater possibility of controlling for other factors that influence demographic and environmental change, such as national resource endowment, climate and topography; soil quality; transportation linkages to markets and cities and availability of off-farm employment; access to family planning, health and education facilities; . . . and national and local government

policies relating directly to the environment, such as restrictions against tree cutting, cost of logging concessions, and protection of parks and nature reserves. All of these factors, and undoubtedly others, may influence demographic processes, agricultural and land use change, and environmental degradation in rural areas.

A second reason for preferring within-country studies is that aggregate country-level data cannot relate well (differences in) natural resources trends to (differences in) demographic variables. If it were true that countries with faster rates of population growth appeared to be experiencing faster rates of forest loss, this would not necessarily mean that the two are related, particularly from the production or supply side, as per the focus in this paper. One would need to see if those areas *within* the country experiencing forest loss are also the areas experiencing population growth (in-migration). This can only be addressed at the country level . . . (Bilsborrow 1992:144-45)

Critical perspectives on the concept of carrying capacity further underscore the need to relate population and environmental processes on local and regional scales defined most appropriately by ecological analysis (see Bayliss-Smith 1980; Glaser 1980; Brookfield 1980; McCall 1985; Talbot 1986; Santos 1990:39-40,75-76; see also McConnell 1991). Carrying capacity is the size of population that can be supported by the resources of an ecological system. In human population, the concept must be understood to be dynamic, that is, open to change through technological and social factors. Hogan argues for the value of the concept of carrying capacity in order to relate demographic processes, resources, environmental trends, technological change, and patterns of production and consumption within specific regions:

The value of the concept of carrying capacity is that it should direct our attention to specific ecosystems, exploited with specific technologies, to produce a specific standard of living. Here one may meaningfully relate population pressure to environmental degradation. (Hogan 1992:116)

Because carrying capacity is altered by technological and institutional change, the

conceptual framework requires the specification of the temporal context for analysis. Hence, the short-term outcomes of migration for environmental change may be conceptualized quite differently for places and regions in comparisons to models with longer-term time horizons in which feedback between migration and social and technological change may be envisioned (cf. Simon 1990:188-92). A useful discussion of issues in the interpretation of the concept of carrying capacity is provided by Cater and Goodall (1992:312-13) who consider carrying capacity within specific destinations for tourists in Australia (see also Bayliss-Smith 1980; Huguet 1992:388). Because of the relatively short-term impact of increasingly large numbers of certain types of international migrants—tourists, business persons, students—in selected places in the United States, it may also be useful to explore the use of the concept of carrying capacity in relationship to the demographic notion of “person-years” of impact (K. Woodrow 199 ).

Meyer and Turner summarize these issues of scale concerning perspectives on population and the environment and also with relevance to conceptual models and research design: “Comparative assessments assume that if population is a key driver of environmental change, then the pressures of population (e.g. density) should

closely match the magnitude of various kinds of environmental change across regions and locales” (Meyer & Turner 1992:53).

***Spatial, Sectoral, and Temporal Linkages***

Finally, there is emerging emphasis on the significance of linkages across geographic scale and among regions that holds theoretical potential for informing conceptual models of the relationships between migration and environmental processes. The published results of interdisciplinary symposium, *The Earth As Transformed by Human Action* (see Turner, et al. 1990) address conceptual issues concerning interregional and intersectoral linkages by disentangling, both conceptually and empirically, the temporal and spatial patterns of the effects of human society on global and regional environmental processes at different scales. In this regard, Merchant (1990) provides critical insight to the characteristics and limitations of models of society-environment interactions. Again, however, the role of interregional and international population movement in processes of transformation in selected regions is not highlighted either in theory or application (see, for example, Ezcurra 1990).

Emphasis on linkages among regions and across geographic scales is often matched with attention to the dynamic dimensions of societal and environmental processes. For example, the University of Michigan Population-Environment Dynamics Project (Ness, Drake & Brechin 1993b) has emphasized the need for interdisciplinary study of human-environmental interaction and for theoretical refinement of general models of environmental impact (cf. Ehrlich & Ehrlich 1990). Transitional analysis, that is, interaction among processes of change, is underscored (cf. Lutz 1994:63; United Nations Secretariat 1991:58). Drake (1993) identifies several areas of global transition which characterize population-environmental dynamics including the demographic transition, epidemiological transition, and the urbanization transition. While trends in international labor and refugee movements are noticeably absent from this conceptualization, the framework is conducive to similar consideration of the prominence of international population movements in regional and global dynamics. The importance of determining the degree of synchrony in rate of change in transitions is particularly salient for the analysis of the role of international migration in social and environmental change in the United States (Drake 1993:334-48).

It is interesting to note that studies that place theoretical emphasis on the linkages between developed and developing countries and increasing international integration among economic sectors vary widely in the attention given to international migration. Some perspectives do not explicitly consider the role of international migration and population circulation as an important dimension of global and interregional economic relationships (see, for example, Bowlby & Mannion 1992:332; Contanza 1992; Cater & Goodall 1992:320; Sadik 1989:4,5; cf. Berreby 1994:49). Other perspectives on economic development in developing countries emphasize the importance of international and interregional labor migration in economic change in both sending and receiving societies and in trends toward increasing global economic integration and interconnectedness (see, for example, Massey, et al. 1987, 1993; Massey 1988; Castles & Miller 1993; Bailey & Ellis 1993; see also Simon 1990:274-76).

Perspectives on the role of the United States in global environmental protection place emphasis on the significance of the United States in global economic integration, international trade, and the potential for sustainable development in southern regions (Ridker 1975; Keyfitz 1991; Cooper 1991; Sadik 1989:4,5). The relationship between U.S. foreign policy

and migration pressures in developing countries has also received increasing analytic attention (see, for example, Tucker, Keely & Wrigley 1990; Loescher & Scanlan 1986; Teitelbaum & Weiner, forthcoming). Absent from these discussions, for the most part, is explicit conceptualization of the role of U.S. immigration policy as an agent of global and regional environmental change. Ehrlich and Ehrlich (1992:331) do relate issues of brain drain to the acquisition by immigrants of patterns of consumption associated with U.S. lifestyles: “. . . even though immigration to the United States does not produce a net increment to the global population, it does produce a net increment in total environmental impact.”

There is a need for additional thinking about the role of international migration and, specifically, immigration to the United States on patterns of environmental change in both sending and receiving communities. The role of environmental degradation in serving as a stimulus to out-migration from agricultural areas, rapid urbanization in developing countries, and international migration is receiving increasing attention (see for example, Myers 1991; M. Schwartz, 199 ). The role of U.S. immigration policy and patterns in these processes is an area of needed theoretical development.

## **Implications for Theoretical Research on U.S. Immigration and the Environment**

This wide-ranging discussion of perspectives on population, migration, and the environment suggests several areas of needed scholarship, the most fundamental of which is the need to revise models of environmental change and impact to incorporate more effectively concepts of migration. Of particular relevance for the United States, moreover, is the specification of effects for different types of international population movements (permanent resettlement, refugee migration, temporary labor migration, and tourism) within theories of environmental impact.

### ***Recommendations for Theoretical Research***

1. General models of environmental change and impact should be reformulated to specify the role of migration and, specifically, international migration in processes of population growth, consumption and production, and technological change.

- a. Hypotheses concerning the short- and long-run effects of migration

processes for these relationships and environmental outcomes should also be derived.

- b. The reformulation of theoretical models should also recognize the importance of geographic scale for both scientific analysis and policy and program development.
- c. Attention should be given to the dynamic relationships among sources of population growth and social, economic, and technological change.
- d. The relevance of intersectoral linkages, illustrated, for example, in the global division of labor in manufacturing, for environmental process at different scales of analysis should be investigated.

2. Specific theoretical research should be devoted to conceptualizing the role of international migration as an agent of change in environmental-related processes: technological change, and the promotion of shifting patterns of consumption and production within both countries of origin and destination. As emphasized above, conceptual models should consider these relationships specific to major types of international migration and mobility.

- a. The environmental consequences of immigration should be specified within economic sectors, as well as among geographic areas; for example, the environmental implications of the relationship between international migration and changes in agricultural practices in countries of origin and countries of destination should be conceptualized, as well as the environmental consequences of relationships between labor migration associated with the spatial and technological reorganization of manufacturing.

3. Theoretical research should be undertaken to conceptualize immigration as a component of population dynamics at different scales of geographic analysis.

- a. A critical assessment of approaches to measuring sources of population growth in relationship to different models of environmental change should be initiated.

4. Theoretical attention is needed concerning the concepts of urban efficiency and scale in relationship to environmental quality, available resources, and patterns of urban and metropolitan spatial growth. These concepts should be related to sources of population growth as outlined in previous recommendations.

## **EMPIRICAL RESEARCH CONCERNING MIGRATION AND ENVIRONMENTAL PROCESSES AND CHANGE**

### **Introduction**

Deep analytic traditions exist in western social science for conceptualizing and measuring the consequences of international migration for national society, economy, polity, and for interregional migration for local communities. Scholarly interest in the environmental consequences of immigration, certainly, in the case of the United States, has a much more shallow history, originating in the late 1960s with environmental concern over national population growth and the role of annual alien immigration in paths to population stabilization (see Coale 1972; U.S. Commission on Population Growth and the American Future 1972; see also Keely & Kraly 1978). Complementary to these concerns is demographic interest in the historical contribution of immigration to national population growth (see Gibson 1975; Keely 1974).

As described above, there is current interest in the environmental implications of immigration for regions, states, and local communities in the United States. Most research, however, tends to focus either on population growth and trends in immigration, i.e., the independent variables, or on environmental processes and problems, the dependent variables. There exists very little direct causal analysis of relationships among population, immigration, and environment in the United States. Sparse empirical attention has been given, for example, to the unique effect of immigration in studies of subnational population dynamics. Similarly, the role of immigration status, nativity, and ethnicity in analyses of consumption and production remains to be fully specified and empirically evaluated. For example, comparison of patterns of energy consumption, commuting, land use patterns, and water conservation practices between foreign and native born, among immigrant cohorts and generations, and among groups of immigrants would add to discussions of the environmental consequences of immigration. Similarly, analyses of the significance of immigration status relative to social and economic characteristics for levels and patterns of consumption should be undertaken.

Because of the relative absence of empirical studies concerning the environmental

consequences of U.S. immigration and, generally, international migration to and from the United States, we have looked broadly at the research literature for empirical studies that are relevant for informing the development of a national research agenda. This review has taken us to scientific areas that at first glance do not appear highly relevant for framing studies on U.S. immigration and the environment. The selected areas of research do, however, illustrate salient issues in conceptualization, research design and analysis, and interpretation of findings.

It should also be acknowledged that comparative research on the implications of trends in international migration and mobility has not given prominent attention to the environmental consequences of population movements in comparison to issues concerning economic and development processes, social integration and immigrant adjustment, and foreign relations (see, for example, Vernez 1990; de la Garza, Rodriguez & Pachon 1990; Massey, et al. 1987; Appleyard 1992; Tucker, Keely & Wrigley 1990; Kritiz, Lim & Zlotnik 1992; Kritiz & Keely 1983; Kubat 1993; Elliott 1989; Zolberg, Suhrke & Aguayo 1989). There is empirical research, most often field studies, however, concerning the converse relationship, that is, the contribution of environmental degradation and crisis to patterns of migration. Studies of

environmental refugees acknowledge the economic and political dimensions of poverty in tandem with population growth in the erosion of local and regional environmental conditions that then result in out-migration. Environmental refugee movements thus emerge from changes in land use and land degradation associated with shifts in agricultural organization, such as farm ownership and land tenure systems, and such patterns of production, as single versus multiple cropping (see, for example, Catanese 1990-91; Tamondong-Helin & Helin 1990-91; Jacobsen 1988; Purcell 1991; Appleyard 1992; Sadik 1989; Talbot 1986; World Resources Institute 1994-95; Zolberg, Suhrke & Aguayo 1989:103-25). Studies of the relationship between natural disasters and migration and population displacement similarly reveal the role of social and economic factors in mediating the differential effects of natural calamities for local and regional populations and communities (see, for example, Clarke et. al. 1989). Research has also addressed the role of environmental factors such as groundwater use in population dynamics and community sustainability (see White 1994).

## **Research on Regional and Local Population- Environmental Dynamics**

Commenting on research concerning economic development in rural areas of developing societies, the United Nations Secretariat (1991:65) makes an important observation about the relationship between population processes and land degradation, relevant for empirical research concerning population, migration, and the environment:

While the outlines of this environmentally destructive interaction between growing populations and land degradation are clear, the magnitude of the problems, their geographical distribution and their causes remain unclear. These ambiguities must be investigated analytically if Governments are to address these environmental problems in an effective way.

There are, however, empirical studies of the interrelationships among population, migration and environmental processes that transcend the analytic problems identified by the UN above. For example, Arizpe, Stone, and Major (1994) have sought to synthesize important empirical research on population and environment in developing societies. Their critical analysis of existing research serves to inform the development of conceptual models of population, migration, and the environment, as well as appropriate research design and data requirements (see also Palloni 1994). Among their conclusions is the need for continued research on the connections between population and environmental processes within local and regional contexts (Arizpe, Stone & Major 1994:8-9; see also Lutz 1994:63).

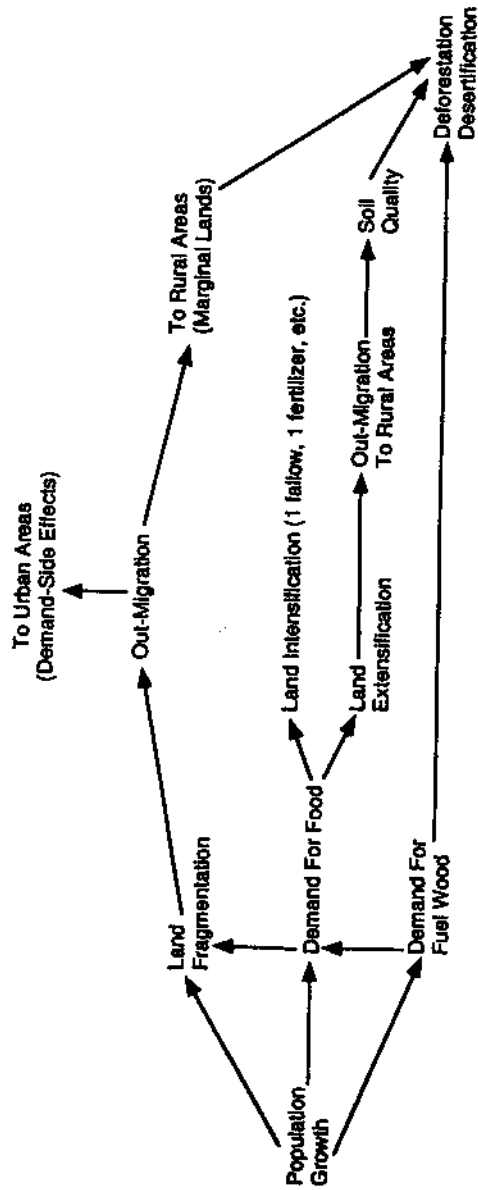
For example, in a series of papers, Bilsborrow and his colleagues have explicitly established goals to conceptualize and measure relationships between demographic processes, notably migration, environmental outcomes, and agricultural practices in particular (see Bilsborrow & Geores 1994; Bilsborrow 1992; Bilsborrow & Stupp 1989; Bilsborrow & DeLargy 1991). Bilsborrow's conceptual model of land extensification in developing societies, shown in **Figure 1**, specifies the nature of the relationships among population growth and trends in land and resource

use, change in land use and agricultural practices, migration, and environmental degradation. While the model might be criticized for the omission of other factors influencing land use change, such as national agricultural and food policies and urban-directed development programs, the empirical research to test the model is significant in measuring the structural and behavioral linkages among social processes and environmental change and, as a result, providing a basis for causal explanation and theoretical development.

