BINU Ukraine National Report on Project Experience (2002-2004)

Agro-biodiversity Indicators Development and Use

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Acronyms

BINU	Biological Indicators for National Use
CBD	Convention on Biological Diversity
DBG	Department of Biotechnology and Genetics (IAB, UAAS)
ERRIU	Environment and Resources Research Institute of Ukraine (Kyiv)
EPR	Environmental Performance Reviews
GEF	Global Environment Facility
IAB	Institute of Agroecology and Biotechnology (UAAS)
IASA	Institute of Applied System Analysis
KQs	Key questions
MENRU	Ministry of the Environment and Natural Resources of Ukraine
NUKMA	National University “Kyiv-Mohyla Academy” in Ukraine
RIVM	National Institute of Public Health and the Environment (The Netherlands)
SBSTTA	Subsidiary Body on the Scientific Technical and Technological Assistance
UAAS	Ukrainian Academy of Agrarian Sciences
ULRMC	Ukrainian Land and Resource Management Center (Kyiv)
UNEP	United Nations Environment Programme
USDA	U.S. Department of Agriculture
USPS-MAP	Ukrainian Soil Protection Service of the Ministry of Agrarian Policy
WCMC	World Conservation Monitoring Centre

Introduction

This report is an extract of the BINU Project materials, including the 1st Ukrainian BINU Project Report: Agro-biodiversity Indicators for National Use (January 2003-September 2003) [3], and 2004 quarterly operational reports.

The Ministry of the Environment and Natural Resources of Ukraine (MENRU) and the United Nations Environment Programme - World Conservation Monitoring Centre (UNEP-WCMC), United Kingdom, have cooperated for several years to assess priorities in biodiversity conservation issues in Ukraine to update statistical data on reserves of Ukraine, especially biosphere reserves, to promote public awareness, and to report on progress and achievements of Ukraine at national and international meetings, and conferences. In 1996, in Kyiv, with the support of UNEP-WCMC, an international seminar was held regarding biodiversity conservation reporting for the Convention of Biodiversity Conservation. During the Fourth Conference of the Parties of the Convention on Biological Diversity (CBD) in Bratislava, Slovakia, in May 1998, MENRU and UNEP-WCMC representatives actively cooperated in developing the project on Biodiversity Indicators for National Use with the direct participation of Ukraine, Philippines, Ecuador and Kenya to be funded by the UNEP Global Environment Facility (GEF), and other donors. In 2000, MENRU and UNEP-WCMC representatives continued such cooperation at a workshop held in Kenya. This cooperation resulted in the inclusion of Ukraine in the 'Biodiversity Indicators for National Use' project (the Project) with Ukraine focusing on the development of indicators for agro-ecosystems. In early 2002, the Project was approved by the GEF. On December 9, 2002, MENRU sent a Letter of Endorsement to the UNEP GEF Coordination Office endorsing the 'Biodiversity Indicators for National Use' project (UNEP GEF: GF/2712-02-4446) in Ukraine, a technical assistance project (the Project) focusing on agro-biodiversity issues, and also endorsing the Ukrainian Land and Resource Management Center (ULRMC) as a principal implementing organization in Ukraine for the Project. On December 12, 2002, MENRU and ULRMC signed the "Agreement on Scientific and Technical Cooperation Concerning the Application of Modern Information Technologies in the Field of Natural Resources Sustainability and Protection in Ukraine." On January 10, 2003, MENRU and UNEP-WCMC signed the Protocol of Cooperation concerning the Project implementation. The executed Protocol of Cooperation recognized a beneficiary of the Project to be MENRU, and further it recognized an implementer of the Project to be ULRMC, a non-governmental organization existing and operating under the laws of Ukraine. Later, on May 26, 2003, the Amendment 1 to the Protocol of Cooperation between MENRU and UNEP-WCMC was signed, in which ULRMC was also recognized to be a project recipient, as well as the project implementer. (More details can be found in the *1st Ukrainian BINU Project Report: Agro-biodiversity Indicators for National Use (January 2003-September 2003)*.