Bilsborrow (1992:145-46) also emphasizes the necessity of measuring changes in these processes over time and the value of survey methodology to identify micro-level relationships:

A number of other scholarly studies have used individual country data on changes over time, sub-national data, to study relevant population-migration-environment linkages, but few identified specific mechanisms by which population factors cause environmental change. . . . I believe we came close to doing this in a study of Guatemala . . . linking rural population growth to land fragmentation and out-migration, but the subsequent link from household to deforestation

**Figure 1.**  
CONCEPTUAL FRAMEWORK OF RELATIONSHIPS BETWEEN POPULATION GROWTH,  
MIGRATION AND THE RURAL ENVIRONMENT



Source: Adapted from Blisborow 1992:129.

is more circumstantial. For this reason I am proposing a household survey in areas of both in-migration and out-migration in rural Ecuador to examine this possible linkage. This is necessary to determine where the migrants come from and why, how they acquire land, and what they are doing with it, including past and present forest-clearing practices.

Interestingly, in a study of the environmental consequences of rural out-migration in Nepal, Thapa (1993) implements several of these analytic recommendations. Thapa utilizes a household survey to measure directly the relationships between household characteristics, agricultural practices, migration patterns, patterns of consumption and remittances, and watershed management practices. The augmentation of household income through remittances did not promote watershed conservation that were devoted primarily to meeting basic household needs; instead, emigration in the study areas was found to be associated with watershed degradation resulting from insufficient labor available for land management and the reliance on pooled labor and economic resources.

Similar analytic strengths are evident in research by Young (1985) and Talbot (1986) that considers migration processes in the

form of settlement schemes in Africa. Young studies the environmental consequences of refugee settlement programs in Somalia by collecting detailed data on the agricultural and domestic practices of refugee households in relationship to measurable environmental outcomes: changes in grazing, vegetation, erosion, and soil quality; trends in irrigation and salinization; and loss of forest resources. Included in the analysis is information on environmental conditions in the selected regions prior to the refugee agricultural program, as well as documentation of trends in agricultural practices and environmental outcomes. In a similar fashion, Talbot (1986) studies the social and environmental effects of population growth in rangeland areas in east Africa. Changes in population size among the Maasai are related to resources, primarily livestock, necessary to support traditional ways of life. Balance between demographic and social structure and natural resources has been disrupted in large part by forces external to Maasai society and include population growth among agricultural groups, development programs concerning settlement of pastoralists, and environmental degradation associated with agricultural change.

A similar framework and approach is followed by McCall (1985) in his detailed analysis of the environmental effects of villagization programs in Tanzania. Like

Bilsborrow, McCall raises important analytic issues concerning the empirical basis for interpreting relationships between such social demographic processes as resettlement and environmental degradation in this region of Africa. His conclusions (1985:139) are provocative: “. . . villages are here to stay and there can be no solution which involves eliminating them. The [environmental] impacts emphasized have been mainly the negative ones; there are of course positive effects on services, information and accessibility. A full evaluation would also have to address the methodological problem of comparing ‘with and without’—what direction would rural development have taken in the past decade without villagization?”

## **Research on Environmental Outcomes**

Environmental research that focuses on direct measurement of environmental processes and quality is often characterized by indirect or cursory measurement of population and social processes that are often presented initially as causes of environmental change (see Keough & Quinn 1991:539-41). For example, research in Japan (Bower & Takao 1993) has documented patterns of land reclamation in

Tokyo Bay and the implications for coastal resources and environmental quality. Causes of land use change include trends in urbanization and migration, industrialization, dredging technology, and political organization among fishing cooperatives. The analytic focus of the research, however, concerns the analysis of environmental outcomes, not the specification and measurement of the relationships among causal influences or between social and demographic causes and environmental effects. In a similar fashion, Tamura (1993) hypothesizes about the effects of urbanization, economic development, and innovations in earthwork technology on residential development in hill regions in Japan but measures environmental processes not causal relationships.

Environmental research concerning coastal zones and marine systems almost uniformly identifies population growth, migration, and temporary population movements (tourism) as ultimate causes of environmental degradation. In their study of fresh and waste water discharge along the California coast, Griggs and McCrory (1975) identify population growth as the fundamental cause of pollution in nearshore marine environments. The empirical substance of the study, however, is the analysis of the spatial variation in volume and composition of

nearshore water discharge rather than an analysis of causal effects of demographic and economic factors. Linden (1990) discusses the complex interactions among social, political, economic, and demographic factors in relationship to environmental processes in tropical coastal zones, but presents detailed documentation only for the environmental problems observed in specific coastal regions. Using a more explicit model of spatial covariation, Saliba (1990) similarly emphasizes the impact of tourism, industrial activity, and agricultural practices for land use change and environmental problems in Mediterranean coastal areas.

Finally, an excellent collection of papers by marine scientists concerning human impacts on the seafloor emphasizes patterns of global and regional social, economic and demographic change as potential causes of environmental degradation of the deep ocean floor (see Hsu & Theide 1992). Aggregate world population growth, trends in migration to coastal areas, and patterns of consumption and economic activity are identified as ultimate causes of marine environmental change (see Milliman 1992; Bunt 1992: 229; Vadus, Bregman & Takahashi 1992). For example, in a summary group statement, Burnett (1992:245) reports:

Pressures caused by exponential population growth over the past several decades have resulted in two great needs which will affect human interaction with the deep ocean: (a) demands for additional resources; and (b) localities for waste disposal. Although large-scale deep ocean mining and solid waste disposal are not presently occurring, depletion of land resources and environmental damage on land require that we give consideration to future use of the seafloor as a course of minerals and as a repository for anthropogenic wastes.

The focus of the analysis, however, is the documentation of available data concerning the characteristics and patterns of change in deep ocean environments and the delineation of information needs for monitoring change.

## **Urbanization and Environmental Issues**

There is extensive research on the relationship between patterns of urban population growth and urban and metropolitan

environmental problems in both developed and developing nations. In not all studies of urbanization, however, is the role of urbanward migration considered separately from natural increase. Speare and White (1992:91) examine the concept of optimum city size given environmental criteria and specify the nature of the relationship between city size and environmental quality by identifying the effect of two concepts, population density and homogeneity:

Smaller cities have two advantages in dealing with the environment. First, because of smaller size and typically lower density, they have less concentration of pollutants to deal with, other things being equal. Second, because they have a smaller and often more homogeneous population, they may have an easier time mobilizing support for programs to regulate and reduce pollution.

The role of migration is considered only indirectly through concepts of urban population growth and racial and ethnic composition. Moreover, while the nature, extent, and trends in urban environmental problems are often documented, the causal relationships between population

growth and environmental outcome are not empirically tested and established (see Milne 1988; Sarre & Smith 1991; Huguet 1992:388-90).

Increasing research is being conducted concerning the consequences of immigration for metropolitan and regional growth patterns in the United States (see Frey 1994; McHugh 1994; Kraly & Hildebrandt 1993; cf. Frey & Speare 1992). Scientific assessment of the effects of immigration for cities and regions has focused on specific infrastructural effects and relationships (see Clarke, et al. 1994; Fix & Passel 1994; Vernez 1993). Studies that seek to address environmental consequences of immigration for urban areas, however, are often plagued with the analytical problems described above: patterns of population growth and immigration are observed to covary with environmental outcomes, while causal relationships are not directly tested. To illustrate, in a study of the sources and distribution of population growth in California, Goodenough (1992:124) states: "[i]n the last decade one-quarter of the US population growth has occurred in the state, generating problems in school provision, transportation, air and water quality and agricultural land conversion." The author interprets shifts in commuting patterns as a response of native residents to intrametropolitan pressures and problems. No direct data on residential choice or commuting behavior, however, are presented.

## **Research on Immigration and the Environment in Australia**

A final body of scholarship that is directly relevant for framing research questions concerning U.S. immigration and the environment derives from Australia. Debates strikingly similar to those emerging in the United States (see Jones 1992:362) circle around the degree to which immigration to Australia should be manipulated in order to achieve national environmental goals and maintain natural capital, relative to such other sources of environmental impact as internal population movements, temporary and seasonal international migration, market forces, patterns of consumption, technological change, etc. Recent government response to increasing public concern about environmental issues in Australia has emerged in the form of goals concerning "ecologically sustainable development." Moreover, according to the National Population Council (1991:x), a group appointed by the Prime Minister to assess the implications of population growth, immigration is considered the essential component in the development of a national population policy for Aus-

tralia. Correspondingly, government sponsored research has been initiated to assess the effect of population growth, hence, levels of immigration, on the "ecological integrity" of Australia, its sparsely populated regions (Clarke, et al. 1990) and metropolitan areas (Murphy, et al. 1990; see also National Population Council 1991; Nieuwenhuysen 1992).

Fincher (1991) has synthesized these and other research findings concerning the relationships among immigration, population, and environmental processes and issues in Australia. Consistent with the discussion above, she underscores conceptual, analytic, and data difficulties inherent in the available empirical research concerning these relationships. For example, research on optimum city size struggles with the identification of justifiable criteria for determining thresholds in population associated with environmental damage. On the one hand, immigration to Australia is clearly associated with the centralization of the population in metropolitan areas. On the other, the hypothesis that immigration results in increased suburbanization and, hence, decentralization of population within metropolitan areas has yet to be effectively tested through either survey research concerning residential choice or analysis of trends in the supply of and demand for housing and service infrastructure

throughout metropolitan areas (see Murphy, et al. 1990). In this regard, Fincher (1991:33) observes that “[i]f refugees, for example, require public housing, then the public and private rental market nearby may suffer. If wealthier business migrants bid up housing prices in certain localities others may be not longer able to afford housing there. Indeed the degree to which immigrants’ arrival ‘pushes’ others to the urban fringe by bidding up house prices further in, or by taking up scarce public and private rental housing, is unclear.” Hence, both patterns of immigrant settlement and the degree of variation in characteristics of immigrant groups also prompts Fincher to note the importance of conducting local and regional analysis of the impacts of immigration on urban infrastructure in Australia cities.

The available research on energy and water consumption in Australian cities has yet to measure directly the effects of urban population growth and immigration. Fincher (1991) identifies the multiple causes of air pollution and increases in the demand for water. For example, the lack of clear evidence on the connection between immigration and residential relocation to the fringes of metropolitan areas erodes conclusions about the general relationship between immigration and automobile energy use (Murphy, et al.

1990:163).

The role of immigration in environmental degradation in nonmetropolitan environments in Australia has been considered by Clarke, et al. (1990) and Flannery (1992) among others (see also Blaikie & Brookfield 1987). Clarke, et al. (1990) place the analysis of environmental issues in both agricultural practices and ecologically fragile environments in Australia, first, in historical context and, second, within a framework of international and regional economic relationships. For example, in assessing the relation of Australian population growth to agricultural sustainability, it is important to reveal the connection between agricultural practices and production for export markets. The relationships between international trade and stock of natural resources must also be considered. Similarly, these issues are also relevant for the analysis of the implications of tourist migration to remote and/or fragile environments throughout Australia.

Whether those tourists are Australian-born or not, or whether they are attracted here because they are friends of recent immigrants, seems rather a trivial point. The importance of wilderness areas to our growing tourist industry, a further use of

our resources for economic growth, is undeniable. . . . Curtailing the immigrant intake of permanent settlers would not stop this. But there is cause to examine the impact on these sites of the growing number tourists and temporary visitors. (Fincher 1991:44)

Coming somewhat full circle, Fincher's perspectives also reveal the conceptual and analytic importance of developing more refined specification of demographic sources of environmental impact.

### **Implications for Empirical Research on the Relationship between U.S. Immigration and the Environment**

As shown here, very little direct research has been initiated concerning the relationships between U.S. immigration and the environment, a situation that is not uncommon in other major immigrant receiving countries (cf. Canada Employment and Immigration Advisory Council 1991; National Population Council 1991). Perspectives on U.S. immigration and

environmental processes remain largely on the conceptual, if not rhetorical, level of analysis, with results of demographic models translated into environmental outcomes concerning resources availability and environmental quality (see, for example, Pimental & Pimental 1992; cf. Parkes & Dennis 1993). In this regard, population-environmental research in the United States lacks precise or explicit specification of relationships between demographic processes and environmental change.

The general observation concerning the status of empirical research on U.S. immigration and the environment is the need for more of it. There is critical need for the initiation of well-designed studies that will yield both descriptive information concerning trends and patterns of demographic and environmental processes in U.S. regions, as well as for causal analyses of the relationships between migration and environmental change. Given this starting point, the recommendations for empirical research for the United States are relatively basic, unlike recommendations for research developed by Fincher for Australia (1991:57-50). In contrast, the suggestions presented below reflect fundamental needs for baseline data on trends and patterns and causal analysis to test hypotheses deriving from conceptual models of immigration-environment relationships. In important ways, several of

the recommendations for research are connected to issues concerning both conceptualization and data availability and quality discussed in sections above and below, respectively.

***Recommendations for Empirical Research***

1. Research should be undertaken to synthesize what is known about the components of population growth and change on the regional, state, metropolitan, and local levels in the United States.

- a. Analytic attention should be given to trends in each source of migration to and from geographic areas, including permanent resident aliens, temporary visitors (including foreign students and temporary workers), and refugees.
- b. Patterns of secondary or internal migration of immigrants should be documented and distinguished from patterns of initial settlement among immigrants.
- c. The process of temporary international movements and mobility, such as international tourism and temporary workers, should be measured and described for regions, states, and metropolitan

and local areas in the United States.

2. Research should be initiated to document what is known about trends and changes in environmental processes, resources, and quality for regions, states, and metropolitan and local areas in the United States. Environmental data should also be organized in relation to such ecological systems as marine and coastal environments, aquifer basins, as well as other relevant units, for example, national parks and wilderness areas.

3. Research to measure causal relationships between immigration processes and selected environmental outcomes should be initiated for regions and local areas.

- a. Macro-level analyses that measure the relationship over time between each source of population change and regional and local environmental indicators should be conducted; control for other exogenous sources of environmental change should be considered carefully in such research.
- b. Micro-level studies of patterns of consumption and use of environmental resources should be initiated to provide estimates at the national and subnational levels.

- c. Studies of environmental behavior should relate the effects of immigrant characteristics (country of birth, length of residence, patterns of internal migration) to the effect of social demographic factors (age, gender, household composition, education, occupation, etc.).
4. The effect of immigration trends in urban environmental quality and resources should be measured, again, within the context of other sources of environmental change and given a dynamic analytic framework. Case studies of environmental change within specific urban and metropolitan areas should be undertaken.
- a. Analysis of the role of immigration in the geographic expansion of U.S. metropolitan areas should be initiated.
  - b. Research on the effect on immigration on urban housing markets and patterns of commuting should be initiated for specific cities and metropolitan areas.

## **METHODOLOGIES FOR ASSESSING THE ENVIRONMENTAL CONSEQUENCES OF U.S. IMMIGRATION**

### **Introduction**

The emerging wisdom from studies and perspectives on population-environment dynamics includes recommendations to pursue research, assessment, and monitoring of interrelationships on local and regional scales (for example, National Research Council 1992; Fincher 1991; Turner, et al. 1990; National Population Council 1991; cf. Linden 1990:10; Bunt 1992:229) and with comparative methods and cooperative synthesis of findings (Ness, Brechin & Drake 1993c; Harf & Trout 1986). These analytical visions of the necessity for regional and local analysis and comparison of effects are particularly consistent with what has been learned from research efforts to assess the economic effects of immigration on U.S. labor markets and communities.

We have initially considered two analytic frameworks that have been developed to study dimensions of environmental change: environmental impact assessment (see Westman 1985; Mather & Sdasyuk 1991; Clark & Herrington 1988; Black 1981) and population-environment monitoring systems (see Westman 1985; Ness, Brechin & Drake 1993b). Environmental impact assessment most often attempts to forecast the impacts of development projects or structural or engineering initiatives, generally, new activities within a geographic area (see, for example, Newson 1992 :261-70; cf. Ofori-Cudjoe 1990). Monitoring systems represent ongoing social and environmental accounting frameworks for the collection and analysis of data over time for specific geographic areas.

## **Environmental Impact Assessment**

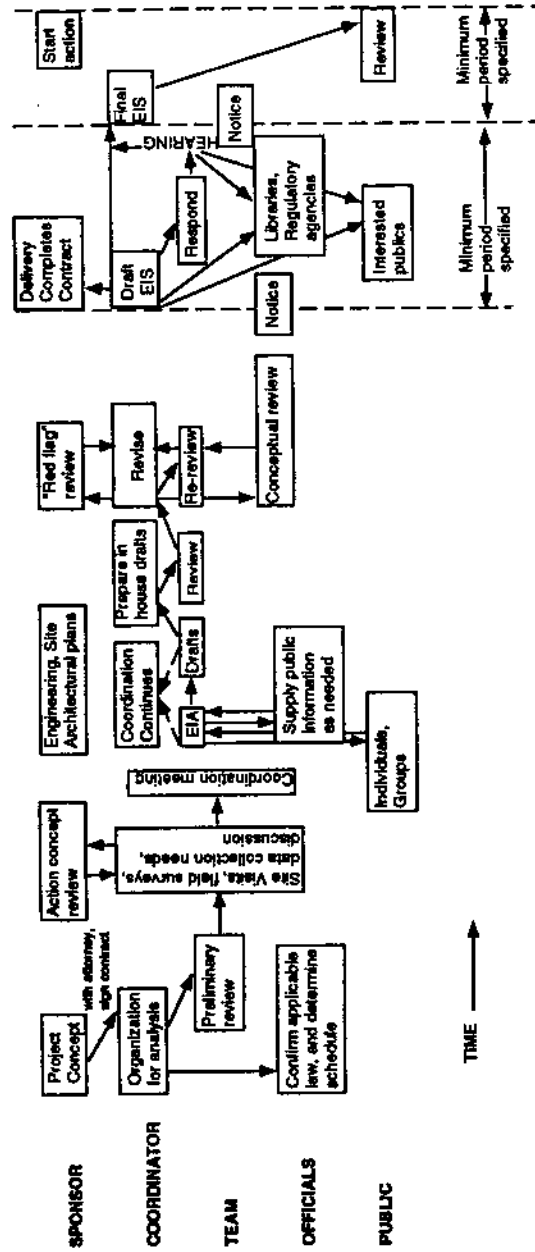
Lein (1991-92:168) describes environmental impact assessment [EIA] as “the principal means of understanding human impacts on the environment within a structured decision-making framework.” The formal adoption of EIA as an approach to anticipating environment change came in 1970 with the requirement in the

National Environmental Protection Act for federal agencies to formulate environmental impact statements [EIS] for proposed activities (see Rosenbaum 1991:14). The analytic objective of the EIA process is the provision of objective, typically quantifiable, information for policy-makers and program administrators concerning the range of environmental consequences of some proposed source of change for a region or place. The results of the process thus contribute to the identification of an “informed trade off among conflicting aspects of a proposed activity” (Lein 1991-92:168). Environmental assessment is thus conducted for a specific place, time and proposed event. The emphasis on short-term environmental effects is, according to Lein, a disadvantage of the methodology for long range environmental planning and the avoidance of irreversible environmental damage.

The steps followed within the EIA process are often described schematically as a decisionmaking tree or flow chart. To illustrate, **Figures 2a** schematically shows the EIA process for the United States, and **Figure 2b** shows the process as organized by the Scientific Committee on Antarctic Research. The actual process of assessment, that is, measurement of environmental outcomes of a proposed program or activity, is usually not specified but represented as an activity box with the

**Figure 2a.**

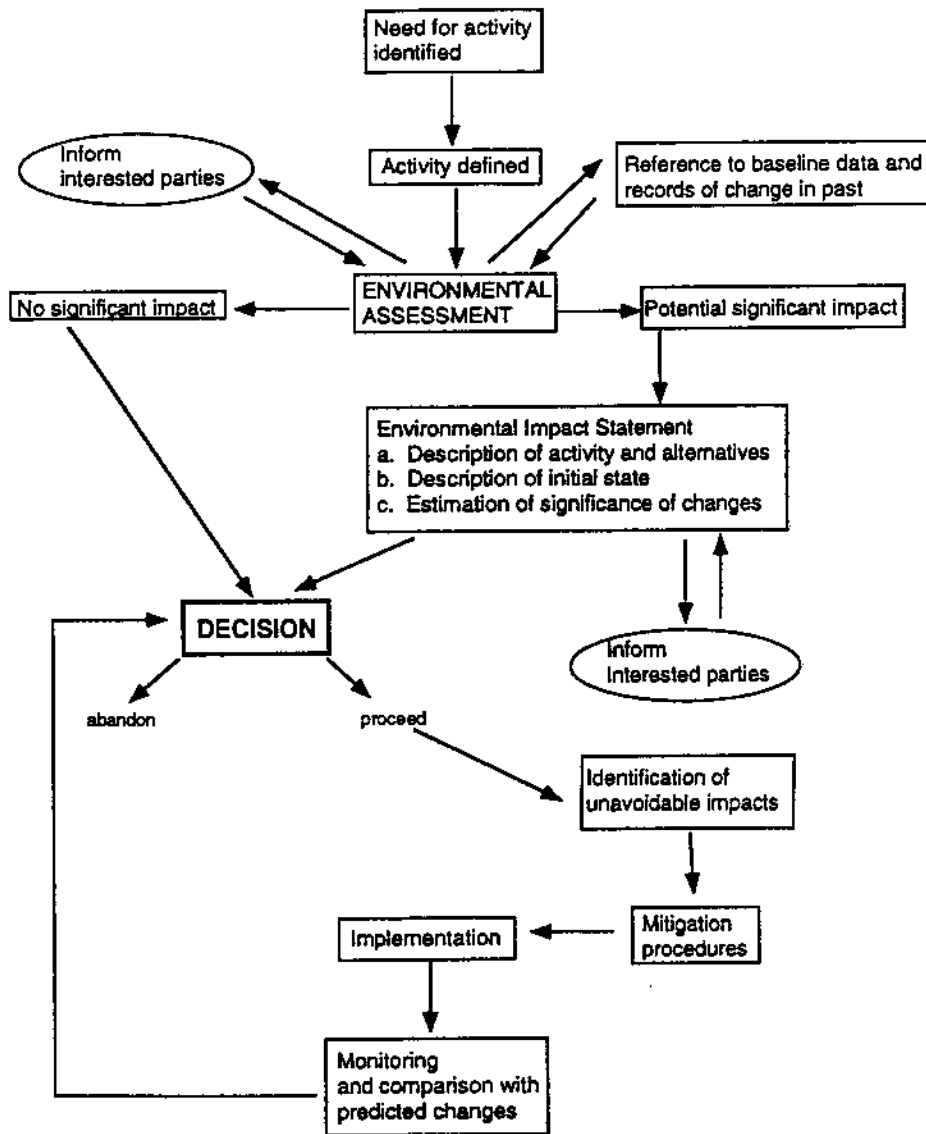
THE PROGRESS OF ENVIRONMENTAL IMPACT ASSESSMENT  
AND THE PREPARATION OF THE STATEMENT [EIS] IN THE UNITED STATES



Sources: Adapted from Black 1981.

**Figure 2b.**

THE ENVIRONMENTAL IMPACT ASSESSMENT (EIA) PROCESS AS ENVISAGED BY SCAR



Source: Adapted from Bonner 1986:86

flow chart. Discussions of environmental impact assessment indicate only in broad strokes the methodological approach. Newson (1992 :268) describes the tasks of assessment as including:

Identification methods—to assist in identifying the project alternatives, project characteristics and environmental parameters to be investigated in assessment

Data assembly methods—to assist in describing the characteristics of the development and of the environment that may be affected.  
Predictive methods—to predict the magnitude of the impacts which the development is likely to have on the environment

Evaluation methods—to assess the significance of the impacts which the development will have on the environment

Communication methods—to assist in consultation and public participation, and in expressing the findings of the study in a form suitable for decision-making purposes

Management methods—to assist in managing the scoping of the

study, the preparation of the impact study, the efficient conduct of the consultation process, etc.

Decision-making method—to assist decision-makers in assessing and understanding the significance of environmental impacts relative to other factors relevant to a decision on the proposed development

Similarly, Bonner (1989:86-87) identifies within the process of EIA: first, specification of the proposed program or activity as well as alternatives; second, provision of baseline environmental data on the local region or site and an estimate of changes in those measures in the absence of the proposed activity; estimates of the “nature, extent, duration and intensity” of the predicted environmental outcomes; and evaluation of the significance of the predicted impacts and possible approaches to mitigate the effects.

Inherent in these methodologies of environmental assessment are theoretical models of the causes and effects of environmental processes. Predictions about the impact of human activities on the environment of a defined region require not only specification of significant causes of environmental impact, change, or disruption, but also of the nature, that



is, form and direction, of the relationships between the causes and outcomes. Newson cautions, moreover, of the problems in predicting environmental change without an appreciation of the full spectrum of sources of change. Hence, answering the basic questions of environmental assessment—“What will be the direction of future change? By how much? How certain are we?” (Newson 1992 :264) requires an assessment analysis that is embedded in a dynamic and comprehensive model encompassing all the important sources of environmental change for the study area. This, according to Newson, is the process of ‘scoping’ (Newson 1992 :264,268; see also McNabb 1989:109; Colthern 1993b:6).

The results of EIA are often summarized in the form of a matrix in which scores are assigned to each combination of impact and outcome. McNabb (1989), among others, has been critical of the tendency in this approach to simplify complex, essentially multivariate relationships between social processes and environmental outcomes. What is as critical is the degree to which the approach subdues the influence of both theory and method. For example, in an *ex post facto* environmental assessment of an electric power plant Ofori-Cudjoe (1990) presents the EIA matrix relating each of the components of the plant construction and operation to

seventeen environmental outcomes, including impacts on the physical, biological, and social environments. The matrix is shown in **Figure 3**. The methods of determining the scores for each cell of the matrix, that is, the level and direction of the impact, rely on observation, documentation, and interviews with members of the resettled communities: “[t]he only positive impacts on the physical environment are on agricultural land-use and surface water quantity. The people expressed a lot of misgivings during our fieldwork. Their oil palm plantations stood in danger of destruction without sufficient compensation” (Ofori-Cudjoe 1990:124). The underlying conceptual relationships, however, remain implicit in the assessment process.

Critical perspectives on EIA underscore the importance of studying environmental change within a multivariate framework in which all exogenous influences on environmental outcomes are documented and comparatively evaluated. The observation of Preston (1993:600) is relevant: “Even if links can be established between demographic and environmental change, there remains the difficult task of evaluating the costs of environmental change relative to other things that humans value.” The approach inherently assumes, moreover, that the counterfactual can be known; that is, that the causes and

consequences of environmental change are sufficiently well understood to be able to predict outcomes resulting from both the presence, as well as the absence, of the causal influence. Using the issue at hand and also following Simon's example (1990:190), one might ask whether enough is known about the role of immigration in technological and environmental change to conclude what the urban environment would have been like in the absence of immigration to the United States during the nineteenth century.

## **Population- Environment Monitoring Systems**

The process of EIA involves not only predictive and hence causal analysis, but also monitoring and auditing of the outcomes of the program or activity through some future point in time (Newson 1992 :264). Population-environment monitoring systems [PEMS] are useful in providing an empirical foundation for evaluation of existing policies (Zinn, Brechin & Ness 1993) and baseline data for identifying subsequent environmental impacts. If the approaches to monitoring are standardized across administrative units, data for smaller geographic units can be aggre-

gated and, thus, results of PEMS can support analysis of regional dimensions of national policies. This characteristic of PEMS is critically salient for purposes of U.S. immigration policy evaluation and recalls the effort by Clark et. al. (1994) to apply common methods of measurement among states in their study of the fiscal impacts of U.S. immigration. Further, population-environment monitoring assumes the collection of longitudinal data concerning interrelationships among social demographic and environmental processes. Newson's emphasis on the importance of identifying all significant causal influences is also salient for the PEMS approach. The analysis of observed trends in population and environment processes must be embedded within the context of social, economic, political, environmental change occurring on each relevant level of analysis: local, regional, national, and global.

## **Relevance of Methodologies for Analysis of Immigration and Environment**

There are challenges to interpreting the predictive results of environmental impact assessment or even the results of environ-

mental monitoring. In reference to EIA statements, Westman (1985:9) states, “[f]or an accurate prediction of cumulative impacts to be made, impact analysts must be able to refer to some plan for the future development of the region. The plans in turn usually derive from a set of policies for regional development and national goals, and values. To speak to the combined effects of independent proposals for a region, impact assessment is dependent on regional planning.” The implication is the need for clearly articulated goals and priorities concerning immigration and the environment for the geographic area. It is important to acknowledge in this regard the potential for conflict between national (and international) goals concerning immigration, for example, family reunification, refugee resettlement, and local and regional concerns, which are increasingly characterized by NIMBY [“not in my backyard”] frames of reference (cf. Castles & Miller 1994).