This useful activity and other works being extended at the CBD level too. Particularly, Project's representatives participated in CBD conferences and meetings. Project materials also were presented during these meetings. In January-February 2003, the Ministry, as well as the National CBD Focal Point, delegated Dr.Vasyl Prydatko, the BINU-Ukraine Project Manager, to represent Ukraine in Montreal, Canada, during the Expert Meeting on Indicators of Biological Diversity, including Indicators for Rapid Assessment of Inland Water Ecosystems (February 10-12, 2003). On February 10-13, 2004, the ULRMC representative, Dr. Vasyl Prydatko participated in seminars and meetings within the framework of the 7th Conference of the Parties to the Convention on Biological Diversity, which took place in Kuala Lumpur, Malaysia. This activity, together with ongoing contributions by WCMC and others, facilitated the acceptance of the document UNEP/CBD/COP/7/L.2720 – February 2004. UNEP-WCMC considered the ULRMC's proposal to hold the International BINU Meeting in Ukraine (also as an option Kenya was under consideration earlier).

On June 14-18, 2004, ULRMC held the International Workshop for National Parties of the BINU Project in Yalta, Ukraine, and provided respective web-service - http://www.ulrmc.org.ua/services/binu/workshops/index.html.

National Biodiversity: Relevant Policies and Targets

Ukraine is actively involved in solving biodiversity conservation issues. This was preceded by the long way and hard work. For instance, the first one from reports on agrobiodiversity in Ukraine - *Agricultural Biological Diversity Conservation in Ukraine* (Review on COP4/Decision IV/6) - was submitted to the Convention Secretariat on November 30, 1998 by the Department for Land Conservation and Biodiversity of the former Ministry of Ecology of Ukraine. A of 2003, the *Second National Report on Biodiversity Conservation in Ukraine* has already been published; it includes information on agrobiodiversity, in particular, genetic resources, as well as thorough revise of *Perspectives of Use, Conservation and Reproduction of Agrobiodiversity in Ukraine* (1). The Report also provides grounds for the Concept of balanced development of the agricultural area in Ukraine, and includes proposals on agrobiodiversity indicators, as well as presents a set of examples. It is very important, especially for the development of the national ecological network, in which landscapes play a significant role.

Rather important for today is also the conclusion of the Ministry for Environmental Protection on the fact that a biodiversity single monitoring system, as well as agroecosystem biodiversity, is not available now in Ukraine [1]. In accordance with other observations, as of August 17, 2004, according to the informational search system “Ukrainian Legislation” data (the Department for Computerized Systems of the Verkhovna Rada Apparatus of Ukraine), 77,128 documents included into the database did not reveal any document including the word “agrobiodiversity”. At the same time, there were found 26 documents in regards with biodiversity, 4 – agrolandscapes, 319 – sorts, and 442 – species [4]*. References to proposals from Ukraine on indication of biodiversity, including agrobiodiversity, are not available in the completed document UNEP/CBD/SBSTTA/7/12 [2].

Thus, such trend is only getting stronger. Due to the BINU Project, a lot of new materials were used for improvement of the situation in the study area, in particular, approaches to using key questions, special forms for indicators description, as well as new informational technologies for using remote sensing data, generating thematic maps, and representing materials by a distant user via Internet.

*Including species, which do not concern agrobiodiversity – dogs, cats etc.

Stakeholder Identification and Consultation

The first task of ULRMC as a new BINU project implementer was to identify key participants, including one donor, one beneficiary, nine recipients and one implementer (Table 1).
In January 2003, ULRMC started the process of identifying major stakeholders for the BINU project. As of September 30, 2003, a list of main BINU project stakeholders in Ukraine included the following governmental institutions and NGOs:

- MENRU – the State Protected Areas Service, State Environmental Inspectorate, State Committee of the Environment and Natural Resources of the Autonomous Republic of Crimea, and the Administrations of the Synevir Natural National Park, and the Opuksky Natural Reserve;

- The State Land Resources Committee of Ukraine (SLRCU) – the Department of State Land Cadastre and Monitoring, representing interests of other BINU Project recipients within SCLRU – the Vinnytsia Oblast State Land Resource Department, and the State Land Resource Department of the Autonomous Republic of Crimea;
- The Ukrainian Academy of Agrarian Sciences (UAAS) with its Hydraulic Engineering and Land Reclamation Research Institute;
- The Ministry of Agrarian Policy of Ukraine (MAPU) – the Department of Agriculture, Chemicalization and Soil Fertility;
- The State Statistics Committee of Ukraine (the Department of Natural Resources and Environmental Statistics);
- The National Security and Defence Council of Ukraine - the Environmental Research and Resources Institute of Ukraine (ERRIU);
- The Ministry of Defence of Ukraine - the National Scientific Research Centre for Defence Technologies and Military Security;
- The Ukrainian Birds Conservation Association (the Official Representative of BirdLife International in Ukraine);
- The Ukrainian Soil Conservation Service of the Ministry of Agrarian Policy of Ukraine, the Information and Program Department.