Turning to the application of the approach to the analysis of the environmental consequences of U.S. immigration, environmental impact assessment may serve as an appropriate approach if the analytic goal is to determine or predict the environmental effects of changes in the levels and patterns of immigration to an area within the country. In this case, the EIA methodology may be useful in assessing

various immigration policy options that might include changes in overall levels of annual alien immigration to the United States, as well as changes in the structure of immigrant admissions in terms of individual and family characteristics. Such analysis would also include models of internal or secondary migration among immigrants and generally consider the consequences of immigration in a longitudinal perspective for the nation, region, and local areas. Comparison of different assumptions about both patterns of geographic settlement and secondary migration among immigrant groups may be particularly relevant for efforts to balance federal immigration goals with economic and environmental goals and programs for states and metropolitan and local areas.

In conducting such analyses of immigration and environmental change, however, the most critical issue in exploring the use of EIA or PEMS is the degree to which the environmental impact study or monitoring system incorporates all factors (social, economic, institutional, etc.) in relationship to population processes (components of growth, rates of growth, etc.) and demographic characteristics (age, gender, education, income, etc.) that are hypothesized to have environmental impact, using the concept of Ness, Drake, and Brechin, the population-environment

dynamic. In the general IPAT model, patterns of consumption [A] and technology [T] may be conceptualized as mediating the effects of demographic characteristics and processes on the environment (cf. Demeny 1991:410; Arizpe, Stone & Major 1994:8; Ehrlich & Ehrlich 1990). Methods of assessing or monitoring environmental change require, however, explicit specification of the nature of the relationships between demographic processes and behaviors, patterns of consumption and production, sources of technological and social change, and environmental outcomes. Moreover, as discussed above, emerging perspectives on global and regional dynamics have focused more critically on reexamining the institutional realm of mediating factors (see Arizpe, Stone & Major 1994; Ness, Brechin & Drake 1993b; Merchant 1990; Simon 1990; Espenshade 1991; Jones 1992), noting the variation in effects at different scales of analysis (see Meyer & Turner 1992:53-54).

As discussed above, these requirements for analysis assume a strong base of knowledge about population, migration and environment dynamics. Another way of expressing these analytic problems is the recognition of the limitations of knowledge about the counterfactual: What would have been the status of an area's environment in the absence of immigration? What will be the patterns of environmental change associated with different

levels and patterns of immigration? Is there sufficient empirical evidence and accumulated knowledge to model or project these relationships in order to predict environmental outcomes associated with different immigration policies?

These issues provide an imperative for analytic approaches seeking to address the relationships among population, migration, and environmental change to incorporate—measure—the significant factors that determine the environmental impact of immigration to the nation or locale, beyond the direct effects of increasing population size. From the emerging literature we can quickly identify such factors as patterns of resource consumption, technological innovation and production of knowledge, conservation behaviors, land use patterns, etc. Further exploratory research may be required, however, to complete the model of causal factors, that is, behaviors and institutional arrangements with environmental impacts.

The challenge is thus to develop behavioral and structural models and incorporate them in methodological approaches to studying environmental change. In this regard, survey methodology has been shown above to hold particular promise for revealing the relationships among population, migration, and the environment. Macro-level analyses of these relationships will provide relevant results if

research designs are dynamic, longitudinal, and encompass or control for the effects for other exogenous sources of environmental change. Finally, the relevance of any EIA, monitoring system, or other more appropriate research design for determining the effect of U.S. immigration on the environment will rest, finally, in the degree to which *national*, *state*, and *local* data collection systems or ongoing surveys can support multivariate analysis of complex dimensions—demographic, economic, institutional, behavioral—of environmental outcomes.

***Recommendations for Research on Methodologies***

1. A review of research methodologies inherent in environmental impact assessments and population-environment monitoring systems should be conducted.
  - a. An inventory should be taken of the degree to, and manner in which, demographic processes have been incorporated in EIAs or statements in the United States or in other immigrant-receiving countries.
  - b. A comparison of PEMS and other demographic accounting systems should be undertaken to assess the degree to which statistical systems embody consistent or complementary concepts of population growth and migration.
  - c. Specific analysis should document the temporal and spatial context of EIAs and monitoring systems.
2. Analysis of assumptions in environmental methodologies concerning causal determinants and correlates of environmental outcomes should be conducted to reveal the degree to which models of environmental change are completely specified.
  - a. Strategies for incorporating hypotheses concerning migration and environmental change and consequences in environmental methodologies should be considered.
3. Analysis of alternative research designs for the study of immigration-environmental relationships should be undertaken.

# **INFORMATION REQUIREMENTS FOR STUDYING THE ENVIRONMENTAL CONSEQUENCES OF U.S. IMMIGRATION**

## **Introduction**

The specification of data needs should be guided both by theory and by the important policy questions concerning U.S. immigration and the environment. While the emphasis of this report is generally on the relevant research concerning immigration, it is important to note the serious concern among environmental scientists about the status of environmental data for the United States and the capacity for monitoring environmental quality and resources for different geographic areas.

Colthern has critically addressed the need for a more coherent statistical base for environmental monitoring and comparative risk assessment (Colthern 1993b:3-10; see also Day 1993; Bunt 1992; Milliman 1992; Burnett 1992). Rosenbaum (1991:60) has raised similar issues specifically for the United States:

One of the nation's major environmental problems remains the neglect of basic research on environmental quality. Almost all current evaluations of environmental quality are compromised in some way by missing data, constricted time frames, and incompatible measurements. At times, estimates of environmental conditions, or the risks from human or environmental exposure to chemical substances, or predictions about future environmental trends must be made on the basis of data so meager that predictions are little more than the scientists' best guess. Data essential to understanding basic environmental trends, the kind of information "everybody should have," often nobody has. Frequently, the data were never created.

Sadik (1989:5) has called for the incorporation of environmental accounting in economic reports and forecasts. McCall (1985:133-34) also describes the need for baseline data on local environmental processes in developing societies.

Fundamental to the analysis of population and the environment, however, are data concerning the components of population change—fertility, mortality, and migration—for regions and communities. Further, because the focus of the present policy debate concerns the impact of *alien* migration, disaggregation of demographic processes by immigration status is also a necessary characteristic of statistical information. Accordingly, the general focus here is on the adequacy of U.S. data on population processes for the measurement of the role of alien immigration in population trends and dynamics on the national, regional, and local scales of analysis.

Problems in the adequacy of national demographic accounts for the comprehensive measurement of trends and components of population change have been well documented (see Valdez, et. al. 1993; Levine, Hill & Warren 1985; U.S. General Accounting Office 1988; Teitelbaum 1986; for a comparative analysis of international migration statistics, see Kraly & Gnanasekaran 1987). Three sets of issues pose particular problems for the empirical evaluation of the role of immigration in environmental processes. First, conceptual problems exist in official data on alien immigration to the United States. While collected on a continuing basis, U.S. statistics on immigration suffer from prob-

lems in validity and reliability in representing demographic concepts of international migration and mobility. Second, U.S. statistics on international migration lack closure: it is not possible to assess the impact of alien immigration on population growth in an area if not all sources of population change are known. No systematic source of data exists on the process of out-migration of aliens or citizens from the United States; measurement of levels and patterns of undocumented migration relies on demographic estimation. Third, and related to the first two issues, alien migration as an annual component of population change is not easily measured at all relevant geographic scales of analysis. Decennial census data do provide very useful data at ten-year intervals; intercensal measures of immigration and local population change are available from Current Population Survey data, however, for large states and metropolitan areas.

Reasons for the persistence of problems in international migration statistics for the United States derive largely from the separation of responsibilities for demographic accounting among federal agencies and programs that differ in mission, resources, and priorities for demographic research. Most industrialized nations, in contrast, have central statistical offices in which data collection, analysis, and dissemina-

tion are coordinated. The absence of a comprehensive population policy is also a critical influence on the status, organization, and management of national demographic statistics. It is also important to add that the United States is not distinctive in the persistence of weaknesses in statistics of international migration. International migration statistics generally are recognized by many nations, both developed and developing, as the weakest component of national population accounts; the lack of international comparability in international migration statistics is also a source of multilateral concern (United Nations 1985; Kraly & Gnanasekaran 1987).

## **Conceptual Issues**

As discussed in the previous section, the effect of immigration on the environment must be considered within the context of, or relative to, other components of population change for specified geographic areas in the United States. Ideally, this requires a demographic perspective guiding the measurement of the process of international migration to and from the United States in which demographic characteristics, specifically length of stay or departure, are documented for all migrants. To address immigration policy issues, citizenship status and category of

visa also must be known along with the full battery of social and economic characteristics, including age, gender, education, household composition, occupation, employment status, income, etc. Clearly, information must be collected for states and local areas and made available for comparative analysis of population dynamics for current time periods. The ideal system of social demographic accounts remains beyond reasonable grasp. It is useful, however, to dwell on the first conceptual issue—the degree to which U.S. immigration statistics represent demographic concepts of international migration.

Statistics on international migration to the United States are collected on an ongoing basis: the U.S. Immigration and Naturalization Service [INS] is mandated to inspect every person seeking entry to the United States. Primarily because of this mission to enforce the Immigration and Nationality Act, official statistics generally reflect legal and administrative categories: U.S. citizen; permanent resident alien; nonimmigrant; refugee; asylee; and parolee. Data on admissions of permanent resident aliens usually serve as the measure of annual international migration to the United States. These statistics, however, refer to date or year of admission to the status of permanent resident alien and not year of actual arrival in the United

States. In many years, the proportion of immigrant admissions that is composed of adjustments of temporary migrants or nonimmigrants to permanent resident is on the order of 35-40 percent. In 1992, for example, 47 percent of immigrant admissions were aliens adjusted from other statuses; a large proportion of these were persons who had been in the United States at least since 1982 and were adjusting status under the provisions of IRCA (U.S. Department of Justice 1993).

Work has been done to manipulate INS administrative data to better represent demographic concepts of international migration (Kraly & Warren 1991, 1992). Data on new immigrant arrivals, arrivals of nonimmigrants who ultimately adjust to permanent resident status, nonimmigrants who remain in the United States for more than one year and subsequently depart, and refugees and asylee approvals have been combined by calendar year of entry to measure the concept of long-term immigration, a statistical concept recommended by the United Nations Statistical Commission (United Nations 1980). Comparison of data measuring this demographic concept with official INS data on admissions yields important differences in the national origins characteristics of annual alien immigration to the United States and, perhaps relatively more salient to this discussion,

patterns of geographic distribution. Large absolute differences in immigration levels have been shown for New York, California, Illinois, and Massachusetts, with large relative differences in levels for smaller areas, notably the District of Columbia.

This work reveals important differences between alternative measures in the magnitude of the demographic effects of immigration for U.S. regions and states. Whether INS will continue to experiment with producing measures of long-term immigration to compare with administrative measures is not known. As mentioned above in the discussion of theory, it may also be useful if data on length of stay of nonimmigrant aliens were analyzed to measure demographic impact using person-years concepts for specific categories of nonimmigrant aliens for major places of destination in the United States.

The U.S. Census Bureau also combines different sources of data, including INS administrative data, to operationalize the concept of net immigration in its program of population estimates and projections (see, for example, Word 1993). The concept of net immigration includes six categories of international migrants for which data are collected or estimated for estimates of annual population change for intercensal years and to operationalize the concept of net immigration for national

population projections. The categories include legal alien immigration, undocumented alien immigration, foreign- and native-born emigration, net migration from Puerto Rico, net movement of armed forces personnel and dependents, and net movement of civilian federal employees and dependents. By seeking to measure international migration on the basis of residence criteria of the decennial census, the concept of net immigration is more relevant for demographic analysis of population change. By omitting some categories of international migration, however, the validity of net immigration as a demographic concept fall shorts. For example, international migration *to* the United States of nonfederal employees and dependents and increasingly important, categories of nonimmigrants with long-term length of stay in the United States (e.g., students and foreign government officials) are not represented in the concept of net immigration (Word 1994).

## **Closure in Demographic Accounts**

Migration from the United States is not directly measured in the federal statistical system and as a result we have no comprehensive source of statistics on

emigration from the United States (Warren & Kraly 1985; Edmonston 1989: 30-36; Kraly & Warren 1991). The measurement of emigration of immigrants and the foreign born derives primarily from residual methods of estimation (Warren & Peck 1980; see also Warren & Kraly 1985). In the past few years, the U.S. Census Bureau has explored the use of multiplicity techniques to estimate emigration using the Current Population Survey [CPS] (Woodrow 1991; Woodrow 1990). Other attempts to estimate emigration of immigrants have relied on linkages among administrative data sets (see Jasso & Rosenzweig 1982). Each of these analytic approaches, however, provides data that are of limited usefulness for the measurement of emigration of either aliens or U.S. citizens from the United States at either the national or sub-national levels or for documenting changes in emigration patterns over time.

There has been consideration of other federal sources of administrative data as a basis for estimating emigration (see Levine, Hill & Warren 1985; Edmonston 1989; Kraly 1991). Social Security files hold promise for the estimation of out-migration from the United States of U.S. citizens and alien workers in social security-covered employment and social security beneficiaries; U.S. Department of State records on U.S. citizens who have regis-

tered at U.S. consulates may be useful for monitoring changes in the size and distribution of the expatriate community; the Nonimmigrant Information System has been shown to be an effective source of information on length of stay of temporary migrants to the United States (see Warren 1990, Kraly & Warren 1991); and the passenger surveys conducted by the U.S. Travel and Tourism Administration may provide a useful sampling frame for survey of intentions concerning departure and residence abroad (Kraly 1991).

No direct data, other than statistics on apprehensions, are available to measure level, trends and characteristics of undocumented alien migration to and from the United States. As with alien emigration, estimates of undocumented migration have been computed using residual methods of demographic estimation for U.S. census data, immigrant data records of the INS, estimates of emigration, and census undercount and assumptions about mortality levels. Reliability of estimates of undocumented migration is thus challenged by the nature of error in measuring the other components of population change, notably legal alien immigration and emigration.

Research by Warren and Passel (1987) has provided the conceptual framework for subsequent development of estimates of

undocumented migration (see, for example, Passel & Woodrow 1987; Woodrow & Passel 1990). Increasingly apparent, however, are constraints on the methodology to provide reliable estimates, particularly at the subnational level. Error in the estimates reflects problems in assumptions about emigration and coverage error in census enumeration and in measuring nonimmigrants and agricultural workers with long-term length of stay in the country (Woodrow 1992). A different estimation methodology using INS data has been applied by Warren to develop estimates of overstay among aliens admitted on nonimmigrant visas, by country of origin (Warren 1990). Extending this analysis, Warren has also estimated the size of the undocumented alien population by state of residence (see Warren 1994a).

### **Availability of Data for Regional and Local Analysis**

These issues concerning the conceptualization and measurement of the process of international migration *to and from* the United States hamper the analysis of the components of population change on the national level. These issues are also rel-

evant for the measurement of the components of population change for states, regions, metropolitan areas, and local communities throughout the United States. As discussed earlier, the issue of geographic scale is critical to rigorous study of the role of population and immigration in environmental change.