Table 1. Key Participants of the BINU Project in Ukraine

Donor Information	United Nations Environment Programme-World Conservation Monitoring Centre (UNEP-WCMC), Cambridge, United Kingdom
Beneficiary Information	Ministry of the Environment and Natural Resources of Ukraine (MENRU), Kyiv, Ukraine
	State Administration of the Environment and Natural Resources under MENRU (branch of Autonomous Republic of Crimea)
	Ukrainian Academy of Agrarian Sciences
	Environmental and Resources Research Institute of Ukraine
	State Service of Protected Areas under the Ministry of the Environment and Natural Resources of Ukraine
	State Statistics Committee of Ukraine
	Ukrainian Land and Resource Management Center
	State Committee on Land Resources of Ukraine
	State Administration of the State Committee on Land Resources in the Autonomous Republic of Crimea
	State Administration of the State Committee on Land Resources in Vinnytsia Oblast
Project Implementer Information	International Association “Ukrainian Land and Resource Management Center”

In 2003, ULRMC considered and involved the following institutions and organizations as BINU Project potential stakeholders: other Departments of the Ministry of Agrarian Policy of Ukraine, the National University named after Taras Shevchenko (the Department of Biology), the National University “Kyiv-Mohyla Academy” (the Department of Biology), the National Academy of Sciences of Ukraine (the Institute of Zoology, the Institute of Botany), the Environmental Policy Committee of the Verkhovna Rada (Parliament) of Ukraine, different protected areas administrations; partners projects and programs (ULTI, UFP), different Ukrainian NGOs, and others.

Organization and Implementation of Producing Indicators

The listed institutions and their representatives from different places of Ukraine (Kyiv, Kerch, Simferopol, Vinnytsia, Svalyava, Uzhhorod, and Synevyr etc.) were involved into information exchange and sharing, as well as indicator proposals generating.
ULRMC involved many external experts to provide agricultural and biodiversity data to support the project. Among these external experts there are Dr. Ihor Dovgal (the Institute of Zoology, NASU), Dr.Valentin Kryzhanovsky (the Institute of Zoology, NASU), Dr. Antonina Ilyinska (the Institute of Botany, NASU), Dr. Oleg Dudkin (the Ukrainian Union for Bird Conservation /BirdLifeInternational-Ukraine), Dr. Oksana Veklich (the Institute of Economics NASU), and Ms. Lyudmyla Kvashuk (the State Statistics Committee of Ukraine). There have been made also many in-kind contributions by the external experts such as Oksana Pniovska, Eugene Buravlyov, Grigoriy Koval (ERRIU), and Inna Kudrik (Kerch).
BINU's recipient representatives, as well as participants of BINU round–tables, seminars, and meetings, have produced numerous ideas and proposals. These representatives come from many organizations including: the National Academy of Sciences of Ukraine (Academician Sozinov), UNEP-WCMC (Dr. Jenkins), RIVM (Dr. Ten Brink, Dr. Tekelenburg), the Environmental and Resources Research Institute of Ukraine (Oksana Pniovska), the State Service of Protected Areas (Lyudmyla Parkhisenko), the State Ecological Inspection of the Ministry of the Environment and Natural Resources of Ukraine (Viktor Rakov), the State Statistical Committee of Ukraine (Lyudmyla Kvashuk and Tetyana Vasylenko), the Ukrainian Academy of Agricultural Sciences - Department of Agriculture (Academician Peter Kovalenko), the Ukrainian Academy of Agricultural Sciences - Research Institute of Hydraulic Engineering and Land Reclamation (Olga Zhovtonogh), UNDP/ULRMC (Oksana Volosko-Demkiv), the National University Kyiv-Mohyla Academy (NUKMA) – Eugene Dyky and Olexiy Zakletsky; the Government Agrarian Policy Coordination Council Secretariat - UNPD Agricultural Policy for Human Development Project (Dr.Nick Kobets); the Institute of Botany (NASU) – Dr. Volodymyr Dubyna and Olexiy Kalynychenko; InterEcoCentre (Dr. Leonid Protsenko); the State Forestry Committee (Sergey Kyrylenko); the National Scientific Centre of Defence Technologies and Military Safety (Dr. Sergey Chumachenko and Dr. Irina Chekanova); the Biosphere Reserve Askania-Nova (Dr. Viktor Gavrylenko); the Ukrainian Union for Birds Conservation (BirdLife International-Ukraine) – Dr. Oleg Dudkin, and others.