The lack of direct data on the place of residence and internal migration patterns of immigrants poses particular problems for analyses which seek to relate flow statistics on alien migration to population characteristics for regional or local areas. For example, the Population Estimates Program of the U.S. Census Bureau incorporates international migration into estimates of annual population for states and counties in the United States using the geographic distribution of previous alien immigration streams. Estimates of annual net immigration are derived from both direct measurement of some categories of alien immigration (e.g., permanent resident alien immigration refugees and nonimmigrants adjusting to permanent resident status) and indirect estimates of other categories (e.g., net undocumented migration and foreign-born emigration). The estimates are allocated to states and counties on the basis of the geographic distribution of alien immigrants, by se-

lected region and country of birth, for alien residents in the United States entering in the five years prior to the decennial census. Assumptions about geographic distribution become increasingly out-dated for measures of annual population growth at the end of the censal decade (see Word 1993).

INS statistics do document intended state and city of residence for immigrants and nonimmigrants admitted to the United States. The reliability and validity of these data on residential intentions, however, are not well understood (see Kraly & Hildebrandt 1993). For the most part, demographers must rely on decennial census data for such analyses using fixed period data on residential change (see, for example, Frey 1994; also Plane & Rogerson 1994:91-95). Census data on previous residence abroad are not ideally suited for the analysis of the demographic impacts of alien immigration for local populations. The temporal limitations of decennial census data also inhibit the measurement of the components of local population change. Increasingly, state and city planners have turned to other administrative sources of data to tap the role of migration in local population dynamics during intercensal years (see Weeks 1992 :492-96; see also Heer & Passel 1987).

## **Implications for Research on U.S. Statistical Information Concerning Population Immigration and the Environment**

It is productive to continue to evaluate issues concerning the measurement of the international migration component of national, regional, and local population dynamics. But to summarize, several issues emerge from this brief review of general problems in U.S. immigration data, each of which has serious implications for the analysis of the relation between immigration and the environment. There exists a lack of a demographic conceptualization of international migration and mobility inherent in INS information systems, the primary source of data on the flow of international migration to the United States. As a result, there is lack of congruence between INS statistics and demographic data collected through the decennial census or the CPS. Comprehensive population characteristics and patterns of in- and out-migration for local areas are measured at ten-year intervals through decennial census data; the Current Population Survey generates very valuable data for

intercensal periods on the role of immigration in population change but only for the nation as a whole and the largest states and metropolitan areas. Finally, lack of closure exists in demographic accounts, notably, the absence of data on emigration from the United States, the international mobility patterns of U.S. citizens, and undocumented migration patterns.

As stated earlier, the nature of the problems in U.S. statistics on international migration for purposes of demographic analysis of national and local population change are relatively well documented. Left unspecified, however, is the nature of the information necessary to determine the environmental impacts of population and migration trends given appropriate demographic data. As embodied in the models of population-environmental dynamics discussed earlier, such "mediating factors" include behavior patterns concerning consumption, production, and conservation among immigrants and internal migrants and residents, as well as such contextual characteristics as industrial mix, patterns of economic and technological change, political organization, and policy and program implementation (see also Ness, Drake & Brechin 1993c:377-406). Moreover, specification of data needs also assumes a clear identification of relevant environmental outcomes for a specific locale, region, or metropolitan area

(see Rosenbaum 1991:60-61; Day 1993; Risler 1993; Colthern 1993b).

A longitudinal survey of immigrants holds strong potential as a means to collect data more effectively on the social demographic behavior and experiences of immigrants. The research community has recognized the value of a survey on immigrants to study directly patterns of settlement and internal mobility among immigrants, as well as social characteristics and economic behavior among immigrant cohorts and how these change over time. Valdez, et al. (1993:2-3) recognize the need for more appropriate data to address the complicated policy questions concerning U.S. immigration and argue strongly for the use of survey methodology to assess the impacts of immigration on regional and local communities (see also Chokor 1985:18). Their study of Salvadorean and Filipino communities in Los Angeles represents an important effort to use survey methods to document the role of immigration in social, political, and economic processes in local areas.

The use of social survey methodology is also highly appropriate for the collection of data concerning environmentally-relevant behavior, attitudes, and impacts of immigrants. To yield results appropriate to environmental research, however,

survey design must address, first, the need for reliable data at different geographic scales and, second, the critical need to compare over time behaviors and characteristics among different groups of immigrants and with U.S. citizens. Similarly, survey results also must foster the comparison of causes and correlates of environmental change in geographic areas experiencing different levels of in- and out-migration, including areas lacking significant alien immigration.

Certainly, there is a great deal of work remaining to develop a comprehensive statement concerning the nature of information and methodologies appropriate for the study of the role of population, and specifically immigration, in environmental processes and change in the United States. Several initial recommendations for policy relevant research clearly emerge, however, from this initial review of information requirements. The recommendations that follow generally focus on the requisite needs for improving the statistical basis for measuring the role of immigration in population change at different scales of analysis; complementary issues should be addressed concerning the status of data on environmental change for places and regions in the United States.

***Recommendations for Improvements in Data***

1. An inventory and comprehensive description should be conducted to document the availability and accessibility of data on environmental processes, quality, and resources for the regions, states, and metropolitan, urban, and local areas in the United States.

2. An inventory and comprehensive description of demographic data available to measure regional, state, and local population dynamics (births, deaths, and migration) for different periods of time (intercensal, annual, etc.) should be developed; social demographic characteristics of population (age, sex, education, occupation, country of birth, length of residence, etc.) that are available also should be identified.

- a. Documentation should be made of the degree to which alien immigration can be identified as a component of population change at different geographic scales and for different periods of time.
- b. Documentation should be made of the degree to which sources of internal migration, both in-migra-

tion and out-migration, can be identified as components of population change at different geographic scales, for different periods of time and for immigrants and U.S. citizens.

- c. Documentation should be made of the degree to which sources of emigration from the country can be identified as components of population change at different geographic scales, for different periods of time, and for immigrants and U.S. citizens.

2. Data available for the measurement of the components of regional and local population change should be evaluated in terms of both validity and reliability.

3. The implications of different concepts of migration, for example, administrative measures versus demographic concepts, should be evaluated empirically for the measurement of regional and local population change.

4. An exploration of the collection or use of alternative sources of population and migration data for measuring local and regional population change should be initiated.

- a. Evaluation should be conducted of the use of sampling techniques in estimation of components of population change for different geographic scales.
  - b. Evaluation should be conducted of the use of survey methodology for the estimation of components of population change for different geographic scales.
  - c. Analysis of the degree to which proposals for a longitudinal survey of immigrants can address issues concerning environmental impact should be conducted.
5. Research on data availability should be coordinated with analytic efforts by environmental scientists to identify regions, places, and locales in the United States for which study of population, immigration, and environmental relationships is particularly salient.

## CONCLUSIONS

The general criticism of Meyer and Turner (1992:51) concerning the state of scholarship on human impacts on the global environment is particularly useful in assessing the current state of scholarship on U.S. immigration and the environment:

Two extremes in approach are ultra-empiricism and ultra-theoreticism. In the former vein, Newell and Marcus [1987] present a correlation of +0.9985 between world population growth and tropospheric CO<sub>2</sub> since the 1950s as proof of population's fundamental role. In the latter, Harvey [1974] deprecated neo-Malthusian arguments for the primacy of population growth in resource depletion as politically founded. The former is apt to mistake correlation for cause (or absence of correlation for causal unimportance) in a highly complex area; the latter is apt to narrow excessively the scope of investigation without recourse to data. Theory—including theory from the social sciences—and evidence need both to be drawn upon.

This review has sought to develop recommendations for scientific research on U.S. immigration and the environment that address the salient analytic issues identified by Meyer and Turner. Four broad themes emerge from the specific recommendations set out in each section of the review.

Research on the environmental consequences of U.S. immigration will benefit

from first, attending to the adequacy of conceptual models of the population-environment relationships, and more generally, perspectives on human environmental impacts, in specifying the role of migration in processes of environmental change. On the basis of this review, it is apparent that theoretical development concerning migration and the environment needs to occur in order to derive relevant and testable hypotheses about causal relationships and effects.

Second, given the significance of geographic scale for empirical findings about the relationship between demographic processes and environmental change, studies for the United States should be initiated on national, regional, and local levels. Results of studies should be interpreted with an explicit appreciation of the differences in the effects of population dynamics for environment processes at different geographic scale: “[Population’s] connections to land-cover change become weaker at increasingly smaller spatial scales because of the importance of the other variables that affect demand or spatially deflect its impacts” (Meyer & Turner 1992:54). Similarly, research results should synthesize the effects of immigration processes spatially, among regions and local areas, and, structurally, across economic sectors.

Research on U.S. immigration and the environment should provide both descriptive results concerning trends in demographic and environmental change at different geographic scales and for specific places, as well as causal insights about the nature of relationships among factors. It is critical that analytic attention be devoted to studying the implications of research design for the production of useful and relevant information for improving our understanding of immigration and environmental processes. Specifically, research results must be relevant first, for the accumulation of knowledge about interrelationships among population, migration and the environment in the United States and second, for the analysis of national policies concerning immigration, population and environmental protection, and programs to allocate federal resources among states and localities. In other national and regional contexts, survey methodology has been shown to hold useful analytic potential for explanatory studies of migration and environmental change and should be explored for the U.S. context.

Finally, the statistical foundation for the analysis of the environmental consequences of U.S. immigration must be strengthened. Migration statistics—data on alien immigration, internal migration

and emigration—must be improved to accommodate local and regional analysis for intercensal periods. As relevant in these times of fiscal restraint in federal spending is the critical need to advocate the continuation and maintenance of current statistical programs: INS statistics on the admission of aliens to the United States must continue to be collected and made accessible for public use; questions concerning nativity, citizenship, and geographic mobility must continue to be asked on the decennial census and the Current Population Survey. Finally, an assessment of the status of indicators of environmental quality and resource availability is a critical component of developing an agenda of policy relevant scientific research.

These broad recommendations beg the question of strategy for stimulating and organizing research efforts to address the important analytic issues concerning U.S. immigration and the environment. Interdisciplinary collaboration is essential for the development of a research program on U.S. immigration and the environment (cf. Preston 1993:600). Interaction among environmental and social scientists must be facilitated to initiate theoretical development, to reflect on research design, and to document the status of available data, and ultimately to establish a framework for interpretation of research results in connection to the policy process.

Given the need for both baseline documentation and exploratory research, it seems highly appropriate to initiate a research program on population, immigration, and environment for specific regions, metropolitan areas, and local communities in the United States. Selected places should be identified as research sites in which an integrated program of research on population dynamics and environmental processes would be implemented. Interdisciplinary collaboration among scientists must be organized within research sites and coordinated with relevant planning and scientific agencies at the federal, state, and local levels. Taken together, national and local priorities for environmental planning and management, national goals for immigration policy, and local needs for population forecasting underscore the importance of a coordinated research program concerning population, immigration, and the environment for regions and communities in the United States.

## **A Final Observation**

Barry Commoner (1975:111) once stated that he knew “. . . of no scientific principle which can tell us how much to rely on population control and how much on

technological change (and the required economic controls) in order to reduce environmental impact. The choice between these alternative paths is clearly a political one, not a matter of science." A somewhat contrasting perspective, inherent in the analysis presented here, holds that research on the relationships between U.S. immigration and the environment is an essential component of rational and honest decisionmaking concerning U.S. immigration. "Green" arguments are currently more acceptable than the ethnocentric rationale for restrictionism of Colgate's President Cutten (Wood 1923). Whether environmental criteria are appropriate grounds for revising immigration policy encompasses questions that are within the grasp of social and environmental research.

## REFERENCES

- AAAS: Resolution on Population Growth. 1991. *Population and Development Review* 17:2 367-70.
- "Antalya Statement" on Global Development. 1991. *Population and Development Review* 17:2 359-63.
- Appleyard, R.T. 1992. Migration and Development: A Critical Relationship. *Asian and Pacific Migration Journal* 1:1-18.
- Appleyard, R.T. 1990. South-North Migration. *International Migration Review* 25:610-24.
- Arizpe, L.; Stone, M.P.; Major, D.C. 1994. *Population and Environment: Rethinking the Debate*. Boulder, CO: Westview.
- Armstrong, P.H. 1992. Human Impacts on Australia's Indian Ocean Tropical Island Ecosystems: A Review. *The Environmentalist* 12:191-206.
- Bailey, A.; Ellis, M. 1993. Going Home: The Migration of Puerto Rican-born Women from the United States to Puerto Rico. *The Professional Geographer* 45: 148-58.
- Bali Declaration on Population and Sustainable Development. *Population and Development Review* 18:4 769-78.
- Barrett, B.F.D.; Therivel, R. 1991. *Environmental Policy and Impact Assessment in Japan*. London and New York: Routledge.
- Barry, R.B; Mather, J.R.; Sdasyuk, G.V. (eds). 1991. *Global Change: Geographical Approaches*. Tucson: University of Arizona Press.
- Bayliss-Smith, T.P. 1980. Population Pressure, Resources and Welfare: Towards a More Realistic Measure of Carrying Ca-

- capacity. In *Population-Environment Relations in Tropical Islands: The Case of Eastern Fiji*. MAB Technical notes 13. Paris: UNESCO.
- Bedford, R.D. 1980. Demographic Processes in Small Islands: The Case of Internal Migration. In *Population-Environment Relations in Tropical Islands: The Case of Eastern Fiji*. MAB Technical Notes 13. Paris: UNESCO.
- Berreby, D. 1994. The Numbers Game. In *Global Issues 94/95* (R.M. Jackson, ed.). Guilford, CT: Dushkin.
- Berry, B.J.L. 1990. Urbanization. In *The Earth as Transformed by Human Action* (B.L. Turner, et al., eds.). New York: Cambridge University Press and Clark University.
- Bikales, G. 1977. Immigration Policy: The New Environmental Battlefield. *National Parks & Conservation Magazine* 12:15.
- Bilsborrow, R.E. 1992. Population Growth, Internal Migration, and Environmental Degradation in Rural Areas of Developing Countries. *European Journal of Population* 8:125-48.
- Bilsborrow, R.E.; Stupp, E.W. 1989. The Effects of Population Growth on Agriculture in Guatemala. Paper presented at Annual Meeting, Population Association of America.
- Bilsborrow, R.E.; DeLargy, P.F. 1991. Land Use, Migration, and Natural Resource Deterioration: The Experience of Guatemala and Sudan. In *Resources, Environment, and Population: Present Knowledge, Future Options* (K. Davis, M.S. Bernstam, eds.). New York: Oxford University.
- Bilsborrow, R.E.; Geores, M. 1994. Population Change and Agricultural Intensification in Developing Counties. In *Population and Environment: Rethinking the Debate*. (L. Arizpe, M.P. Stone, D.C. Major, eds.). Boulder, CO: Westview.
- Black, P.E. 1981. *Environmental Impact Analysis*. New York: Praeger.
- Blaikie, P.; Brookfield, H. Eds. 1987. *Land Degradation and Society*. London: Methuen.
- Bongaarts, J. 1992. Population Growth and Global Warming. *Population and Development Review* 18:299-319.
- Bonner, W.N. 1989. Environmental Assessment in the Antarctic. *Ambio* 18:83-89.
- Boserup, E. 1981. *Population and Technological Change: A Study of Long-term Trends*. Chicago: University of Chicago.
- Bouvier, L.F. 1992. How to Get There From Here: The Demographic Route to