Recent consultations with Dr. Tatiana Lev (Ukrainian Soil Protection Service of the Ministry of Agrarian Policy of Ukraine) have also been informative. Students of the ULRMC's University Fellowship Program (Yana Sapiton, Oleksiy Kalynychenko, and Yaroslav Parkhisenko) helped in designing several thematic maps related to the agriculture landscape associated with protected areas.

Modern remote sensing data have been received and adapted for the Project recipients from different sources: ULRMC (1986-2003); United States Geological Survey (USGS), 2000-2003; Maryland University Global Land Cover Facility (1986-1993).

Key Questions: Selection Process

A total of 64 key questions were offered by the Ukrainian participants at the BINU Project Workshop in Kyiv (January, 2003). With the assistance of RIVM experts and participants of the workshop, this initial set of questions was further reduced up to 24 major questions.
In follow-up discussions with stakeholders and the Working Group from February through May 2003, participants identified the most important questions, (see

http://www.ulrmc.org.ua/services/binu/kq_matrix.html). A final array of five primary questions was proposed for the study of wild biodiversity in agricultural lands of Ukraine (Table 2).

Table 2. Major Key Questions Concerning Wild Biodiversity

Key Question 1: What is the current status of agro-biodiversity in Ukraine?
Key Question 2: What are the main factors causing loss or increase of agro-biodiversity, and how do changes in the land use practices impact loss or increase of agro-biodiversity?
Key Question 3: What lands could be returned to the natural status in the near future?
Key Question 4: To what extent are national biodiversity indicators linked with the international ones, and how could the existing national statistics help build nationally and internationally applicable indices for decision-making?
Key Question 5: How can scenarios of agro-biodiversity changes be built, and how can biodiversity loss be stopped in the near future?

These key questions (KQs) were presented by the Ukrainian delegation at the WCMC workshop in Cambridge, UK (July, 2003).

As of December 2004, all the KQs and respective indicators have been integrated into the bilingual Searchable List of Indicators package at the BINU Ukraine Web-page - http://www.ulrmc.org.ua/services/binu/is/index.asp?lang=EN. The product has a possibility to be unified in the future as a system, which will help distant visitors not only copy Indicators Fact Sheets, but also construct thematic reports, diagrams, and maps.

Data Availability and Processing

Integrated assessment of biodiversity in agroecosystems has never been performed in Ukraine before. The BINU Project has used official statistics archived by the State Statistics Committee, the Ministry for Environmental Protection of Ukraine, the Ministry of Agrarian Policy, as well as scientific statistics and published data (see *1st Ukrainian BINU Project Report* [3]). The respective details have been included to all Indicators Fact Sheet as the Data source and updating process.
Thanks to the work of involved scientists, new biological data (on plants, insects, birds, mammals, n=128) have been received, these data were of assistance in LPI, and NCI calculation, or in species trends for the 1950-2003 developing.

The Project used also remote sensing data for Landsat 4, Landsat 7, and MODIS for the pilot-GIS, which helped to generate thematic maps, and which had not been used earlier for agrobiodiversity purposes. On the basis of the new 2002 remote sensing data, and MODIS, the BINU/Ukraine team developed an approach for studying the dimension, mosaic and changes of the agroecosystem, or the agrolandscape (agrosphere) surface, and provided experts with detailed maps based on other RS sources. The evaluated agrosphere area comprised 64%, and the non-agrosphere one - 36%.

In addition to the special bilingual Searchable List of Indicators at the BINU Ukraine Web-page - http://www.ulrmc.org.ua/services/binu/is/index.asp?lang=EN, we developed a searchable system on the Agricultural Ecoregion and indicator species habitats at the web-site - http://www.ulrmc.org.ua/services/ecoreg/start_pm.html.

Ecosystem: Specific Issues

Changes in the land use structure as a result of implementation of the Stolypin's land reform in 1909[1] created a very important factor in changing the society-environment relationships in the former Russian Empire. During that period, every peasant had an opportunity to become a landowner; only forests, meadows, wetlands, and water bodies were usually retained as community lands. The land reform was especially successful and popular within Ukraine. It promoted independent farming and traditional Ukrainian modes of rural economy, including traditional land use, rotation and alternation of crops, better agricultural production, use of natural fertilizers etc. At the same time, the reform stimulated strong agricultural expansion, e.g., destruction of forests, ploughing virgin lands and devastation of some natural ecosystems. It is well known also that in 1930s the Ukrainian agriculture system suffered seriously through the famine initiated by the Stalin's regime. With the collapse of the USSR in 1991, and the ensuing economic crisis, new pressures on the agricultural system were in effect.

Due to the natural fertility of its soils, Ukraine was one of the Soviet Union's main suppliers of grain (25% of the total production), meat and milk (20%), and sugar (50%). Through production pressures, there was developed farming in the areas not appropriate for that purpose, such as on slopes, natural steppes, peat lands, in drained wetlands, or on dry lands.

The most of agricultural land in Ukraine is tilled, and because of the fact that it is exposed to wind and water erosion, it is subject to a great deal of pressure. Each year, up to 330 million tons of fertile soil is lost due to erosion [3].

Figure 1. Major agricultural regions of Ukraine: 1 - Polissya (Forest); 2 - Forest-Steppe; 3-5 – Steppe (Steppe, Steppe-Arid, Steppe-Semi-Arid); 6 - Crimea Mountains; 7 - Carpathian Mountains. *Source: see the text.*

Agricultural lands in Ukraine are subdivided by some experts into as many as 32 agricultural provinces based on agricultural districts, relief and soil types [5]. Other authors [6] subdivide the country into nine agrarian regions: Western Polissya, Polissya; Western Forest Steppe, Dnipro Left Bank Forest Steppe, Dnipro Right Bank Forest Steppe; Northern Steppe, Southern Steppe; Carpathian Mountains, Crimean Mountains. ULRMC has worked with the Working Group and External Experts to consolidate the agricultural regions of Ukraine into five major ecological units based on natural zoning (see Figure 4). These regions are forest, forest-steppe, steppe, Carpathian Mountains, and Crimea Mountains. These units will be important for determining trends in biodiversity that depending upon particular agricultural landscapes.

No map for the Ukrainian agroecosystem based on RS data had existed prior to the BINU Project! ULRMC was the first institution to develop the approach for studying the dimension, mosaic and

[1] P. A. Stolypin, 1862--1911, the Russian statesman and political reformer; the Russian Prime Minister and Minister of Internal Affairs (1906 to 1911).

changes of the agroecosystem, or the agrolandscape (agrosphere) surface on the basis of the new 2002 remote sensing data, and MODIS, and that was demonstrated to SBSTTA9 in Montreal (Figure 2).