---

RESEARCH  
P A P E R

- 60 -

---

- Optimal Population Size. In *Elephants in the Volkswagen: Facing the Tough Questions about Our Overcrowded Country* (L. Grant, ed.). New York: W.H. Freeman.
- Bouvier, L. 1991. Immigration and Rising U.S. Fertility: A Prospect of Unending Population Growth. *Center for Immigration Studies (Background)* 1-91:1.
- Bouvier, L.F. 1981. The Impact of Immigration on U.S. Population Size. *Population Trends and Public Policy 1*. Washington, DC: Population Reference Bureau.
- Bower, B.; Takao, K., (eds.). 1993. *Who Speaks for Tokyo Bay?* Rotterdam: A.A. Balkema.
- Bowlby, S.R.; Mannion, A.M. 1992. Perspective and Prospect. In *Environmental Issues in the 1990s* (A.M. Mannion, S.R. Bowlby, eds.). Chichester: Wiley.
- Brookfield, H.C. 1980. Introduction: The Conduct and Findings of the Interdisciplinary Fiji Project. In *Population-Environment Relations in Tropical Islands: The Case of Eastern Fiji. MAB Technical Notes 13*. Paris: UNESCO.
- Brown, L.; Commoner, B.; Cousteau, J. (eds.). 1991. *Environment in Peril*. Washington: Smithsonian Institution Press.
- Bunt, J.S. 1992. How Can Fragile Marine Ecosystems Best Be Conserved? In *Use and Misuse of the Seafloor Environmental Sciences Research Report ES 11* (K.J. Hsu, J. Thiede, eds.). Chichester: John Wiley.
- Burnett, W.C. 1992. Group Report: How Can We Assess the Likely Impact of Humans on the Deep Seafloor? In *Use and Misuse of the Seafloor Environmental Sciences Research Report ES 11*. (K.J. Hsu, J. Thiede, eds.). Chichester: John Wiley.
- Butzer, K. 1990. The Realm of Cultural-Human Ecology: Adaptation and Change in Historical Perspective. In *The Earth as Transformed by Human Action* (B.L. Turner, et al., eds.). New York: Cambridge University Press.
- Caldwell, L.K. 1985. *Population and Environmental: Inseparable Policy Issues*. Washington, DC: Environmental Fund.
- Canada Employment and Immigration Advisory Council. 1991. *Immigration in the 1990s*. Hull.
- Canada Ministry of National Health and Welfare. 1989. *Charting Canada's Future: A Report of the Demographic Review*. Ottawa: Minister of Supply and Services.
- Carnegie Commission on International Migration Policy. 1992. *Population and Development Review* 18:3 585-87.

- Castles, S; Miller, M.J. 1993. *The Age of Migration: International Population Movements in the Modern World*. New York: Guilford Press
- Catanese, A.V. 1990-91. Haiti's Refugees: Political, Economic, Environmental. *Field Staff Reports Latin America*. 17. Universities Field Staff International.
- Cater, E.; Goodall, B. 1992. Must Tourism Destroy Its Resource Base? In *Environmental Issues in the 1990s* (A.M. Mannion, S.R. Bowlby, eds.). Chichester: Wiley.
- Cervantes, J.F.; Reza, M.; Martinez, V.M.. 1993. Environmental Planning by Geocodynamic Assessment in the Basin of Mexico. In *Geomorphology and Geocology: Applied Geomorphology* (M. Pesci, G. Richter eds.). Berlin: Gebruder Borntraeger.
- Chokor, B.A. 1985. Research Policy and Review 7: Developments in Environmental-Behaviour-Design Research: A Critical Assessment in the Context of Geography and Planning with Special Reference to the Third World. *Environment and Planning A* 18:5-26.
- Clark, M.; Herrington, J. (eds.). 1988. *The Role of Environmental Impact Assessment in the Planning Process*. London: Mansell.
- Clark, R.L.; et al. 1994. *Fiscal Impacts of Undocumented Aliens: Selected Estimates for Seven States*. Washington, DC: Urban Institute.
- Clarke, H.; et al. (eds.). 1990. *Immigration, Population Growth and the Environment*. Canberra: Australian Government Printing Office.
- Clarke, J.; et al. (eds.) 1989. *Population and Disaster*. Cambridge: Basil Blackwell.
- Clarke, J.; Khogali, M.; Kosinski, L. (eds.). 1985. *Population and Development Projects in Africa*. Cambridge: Cambridge University.
- Coale, A.J. 1975. Man and His Environment. In *Population, Environment, and the Quality of Life* (P. Marden, D. Hodgson, eds.). New York: AMS Press, Inc.
- Coale, A.J. 1972. Alternative Paths to a Stationary Population. In *U.S. Commission on Population Growth and the American Future, Demographic and Social Aspects of Population Growth, Vol. 1, Commission Research Reports* (C.F. Westoff, R. Parke, Jr., eds.). Washington, DC: Government Printing Office.
- Coats, R.; Swanson, M.; Williams. P. 1989. Hydrologic Analysis for Coastal Wetland Restoration. *Environmental Management* 13:715-27.

---

RESEARCH  
P A P E R

- 62 -

---

- Cohen, M.N. 1992. The Epidemiology of Civilization. In *Human Impact on the Environment: Ancient Roots, Current Challenges* (J.E. Jacobsen, J. Firor eds.). Boulder, CO: Westview.
- Colby, M.E. 1990. Environmental Management in Development: The Evolution of Paradigms. *World Bank Discussion Papers* 80.
- Colthern, C.R. (ed.). 1993a. *Comparative Risk Assessment*. Boca Raton: Lewis.
- Colthern, C.R. 1993b. Introduction and Overview of Difficulties Encountered in Developing Comparative Rankings of Environmental Problems. In *Comparative Risk Assessment* (C.R. Colthern, ed.). Boca Raton: Lewis.
- Commoner, B. 1991. The Failure of the Environmental Effort. In *Environment in Peril*. Washington: Smithsonian Institution Press.
- Commoner, B. 1975. Response. In *Population, Environment and the Quality of Life* (P.G. Marden, D. Hodgson, eds.). New York: AMS Press.
- Conniff, R. 1994. The War on Aliens. In *Global Issues 94/95* (R.M. Jackson, ed.) Guilford, CT: Dushkin.
- Contanza, R. 1992. Escaping the Overpopulation Trap. In *Elephants in the Volkswagen: Facing the Tough Questions about Our Overcrowded Country* (L. Grant, ed.) New York: W.H. Freeman.
- Cooke, P.J. 1992. Group Report: Offshore Petroleum Hydrocarbon Exploitation—Reserves, Impacts, and Alternatives. In *Use and Misuse of the Seafloor Environmental Sciences Research Report ES 11* (K.J. Hsu, J. Thiede, eds.). Chiches-ter: John Wiley.
- Cooper, M. 1993. Population Growth. *Congressional Quarterly Researcher* 3:26 601.
- Cooper, R.N. 1991. The World Economic Climate. In *Preserving the Global Environment* (J.T. Mathews, ed.). New York: W.W. Norton and Company.
- Davis, A.A. 1992. The Geographer's Role in the Solution of Environmental Problems. *The Professional Geographer* 44: 209-11.
- Davis, K.; Bernstam, M.S. (eds.). 1991. *Resources, Environment, and Population: Present Knowledge, Future Options*. New York: Oxford University.
- Day, R.R. 1993. The Impact of Data Gaps in EPA's Regional Comparative Risk Projects. In *Comparative Risk Assessment* (C.R. Colthern, ed.). Boca Raton: Lewis.

- Demery, P. 1991. Tradeoffs Between Human Numbers and Material Standards of Living. In *Resources, Environment, and Population: Present Knowledge, Future Options* (K. Davis, M.S. Bernstam, eds.). New York: Oxford University.
- Demery, P. 1990. Population. In *The Earth as Transformed by Human Action* (B.L. Turner, et. al., eds.). New York: Cambridge University Press and Clark University.
- Detwyler, T.R. (ed.). 1971a. *Man's Impact on Environment*. New York: McGraw-Hill Book Company.
- Detwyler, T.R. 1971b. Summary and Prospect. In *Man's Impact on Environment* (T.R. Detwyler, ed.). New York: McGraw-Hill Book Company.
- Drake, W.D. 1993. Towards Building a Theory of Population-Environment Dynamics: A Family of Transitions. In *Population-Environment Dynamics* (G.D. Ness, W.D. Drake, S. Brechin, eds.). Ann Arbor: The University of Michigan Press.
- Dubos, R. 1971. Man and His Environment: Scope, Impact, and Nature. In *Man's Impact on Environment* (T.R. Detwyler, ed.). New York: McGraw-Hill Book Company.
- "Earth Summit" on Population. 1992. *Population and Development Review* 18:3 571-82.
- Edmonston, B. 1989. *International Migration and Population Growth: A Paper Assessing Data for Policy Research*. Washington, DC: Urban Institute.
- Edmonston, B; Passel, J. 1992. Immigration and Immigrant Generations in Population Projections. *International Journal of Forecasting* 8:459-78.
- Ehrlich, P. 1991. Can We Respond to the Growing Environmental Threat to Civilization? In *Environment in Peril*. Washington: Smithsonian Institution Press.
- Ehrlich, P.R.; Ehrlich, A.H. 1990. *The Population Explosion*. New York: Simon and Schuster.
- Ehrlich, P.R.; Ehrlich, A.H. 1992. The Most Overpopulated Nation. In *Elephants in the Volkswagen: Facing the Tough Questions about Our Overcrowded Country* (L Grant, ed.). New York: W.H. Freeman.
- Elliott, D. 1989. *International Migration and Population Homeostasis: A Historical Study*. New York: Garland.
- Espenshade, T.J. 1991. Book Review: The Population Explosion. *Population and Development Review* 17:331-39.

---

RESEARCH

PAPER

- 64 -

---

Espenshade, T.J. 1986. Population Dynamics with Immigration and Low Fertility. In *Below-Replacement Fertility in Industrial Societies: Causes, Consequences, Policies* (K. Davis, M. Bernstein, R. Ricardo-Campbell, eds.). *Population and Development Review* 12:Supplement.

Espenshade, T.J.; Bouvier, L.F.; Arthur, W.B. 1982. Immigration and the Stable Population Model. *Demography* 19: 125-33.

Ezcurra, E. 1990. The Basin of Mexico. In *The Earth as Transformed by Human Action* (B.L. Turner, et al., eds.). New York: Cambridge University Press.

Federation for American Immigration Reform. 1991. *World Refugee Report* Washington, DC.

Feichtinger, G.; Steinmann, G. 1992. Immigration into a Population with Fertility below Replacement Level—The Case of Germany. *Population Studies* 46:275-84.

Fincher, R. 1991. *Immigration, Urban Infrastructure and the Environment*. Canberra: Bureau of Immigration Research.

Findlay, A.M. 1991. Population Geography. *Progress in Human Geography* 15: 64-72.

Fix, M.; Passel, J. 1994. *Immigration and Immigrants: Setting the Record Straight*. Washington, DC: Urban Institute.

Flannery, T. 1992. Australia—Overpopulated or Last Frontier: A Biological Perspective. Paper presented at the Second National Immigration Outlook Conference, November 11-13, Sydney.

Foell, W.K. 1976. Ecological and Environmental Research at the International Institute for Applied Systems Analysis. *Ecological Modelling* 2:287-94.

French, H.F. 1992. Strengthening Global Environmental Governance. In *State of the World 1992. A Worldwatch Institute Report on Progress Toward a Sustainable Society* (L. Brown, ed.). New York: W.W. Norton and Company.

Frey, W.H. 1994. Immigration and Internal Migration “Flight” from High Immigration States: 1990 Census Findings for California. Paper presented at the Annual Meeting of the Association for American Geographers, March 29-April 2, San Francisco.

Frey, W.H.; Speare, A. Jr. 1992. The Revival of Metropolitan Population Growth in the United States: An Assessment of Findings from the 1990 Census. *Population and Development Review* 18: 129-46.

- Galbraith, J.K. 1991. The Economic Case for the Environment. In *Environment in Peril*. Washington, DC: Smithsonian Institution Press.
- de al Garza, R.; Rodriguez, N.; Pachon, H. 1990. The Domestic and Foreign Policy Consequences of Mexican and Central American Immigration: Mexican-American Perspectives. In *Immigration and International Relations: Proceedings of a Conference on the International Effects of the 1986 Immigration Reform and Control Act* (G. Vernez, ed.). Santa Monica and Washington, DC: Rand Corporation and Urban Institute.
- Gerba, C.P.; Rose, J.B. 1993. Estimating Viral Disease Risk from Drinking Water. In *Comparative Risk Assessment* (C.R. Colther, ed.). Boca Raton: Lewis.
- Gibson, C. 1975. The Contribution of Immigration to the United States Population Growth: 1790-1970. *International Migration Review* 9:157-77.
- Gilliam, H. 1993. Bursting at the Seams. *San Francisco Examiner-Chronicle* 7.
- Glaser, G. 1980. *Forward: Population-Environment Relations in Tropical Islands: The Case of Eastern Fiji*, MAB Technical Notes 13. Paris: UNESCO.
- Goodenough, R. 1992. The Nature and Implications of Recent Population Growth in California. *Geography* 77: 123-33.
- Goudie, A. 1990. *The Human Impact on the Natural Environment*. Cambridge: The MIT Press.
- Grainger, A. 1993. Population as Concept and Parameter in the Modeling of Deforestation. In *Population-Environment Dynamics* (G.D. Ness, W.D. Drake, S. Brechin, eds.). Ann Arbor: The University of Michigan Press.
- Grant, L. (ed.). 1992. *Elephants in the Volkswagen: Facing the Tough Questions about Our Overcrowded Country*. New York: W.H. Freeman.
- Griggs, G.B.; McCrory, P.A. 1975. Comparative Discharges of Fresh and Waste Water along the California Coast. *Environmental Geology* 1:89-95.
- Hagerstrand, T.; Lohm, U. 1990. Sweden. In *The Earth as Transformed by Human Action* (B.L. Turner, et al., eds.). New York: Cambridge University Press.
- Harf, J.E.; Trout, T. 1986. *The Politics of Global Resources: Population, Food, Energy, and Environment*. Durham: Duke University Press.