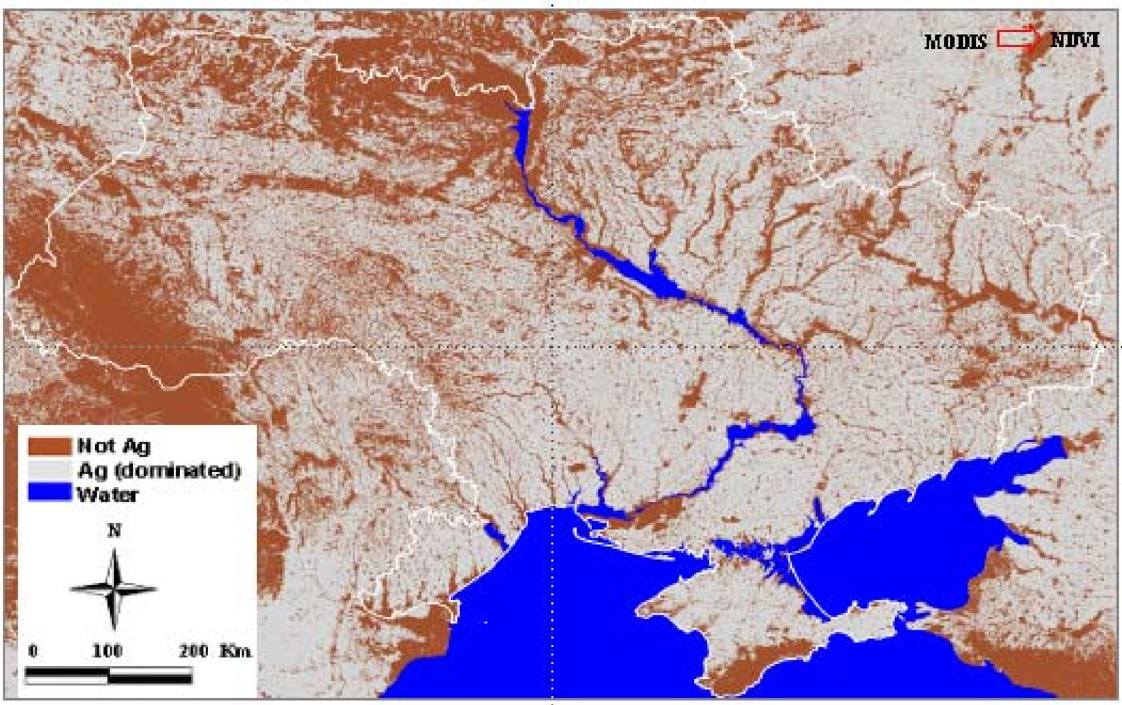
Indicators

Ukraine has analysed and proposed the definition for agrobiodiversity for the BINU Project based on all available FAO, and CBD materials, and this definition was published at the ULRMC BINU web-site as a leaflet titled "What is Agrobiodiversity?"

Ukraine has proposed ten criteria for evaluating indicators:

- Are data available for the indicator?
- Does the indicator answer the key question?
- Could the indicator answer more than one key question?
- Is the indicator precise in wording and interpretation?
- Is the indicator biologically sound?
- Can we implement the indicator with limited resources?
- Is the indicator appropriate for large areas?
- Is the indicator useful for forecasting?
- Does the indicator have spatial characteristics that can be included into a GIS?
- Does the indicator measure diversity from a unique perspective (i.e. different from other indicators)?

Figure 2. Agricultural Lands of Ukraine Based on MODIS Images (2002)
Source: ULRMC, 2004



In 2003, ULRMC compiled a list of biodiversity indicators from several sources, including EPR [7]. General indicators and indicators specific to agriculture were based on a draft version of *“Developing Indicators for National-Level Monitoring of Biodiversity”* written by the biodiversity Expert Group, which met in Montreal, Canada (February, 2003). Additional indicators were taken from a list proposed by the European Centre for Nature Conservation (ECNC). Finally, biologists at ULRMC developed several new indicators for consideration.

Indicators were matched to the six key questions for wild, associated and genetic agro-biodiversity [3]. Upon reviewing the data availability for the proposed indicators, ULRMC concluded that some of the indicators would not be useful for Ukraine. Consideration of the key questions and application of the “ten criteria" from the previous section helped to exclude about 36% of the proposed indicators from our previous list.

Table 3. BINU Project Evaluation of Indicators in 2003

Results	n	%
Indicators with no data	31	36
Indicators with data	55	64
Indicators for which RS and GIS applications could be useful (out of 55)	11	13

Many proposed indicators with available data related to more than one key question (see the Searchable List of Indicators at the web). In 2003-2004, ULRMC received additional information about existing annual statistics from the State Statistics Committee of Ukraine, and updated the list. As of today, there are 80 indicators/indices/parameters used for analysis, and 40 Indicators Fact Sheets were completed. (Some of “parameters” are not covered by the Indicators Fact Sheets, but there are texts or “stories” about the situation related to common policy, or when it is impossible to complete a fact sheet strongly.)

The BINU Team used the Indicators Fact Sheet form proposed by the WCMC and approved it during the 3rd International BINU Project Workshop, which took place in June 2004, in Yalta, Ukraine. Each Fact Sheet has a chapter on the calculation procedure.
Finally, series of thematic maps were developed to illustrate the Indicators Fact Sheets. The 1st Ukrainian report [2] demonstrates such combination of several technical approaches, as RS data usage (agrolandscape serving as a background), and GIS (which allowed looking over the statistics on pesticides usage in 1999-2002 by regions).

Based on information provided by Dr. Tekelenburg, ULRMC developed an ecological profile matrix to be completed by external experts for selected indicator species. The profile parameters, shown in Table 4 describe the ecological niches of respective species, their threats, and environmental significance.

Table 4. Ecological Profiles of Indicator Species

Animals and Plants	**Animals Only**	**Plants Only**
Position in Food Chain	Food Type	Moisture
Causes of Change	Dispersion	Acidity
Policy Relevance	Movement	Nutrient Requirements
Environmental Significance	MVP Area	Salt Tolerance
		Structure

As of September 2003, significant progress had been made on collecting data related to the indicators, including the species profiles. Selected indicative wild species by natural agriculture zones have been involved into the analysis of 128 species to date.

An indicative group of species and species (proposed by the BINU Project) included invertebrates, plants, birds, and mammals (n=128).

Invertebrates. Forest: *Papilio machaon, Lucanus cervus, Argyroneta aquatica, Cybister lateralimarginalis, Hyrudo medicinalis, Helix pomatia, Bradybaena fruticum, Zerynthia polyxena, Limnophilus flavicornis, Asellus aquaticus*. Forest-Steppe: *Helix pomatia, Lucanus cervus, Papilio machaon, Argyroneta aquatica, Cybister lateralimarginalis, Hyrudo medicinalis, Bradybaena fruticum, Helix albescens, Zerynthia polyxena, Limnophilus flavicornis, Asellus aquaticus, Iphiclides podalirius*. Steppe: *Papilio machaon, Carabus hungaricus, Empusa pennicornis, Helix albescens, Mantis religiosa, Pimella subglobosa, Saga peda*. Crimea Mountains: *Helix lucorum tauricus, Procenus scabrosus tauricus, Empusa fasciata, Calasoma sycophanta, Libeloides macaronius, Calopteryx splender taurica*. Carpathian Mountains: *Bielzia coerulans, Helix pomatia, Lucanus cervus, Perla maxima, Cerambyx cerdo cerdo*. Steppe: *Papilio machaon, Mantis religiosa, Empusa pennicornis, Pimella subglobosa, Carabus hungaricus, Helix albescens, Saga peda. Bees (Apis sp.) are also included in this group of indicative invertebrates and the discussion on genetics (below).*
Plants. Forest: *Diplotaxis tenuifolia, Alyssum gmelinii, Lunaria rediviva, Dentaria glandulosa, Hesperis pycnotricha, Sisymbrium strictissimum, Erysimum sylvaticum, Arabis pendula, Dentaria quinquefolia, Alliaria petiolata, Cardamine tenera, Turritis glabra*. Forest-Steppe: *Lepidium latifolium, Erysimum hieracifolium, Diplotaxis tenuifolia, Schivereckia podolica, Alyssum gmelinii, Thlaspi praecox, Erucastrum gallicum, Schivereckia mutabilis, Matthiola fragrans, Sisymbrium volgense, Turritis glabra*. Steppe: *Crambe tataria, Erysimum leucanthemum, Rorippa hybrida, Brassica campestris, Bunias orientalis.* Crimea Mountains: *Hesperis steveniana., Alyssum calycocarpum, Sobolewskia sibirica, Thlaspi perfoliuatum, Lepidium virginicum.* Carpathian Mountains: *none*.
Birds. Forest: *Columba palumbus, Tyto alba, Acrocephalus paludicola. Forest-Steppe: Botaurus stellaris, Ciconia ciconia, Anser anser, Circus cyaneus, Falco subbuteo, Falco tinnunculus, Perdix perdix, Crex crex, Tringa stagnatilis, Vanellus vanellus, Athene noctua, Merops apiaster, Lullula arborea, Anthus trivialis, Anthus pratensis, Lanius minor, Acrocephalus palustris, Turdus philomelos, Carpodacus erythrinus, Miliaria calandra, Emberiza hortulana, Saxicola rubetra*. Steppe: *Falco subbuteo, Falco tinnunculus, Falco vespertinus, Coturnix coturnix, Vanellus vanellus, Columba palumbus, Athene noctua, Hirundo rustica, Melanocorypha calandra, Lullula arborea, Galerida cristata, Motacilla flava, Lanius collurio, Pica pica, Sylvia communis, Passer montanus, Carduelis chloris, Carduelis carduelis, Carduelis cannabina, Emberiza schoeniclus*. Crimea Mountains and Carpathian Mountains: *Falco tinnunculus, Coturnix coturnix, Columba palumbus, Streptopelia turtur, Cuculus canorus, Hirundo rustica, Motacilla cinerea, Lanius collurio, Pica pica, Passer montanus, Carduelis chloris, Carduelis cannabina, Emberiza citrinella*.
Mammals. Forest: *Talpa europaea, Crocidura leucodon, Lepus europaeus, Micromys minutes, Glis glis, Cricetus cricetus, Microtus oeconomus, Vulpes vulpes, Mustela nivalis, Capreolus capreolus.* Forest-Steppe: *Talpa europaea, Lepus europaeus, Citellus suslicus (C. citellus), Marmota bobak, Spalax microphtalmus (S. polonicus), Cricetus cricetus, Allactaga jaculus, Vulpes vulpes, Mustels eversmanni, Capreolus capreolus.* Steppe: *Lepus europaeus,Mustela eversmanni,Rhinolophus hipposideros, Sicista subtilis, Erinaceus europaeus.* Crimea Mountains: *Crocidura suaveolens, Allactaga jaculus (major), Apodemus flavicollis (Sylvimus tauricus), Capreolus capreolus, Citellus pygmaeus, Cricetulus migratorius, Ellobius talpinus*. Carpathian Mountains: *Vulpes vulpes, Felis lynx, Ursus arctos, Glis (Myoxus) glis*. *Cattle and sheep are also included in this group of indicative mammals, and the discussion on genetics (see below).*