---

RESEARCH  
P A P E R

- 66 -

---

- Harvey, D. 1974. Population, Resources, and the Ideology of Science. *Economic Geography* 50:256-77.
- Heer, D.; Passel, J. 1987. Comparison of Two Methods for Estimating the Number of Undocumented Mexican Adults in Los Angeles County. *International Migration Review* 21:1446-74.
- Herrmann, R. (ed.). 1992. *Managing Water Resources During Global Change*. Bethesda: American Water Resources Association Technical Publication Series.
- Hogan, D.J. 1992. The Impact of Population Growth on the Physical Environment. *European Journal of Population* 8:109-23.
- Hsu, K.J.; Thiede, J. (eds.). 1992. *Use and Misuse of the Seafloor. Environmental Sciences Research Report ES 11*. Chichester: John Wiley.
- Huguet, J.W. 1992. Migration and Urbanization: Interrelationships with Socio-economic Development and Evolving Policy Issues. *Asian and Pacific Migration Journal* 1:386.
- Impact of Immigrants on the US: Shattering the Myths*. Washington, DC: National Immigration, Refugee, and Citizenship Forum.
- Jackson, R.M. (ed.). 1994. *Global Issues 94/95*. Guilford, CT: Dushkin.
- Jacobsen, J. 1988. *Environmental refugees: a Yardstick of Habitability. Worldwatch Paper 86*. Washington, DC: Worldwatch Institute.
- Jacobsen, J.E.; Firor, J. (eds.). 1992. *Human Impact on the Environment: Ancient Roots, Current Challenges*. Boulder, CO: Westview.
- Jasso, G.; Rosenzweig, M. 1982. Estimating the Emigration Rates of Legal Immigration Using Administrative and Survey Data: The 1971 Cohort of Immigration to the United States. *Demography* 19: 279-90.
- Jones, H. 1992. The New Global Context of International Migration: Policy Options for Australia in the 1990s. *Area* 24:359-66.
- Kates, R.W. 1987. The Human Environment: The Road Not Taken, the Road Still Beckoning. *Annals of the Association of American Geographers* 77:525-84.
- Kates, R.W.; Turner, B.L. II; Clark, W.C.. 1990. The Great Transformation. In *The Earth as Transformed by Human Action* (B.L. Turner, et al., eds.). New York: Cambridge University Press.

- Keely, C.B. 1974. The Estimation of the Immigrant Component of Population Growth. *International Migration Review* 8:431-35.
- Keely, C.B.; Kraly, E.P. 1978. Recent Net Alien Immigration to the United States: Its Impact on Population Growth and Native Fertility. *Demography* 15:267-84.
- Kennan, G.F. 1993. *Around the Cragged Hill: A Personal and Political Philosophy*. New York and London: W.W. Norton and Company.
- Keough, M.J; Quinn, G.P.. 1991. Causality and the Choice of Measurements for Detecting Human Impacts in Marine Environments. *Australian Journal of Marine and Freshwater Research* 42:539-54.
- Keyfitz, N. 1993. Thirty Years of Demography and *Demography*. *Demography* 30:533-49.
- Keyfitz, N. 1991. Population Growth Can Prevent the Development That Would Slow Population Growth. In *Preserving the Global Environment* (J.T. Mathews, ed.). New York and London: W.W. Norton and Company.
- Keyfitz, N. 1971. Migration as a Means of Population Control. *Population Studies* 25:63-72.
- Kim, N.K. 1993. Temporal Variations in Exposure Data. In *Comparative Risk Assessment* (C.R. Colthorn, ed.). Boca Raton: Lewis.
- Kraly, E.P. 1991. *Balancing the Equation: Federal Statistical Resources for the Measurement of Alien Emigration from the United States*. Report prepared for the U.S. Immigration and Naturalization Service Office of Plans and Analysis.
- Kraly, E. 1981. Immigration Debate and Demographic Policy. In *The Unavoidable Issue: U.S. Immigration Policy in the 1980s* (D.G. Papademetriou, M.J. Miller, eds.). Philadelphia: Institute for the Study of Human Issues.
- Kraly, E.P.; Gnanasekaran, K.S. 1987. Efforts to Improve International Migration Statistics: A Historical Perspective. *International Migration Review* 21:967-95.
- Kraly, E.P.; Hildebrandt, C. 1993. The Measurement of Immigration to Regions and States in the United States. Paper presented at the Annual Meeting of the Population Association of America, April 6-10, Atlanta.
- Kraly, E.P.; Warren, R. 1992. Estimates of Long-Term Immigration to the United States: Moving U.S. Statistics Toward United Nations Concepts. *Demography* 29:613-28.

Kraly, E.P.; Warren, R. 1991. Long-Term Immigration to the United States: New Approaches to Measurement. *International Migration Review* 25:60-92.

Kritz, M.; Keely, C.B. (eds.). 1983. *Global Trends in Migration: Theory and Research on International Population Movements*. Staten Island: Center for Migration Studies.

Kritz, M.; Lim, L.L.; Zlotnik, H. (eds.). 1992. *International Migration Systems: A Global Approach*. New York: Oxford University.

Kubat, D. (ed.). 1993. *The Politics of Migration Policies: Settlement and Integration*. Staten Island: Center for Migration Studies.

Lein, J.K. 1991-92. On the Application of Expert Systems in Environmental Performance Assessment. *Journal of Environmental Systems* 21:167-83.

Levine, D.B.; Hill, K.; Warren, R. (eds.). 1985. *Immigration Statistics: A Story of Neglect*. Washington, DC: National Academy of Sciences.

Linden, O. 1990. Human Impact on Tropical Coastal Zones. *Nature and Resources* 26:3-11.

Loescher, G.; Scanlan, J.A. 1986. *Calculated Kindness: Refugees and America's Half-Open Door, 1945 to the Present*. New York: Free Press.

Lowe, M. 1992. Shaping Cities. In *State of the World 1992: A Worldwatch Institute Report on Progress Toward a Sustainable Society* (L. Brown, ed.). New York: W.W. Norton and Company.

Lowe, M.S.; Bowlby, S.R. 1992. Population and Environment. In *Environmental Issues in the 1990s* (A.M. Mannion, S.R. Bowlby, eds.). Chichester: John Wiley.

Lowenthal, D. 1991. Environmental Conflict. *National Geographic Research and Exploration* 7:266-75.

Lowenthal, D. 1990. Awareness of Human Impacts: Changing Attitudes and Emphases. In *The Earth as Transformed by Human Action* (B.L. Turner, et al., eds.). New York: Cambridge University Press.

Lutz, W. 1994. World Population Trends: Global and Regional Interactions between Population and Environment. In *Population and Environment: Rethinking the Debate* (L. Arizpe, M.P. Stone, D.C. Major, eds.). Boulder, CO: Westview.

MacKellar, F.L.; Vining, D.R. 1988. Research and Policy Review 26: Where Does

- the United States Stand in the Global Resource Scarcity Debate? *Environment and Planning A* 20:1567-73.
- Mann, D. 1990. Fewer People for a Better World. *Environmental Conservation* 17:262.
- Mannion, A.M.; Bowlby, S.R. (eds.). 1992. *Environmental Issues in the 1990s*. Chichester: John Wiley.
- Man's Impact on the Global Environment. 1970. *Report of the Study of Critical Environmental Problems*. Cambridge and London: The MIT Press.
- Marden, P.G.; Hodgson, D. 1975. The Relation of Population and Environment: A Debate. In *Population, Environment, and the Quality of Life* (P. Marden, D. Hodgson, eds.). New York: AMS Press, Inc.
- Massey, D. 1988. Economic Development and International Migration in Comparative Perspective. *Population and Development Review* 19:383-413.
- Massey, D.; et al. 1993. Theories of International Migration: A Review and Appraisal. *Population and Development Review* 19:431-66.
- Massey, D.; et al. 1987. *Return to Aztlan: The Social Process of International Migration from Western Mexico*. Berkeley: University of California.
- Mather, J.R; Sdasyuk, G. (eds.). 1991. *Global Change: Geographical Approaches*. Tucson: University of Arizona Press.
- Mathews, J.T. 1991a. The Implications for U.S. Policy. In *Preserving the Global Environment* (J.T. Mathews ed.). New York: W.W. Norton and Company.
- Mathews, J.T. 1991b. *Preserving the Global Environment*. New York: W.W. Norton and Company.
- McCall, M. 1985. Environmental and Agricultural Impacts of Tanzania's Villagization Programme. In *Population and Development Projects in Africa* (J. Clarke, M. Khogali, L. Kosinski, eds.). Cambridge: Cambridge University.
- McConnell, R.L. 1991. The Real Environmental Crisis, Or What Happened to Government by the People, for the People? *Population and Environment* 12:407-16.
- McHugh, K. 1994. Spatial and Temporal Redistributors in the U.S. Interstate Migration System, 1960-1990. Paper presented at the Annual Meeting of the Association for American Geographers, March 29-April 2, San Francisco.

---

RESEARCH

PAPER

- 70 -

---

- McNabb, S. 1989. Logical Inconsistencies . . . *Human Organization* 48:108-16.
- McNicoll, G. 1992a. The United Nations' Long-Range Population Projections. *Population and Development Review* 18:333-40.
- McNicoll, G. 1992b. The Agenda of Population Studies: A Commentary and Complaint. *Population and Development Review* 18:399-420.
- Mehta, M.; Sudarshan, G. 1992. Population Pressure on Urban Water Supply and Management—A Case Study of Nagpur City, Maharashtra, India. In *Managing Water Resources During Global Change*. Bethesda, MD: American Water Resources Association Technical Publication Series.
- Melosi, M.V. 1993. Pollution and the Emergence of Industrial America. In *Human Impact on the Environment: Ancient Roots, Current Challenges* (J.E. Jacobsen, J. Firor, eds.). Boulder, CO: Westview.
- Merchant, C. 1990. The Realm of Social Relations: Production, Reproduction, and Gender in Environmental Transformations. In *The Earth as Transformed by Human Action* (B.L. Turner, et al., eds.). New York: Cambridge University Press.
- Meyer, W.B.; Turner, B.L. II. 1992. Human Population Growth and Global Land Use/Cover Change. *Annual Review of Ecology and Systematics* 23:39-61.
- Milliman, J.D. 1992. Management of the Coastal Zone: Impact of Onshore Activities on the Coastal Environment. In *Use and Misuse of the Seafloor. Environmental Sciences Research Report ES 11* (K.J. Hsu, J. Thiede, eds.). Chichester: John Wiley.
- Milne, A. 1988. Our Drowning World. In *Population, Pollution and Future Weather*. Bridport: Prism.
- Mink, S.D. 1992. *Poverty, Population, and the Environment: World Bank Discussion Papers 189*. Washington, DC: The World Bank.
- Mitra, S. 1983. Generalization of Immigration and the Stable Population Model. *Demography* 20:111-15.
- Morrill, R.L. 1987. A Theoretical Imperative. *Annals of the Association of American Geographers* 77:535-41.
- Muller, T. 1993. *Immigrants and the American City*. New York: New York University.
- Munich Summit on the Environment and on Population. 1992. *Population and Development Review* 18:583-84.

- Murdock, S. 1991. International Dimensions of Post-1980 Internal Migration in the United States: The Role of Sustenance Specialization and Dominance. *Sociological Inquiry* 61:491-504.
- Murphy, P.; et al. 1990. *Impact of Immigration on Urban Infrastructure*. Canberra: Australian Government Printing Service.
- Myers, N. 1993. *Ultimate Security: The Environmental Basis of Political Security*. New York: W.W. Norton and Company.
- National Academy of Sciences. 1991. NAS on Policy Implications of Greenhouse Warming. *Population and Development Review* 17:364-67.
- National Population Council, Population Issues Committee. 1991. *Population Issues and Australia's Future: Environment, Economy and Society. Final Report*. Canberra: Australian Government Publishing Service.
- National Research Council. 1986. *Population Growth and Economic Development: Policy Questions*. Washington, DC: Government Printing Office.
- Ness, G.D. 1993. The Long View: Population-Environment Dynamics in Historical Perspective. In *Population-Environment Dynamics* (G.D. Ness, W.D. Drake, S. Brechin, eds.). Ann Arbor: The University of Michigan Press.
- Ness, G.D.; W.D. Drake; S.R. Brechin, 1993a. Global Perspectives: History, Ideas, Sectoral Changes, and Theories. In *Population-Environment Dynamics* (G.D. Ness, W.D. Drake, S. Brechin, eds.). Ann Arbor: The University of Michigan Press.
- Ness, G.D.; Drake, W.D.; Brechin, S.R. (eds.). 1993b. *Population-Environment Dynamics*. Ann Arbor: The University of Michigan Press.
- Ness, G.D.; Drake, W.D.; Brechin, S.R. 1993c. Summary, Conclusion, and Next Steps. In *Population-Environment Dynamics* (G.D. Ness, W.D. Drake, S. Brechin, eds.). Ann Arbor: The University of Michigan Press.
- Newell, N.D.; Marcus, L. 1987. Carbon Dioxide and People. *Palaios* 2:101-03.
- Newson, M. 1992a. The Geography of Pollution. In *Managing the Human Impact on the Natural Environment: Patterns and Processes* (M. Newson, ed.). London: Belhaven.
- Newson, M. (ed.). 1992b. *Managing the Human Impact on the Natural Environment: Patterns and Processes*. London: Belhaven.

- Newson, M. 1992c. Planning, Control or Management? In *Managing the Human Impact on the Natural Environment: Patterns and Processes* (M. Newson, ed.). London: Belhaven.
- Nieuwenhuysen, J. 1992. An Overview of Recent Research on Australian Immigration. Paper presented at the Second National Immigration Outlook Conference, November 11-13, Sydney.
- Ofori-Cudjoe, S. 1990. Environmental Impact Assessment in the Ghana—An Ex Post Evaluation of the Volta Resettlement Scheme: The Case of the Kpong Hydro-Electric Project. *The Environmentalist* 10:115-26.
- Ogata, S. 1989. Interlinking Problems of Population, Environment and Development. *Development* 4:46-48.
- Palloni, A. 1994. The Relation between Population and Deforestation: Methods for Drawing Causal Inferences from Macro and Micro Studies. In *Population and Environment: Rethinking the Debate* (L. Arizpe, M.P. Stone, D.C. Major, eds.). Boulder, CO: Westview.
- Parkes, A.S.; Dennis, F. 1993. *Backlash: A Biologist Looks at Problems of Population and the Environment*. Cambridge: Cambridge University.
- Passel, J.; Woodrow, K. 1987. Change in the Undocumented Alien Population in the United States, 1979-1983. *International Migration Review* 21:1304-34.
- Patten, D.T. 1991. Human Impacts in the Greater Yellowstone Ecosystem: Evaluating Sustainability Goals and Eco-redevelopment. *Conservation Biology* 5:405-11.
- Pfister, C.; Messerli, P. 1990. Switzerland. In *The Earth as Transformed by Human Action* (B.L. Turner, et al., eds.) New York: Cambridge University Press and Clark University.
- Pimentel, D.; Pimentel, M. 1992. Land, Energy, and Water: The Constraints Governing Ideal U.S. Population Size. In *Elephants in the Volkswagen: Facing the Tough Questions about Our Overcrowded Country* (L. Grant, ed.). New York: W.H. Freeman.
- Plane, D.A.; Rogerson, P.A. 1994. *The Geographical Analysis of Population: With Applications to Planning and Business*. New York: John Wiley.
- Pollard, J.H. 1973. *Mathematical Models for the Growth of Human Populations*. Cambridge: Cambridge University.
- Population-Environment Balance, Inc. 1992. Why Excess Immigration Damages the Environment. *Population and Environ-*

- ment: A Journal of Interdisciplinary Studies* 13:303-12.
- Postel, S. 1992. Denial in the Decisive Decade. In *State of the World 1992* (L. Brown, ed.). New York: W.W. Norton and Company.
- Preston, S.H. 1993. The Contours of Demography: Estimates and Projections. *Demography* 30z:593-606;
- Purcell, J. 1991. Migration: Challenges for the World Community. *People* 18:3-6.
- Repetto, R. 1987. *Population, Resources, Environment: An Uncertain Future. Population Bulletin 42*. Washington, DC: Population Reference Bureau.
- Ridker, R.G. 1975. Resource and Environmental Consequences of Population Growth in the United States: A Summary. In *Population, Environment, and the Quality of Life* (P. Marden, D. Hodgson, eds.). New York: AMS Press.
- Risler, P. 1993. The Use of Economic Data and Analysis in Comparative Risk Projects: Questions of Policy and Reliability. In *Comparative Risk Assessment* (C.R. Colthern, ed.). Boca Raton: Lewis.
- Robert McNamara on Global Population Policy. 1992. *Population and Development Review* 18:200-02.
- Rolph, E.S. 1992. *Immigration Policies: Legacy from the 1980s and Issues for the 1990s*. Santa Monica: RAND.
- Rosenbaum, W.A. 1991. *Environmental Politics and Policy*. Washington, DC: Congressional Quarterly Press.
- Royal Society of London and U.S. National Academy of Sciences. 1992. *Population Growth, Resource Consumption, and a Sustainable World*. London and Washington, DC: Royal Society of London and U.S. National Academy of Sciences.
- Sadik, N. 1989. *Safeguarding the Future*. New York: United Nations Population Fund.
- Saliba, L.J. 1990. Coastal Land Use and Environmental Problems in the Mediterranean. *Land Use Policy* (July) 217-30.
- Santos, M.A. 1990. *Managing Planet Earth: Perspectives on Population, Ecology, and the Law*. New York: Bergin and Garvey.
- Sarre, P.; Smith, P. 1991. *One World for One Earth: Saving the Environment*. London: Earthscan Publications.

---

RESEARCH

PAPER

- 74 -

---

- Schwartz, M. 199 . Personal communication.
- Serow, W.J. 1991. Recent Trends and Future Prospects for Urban-Rural Migration in Europe. *Sociologia Ruralis* 31: 269-80.
- Simcox, D.E. 1992. Sustainable Immigration: Learning to Say No. In *Elephants in the Volkswagen: Facing the Tough Questions about Our Overcrowded Country* (L. Grant, ed.). New York: W.H. Freeman.
- Simmons, A.B. 1994. Sixty Million on the Move. In *Global Issues 94/95* (R.M. Jackson, ed.). Guilford, CT: Dushkin.
- Simon, J.L. 1990. *Population Matters: People, Resources, Environment, and Immigration*. New Brunswick: Transaction Publishers.
- Simon, J.L. 1981. *The Ultimate Resource*. Oxford: Martin Robertson.
- Smil, V. 1991. Population Growth and Nitrogen: An Exploration of a Critical Existential Link. *Population and Development Review* 17:569-601.
- Smil, V. 1990. Nitrogen and Phosphorus. In *The Earth as Transformed by Human Action* (B.L. Turner, et al., eds.). New York, Cambridge University Press and Clark University.
- Smith, F.J. 1975. Ecological Perspectives. In *Population, Environment, and the Quality of Life* (P. Marden, D. Hodgson, eds.). New York: AMS Press.
- Smith, Z.A. 1992. *The Environmental Policy Paradox*. Englewood Cliffs: Prentice-Hall.
- Soden, D.L.; Conary, J.S.. 1992. After the Fact: U.S.-Mexico Relations and Desalinization of the Colorado. In *Managing Water Resources During Global Change* (R. Herrmann, ed.). Bethesda, MD: American Water Resources Association Technical Publication Series.
- Speare, A. Jr.; White, M. 1992. Optimal City Size and Population Density for the Twenty-First Century. In *Elephants in the Volkswagen: Facing the Tough Questions about Our Overcrowded Country* (L. Grant, ed.). New York: W. H. Freeman.
- Speare, A. Jr.; White, M. 1990. Optimal City Size and Population Density for the Twenty-First Century. *NPG Forum* (Oct) 1-6.
- Spencer, D.; Goodall, B. 1992. Counterurbanization and Environmental Quality. In *Environmental Issues in the 1990s* (A.M. Mannion; Bowlby, S.R., eds.). Chichester: John Wiley.

- Stern, P.C.; Young, O.R.; Druckman, D. (eds.). 1992. *Global Environmental Change: Understanding the Human Dimensions*. Washington, DC: National Academy Press.
- Stevenson, A.; Newson, M. 1992. Natural Environments of the Future: Adapting, Conserving, Restoring. In *Managing the Human Impact on the Natural Environment: Patterns and Processes* (M. Newson, ed.). London: Belhaven.
- Talbot, L.M. 1986. Demographic Factors in Resource Depletion and Environmental Degradation in East African Rangeland. *Population and Development Review* 12:441-51.
- Tamondong-Helin, S.; Helin, W. 1990-91. Migration and the Environment: Interrelationships in Sub-Saharan Africa. *Field Staff Reports Africa* 22. Universities Field Staff International.
- Tamura, T. 1993. Large-Scale Residential Developments as a Factor in Environmental Change in Japan. *The Science Reports of the Tohoku University (Geography)* 43:1-12.
- Tarr, J.A.; Ayres, R.U. 1990. The Hudson-Raritan Basin. In *The Earth as Transformed by Human Action* (B.L. Turner, et al., eds.). New York: Cambridge University Press.
- Teitelbaum, M.S. 1992. The Population Threat. *Foreign Affairs Journal* (Winter) 63.
- Teitelbaum, M. 1986. Intersections: Immigration and Demographic Change and Their Impact on the United States. In *World Population and U.S. Policy* (J. Menken, ed.). New York: W.W. Norton and Company.
- Teitelbaum, M.; Weiner, M. (eds.). Forthcoming. *Threatened Peoples Threatened Borders: World Migration and U.S. Policy*. New York: W.W. Norton and Company.
- Thapa, G.B. 1993. Impacts of Emigration of Mountain Watersheds in the Upper Pokhara Valley, Nepal. *Asian and Pacific Migration Journal* 2:417-38.
- Thiede, J.; Hsu, K.J. 1992. Summary: The Future of Ocean Resources. In *Use and Misuse of the Seafloor Environmental Sciences Research Report ES 11* (K.J. Hsu, J. Thiede, eds.). Chichester: John Wiley.
- Thornton, J.A.; Williams, W.D.; Ryding, S.-O. 1992. Emigration, Economics and Environmental Pollution in Southern Africa. In *Managing Water Resources During Global Change*. Bethesda, MD: American Water Resources Association Technical Publication Series.

---

RESEARCH

PAPER

- 76 -

---

Tietenberg, T.H. 1991. Managing the Transition: The Potential Role for Economic Policies. In *Preserving the Global Environment* (J.T. Mathews, ed.). New York and London: W.W. Norton and Company.

Tucker, R.; Keely, C.B.; Wrigley, L. 1990. *Immigration and U.S. Foreign Policy*. Boulder, CO: Westview.

Turk, A.; Turk, J.; Wittes, J.T. (eds.). 1972. *Ecology, Pollution, Environment*. Philadelphia, London, and Toronto: W.B. Saunders.

Turner, B.L.; et al. (eds.). 1990. *The Earth as Transformed by Human Action*. New York: Cambridge University Press and Clark University.

United Nations. 1990. *Global Outlook 2000: An Economic, Social, and Environmental Perspective*. New York: United Nations Publications ST/ESA/215/Rev 1.

United Nations. 1984. *Population, Resources, Environment and Development*. New York: United Nations Publications ST/ESA/SER.A/90.

United Nations. 1980. *Recommendations on Statistics on International Migration. Statistical Papers Series M, No. 58*. New York.

United Nations Secretariat. 1991. Relationships between Population and Environment in Rural Areas of Developing Countries. *Population Bulletin of the United Nations* 31:32 52-69.

U.S. Commission on Population Growth and the American Future. 1972. *Population and the American Future*. Washington, DC: Government Printing Office.

U.S. Congress, Office of Technology Assessment. 1982. *Global Models, World Futures, and Public Policy: A Critique*. Washington, DC: OTA Publishing.

U.S. Department of Justice. 1993. *1992 Statistical Yearbook of the Immigration and Naturalization Service*. Washington, DC: Government Printing Office.

U.S. General Accounting Office. 1988. *Immigration: The Future Flow of Legal Immigration to the United States*. Washington, DC: Government Printing Office.

Vadus, J.R.; Bregman, R.; Takahashi, P.K. 1992. The Potential of Ocean Energy Conversion Systems and Their Impact on the Environment. In *Use and Misuse of the Seafloor Environmental Sciences Research Report ES 11* (K.J. Hsu, J. Thiede, eds.). Chichester: John Wiley.

- Valdez, R.B; et al. 1993. *Immigration: Getting the Facts: RAND Issue Paper 1*. Santa Monica: Rand Corporation Program for Research on Immigration Policy.
- Vernez, G . 1994. *Comparison of Immigration and Refugee Policy Regimes Among Major Western Nations: A Documented Briefing*. Santa Monica: Rand Corporation.
- Vernez, G. 1993. Statement of Georges Vernez before the Select Committee on Statewide Immigration Impact, California State Assembly.
- Vernez, G. (ed.). 1990. *Immigration and International Relations: Proceedings of a Conference on the International Effects of the 1986 Immigration Reform and Control Act*. Santa Monica and Washington, DC: Rand Corporation and Urban Institute.
- Vernez, G.; Ronfeldt, D. 1991. The Current Situation in Mexican Immigration. *Science* 251:1189.
- Vitousek, P.M. 1992. Global Environmental Change: An Introduction. *Annual Review of Ecology and Systematics* 23:1-14.
- Waldron, I.; Ricklefs, R.E. 1973. *Environment and Population: Problems and Solutions*. New York: Holt, Rinehart and Winston.
- “Warning to Humanity”—A Declaration by Scientists on Global Issues. 1992. *Population and Development Review* 18:782.
- Warren, R. 1994a. *Estimates of the Undocumented Immigrant Residents in the United States, by Country of Origin and State of Residence: October 1992*. Washington, DC: U.S. Immigration and Naturalization Service.
- Warren, R. 1994b. Immigration’s Share of U.S. Population Growth: How We Measure It Matters. *Population Today* (September) 3.
- Warren, R. 1990. Annual Estimates of Nonimmigrant Overstays in the United States: 1985 to 1988. In *Undocumented Migration to the United States* (F. Bean, B. Edmonston, J. Passel, eds.). Santa Monica and Washington, DC: Rand Corporation and Urban Institute.
- Warren, R.; Kraly, E.P. 1985. *The Elusive Exodus: Emigration from the United States. Population Trends in Public Policy* 8. Washington, DC: Population Reference Bureau.
- Warren, R.; Passel, J. 1987. A Count of the Uncountable: Estimates of Undocumented Aliens Counted in the 1980 United States Census. *Demography* 24:375-93.

---

RESEARCH

PAPER

- 78 -

---

- Warren, R.; Peck, J.M. 1980. Foreign-Born Emigration from the United States. *Demography* 17:71-84.
- Weeks, J.R. 1992a. How to Influence Fertility: The Experience So Far. In *Elephants in the Volkswagen: Facing the Tough Questions about Our Overcrowded Country*. New York: W.H. Freeman.
- Weeks, J.R. 1992b. Population. In *Introduction to Concepts and Issues*. Belmont, CA: Wadsworth.
- Westman, W. 1985. *Ecology, Impact Assessment, and Environmental Planning*. New York: John Wiley.
- White, S.E. 1994. Ogallala Oases: Water Use, Population Redistribution, and Policy Implications in the High Plains of Western Kansas, 1980-1990. *Annals of the Association of the American Geographers* 84:29-45.
- Whitmore, T.M.; et al. 1990. Long-Term Population Change. In *The Earth as Transformed by Human Action* (B.L. Turner, et al., eds.). New York: Cambridge University Press
- Williamson, F.S.L. 1975. Population Pollution. In *Population, Environment and the Quality of Life* (P. Marden, D. Hodgson, eds.). New York: AMS Press.
- Wilmoth, J.R.; Ball, P. 1992. The Population Debate in American Popular Magazines, 1946-1990. *Population and Development Review* 18:631-68.
- Wood, H.W. 1923. *Who Shall Inherit the Land of Our Fathers?* American Defense Society.
- Woodrow, K.A. 199 . Personal communication.
- Woodrow, K.A. 1992. A Consideration of the Effect of Immigration Reform on the Number of Undocumented Residents in the United States. *Population Research and Policy Review* 11:117-44.
- Woodrow, K.A. 1991. Using Census and Survey Data to Measure Undocumented Immigration and Emigration from the United States. *Statistical Journal of the United Nations Economic Commission for Europe* 7:241-51.
- Woodrow, K.A. 1990. Emigration from the United States Using Multiplicity Surveys. Paper presented at the Annual Meeting of the Population Association of America, Toronto.
- Woodrow, K.A.; Passel, J. 1990. Post-Irca Undocumented Immigration to the United States: Assessment Based on the June 1988 CPS. In *Undocumented Migration to the United States* (F. Bean, B.

Edmonston, J. Passel, eds.). Santa Monica and Washington, DC: Rand Corporation and Urban Institute.

Word, D. 1993. The Census Bureau Approach for Allocating International Migration to States, Counties and Places: 1981-1991. Paper presented at the Annual Meeting of the Population Association of America, April 1-3, Cincinnati.

World Resources Institute. 1994. *World Resources 1994-95*. New York: Oxford University.

Young, L. 1985. A General Assessment of the Environmental Impact of Refugees in Somalia with Attention to the Refugee Agricultural Programme. *Disaster* 9: 122-33.

Zinn, F.D.; Brechin, S.R.; Ness, G.D. 1993. Perceiving Population-Environment Dynamics: Toward an Applied Local-Level Population-Environment. In *Population-Environment Dynamics* (G.D. Ness, W.D. Drake, S. Brechin, eds.). Ann Arbor: The University of Michigan Press.



---

THE COMMISSION'S RESEARCH PAPERS, WHICH PRESENT THE RESULTS OF COMMISSION-SPONSORED RESEARCH, ARE INTENDED TO ELICIT COMMENT AND PROVOKE DISCUSSION. THE VIEWS PRESENTED IN THESE PAPERS ARE THOSE OF THE AUTHORS AND DO NOT NECESSARILY REFLECT THOSE OF THE COMMISSION.

RESEARCH  
P A P E R

**U.S. COMMISSION ON IMMIGRATION REFORM**  
**2430 E STREET NW, SOUTH BUILDING**  
**WASHINGTON, DC 20037**  
**202-776-8400**

U.S. COMMISSION ON IMMIGRATION REFORM