Data for indicator species not only provide valuable information on taxonomic diversity, but may also serve as indicators of population trends and genetics. A reduction in indicator species population numbers means a risk of depletion of their gene pools and/or even extinction of some local populations.

The material was used for the development of a respective map developer using the BINU Project web-site at the ULRMC web-page - http://www.ulrmc.org.ua/services/ecoreg/start_pm.html.

Dissemination, communication, uptake and use

The main approaches taken to ensure that indicators reach their audience are the following: (i) usage of official data/statistics and/or indicators (!), which have been approved/suggested by the state's institutions, and usage of popular new ITs (i.e. GIS and RS) to build maps based on that data/statistics that is easier for decision makers to comprehend, (ii) involvement of the state's institutions into the process of indicators calculation and new indicators development, (iii) dissemination of analysed and approved results among all involved institutions, including the beneficiary and the recipients of the project, (iv) organizing and/or participating in national/international workshops and events, (v) special web-page development and maintenance, including the Searchable List of Indicators, leaflets examples, and publications. We hope that all these actions will assure that the indicators are used effectively in the near future.

As an example of the above-mentioned, ULRMC has submitted the indicator support materials, methodologies, and maps based on current statistics and remote sensing data of agro-landscape/agro-ecosystem (MODIS, Landsat) to the Ministry for Environmental Protection of Ukraine for its day-to-day usage and for preparation of the annual state-of-the environment report (#983/2, as of May 24, 2004). ULRMC has also submitted the BINU Project results (№842/2, as of January 29, 2004) to the State Statistics Committee of Ukraine and obtained an official reply №08-05-6-31 as of April 4, 2004 that some indicators would be used by the Committee for compiling of the Environment Yearbook of Ukraine.

The ULRMC package for the Ministry for Environmental Protection of Ukraine included the first synthesized GIS picture of Ukrainian agro-landscapes based on MODIS 2002 data and a mosaic of Ukraine built on 55 Landsat images, including those from the ULRMC archive and the Maryland University (USA) sources of information (1986-1993). The respective mosaic picture (four A0-size map-cases) with references to the BINU Project was submitted to the Ukrainian Agrarian University (UAU) to support students' practices and help them prepare for the Global Forum on Soil Conservation to be hosted by UAU in Kyiv in 2006. Two compact discs with the BINU materials for Ukrainian users were distributed to all recipients of the project in 2003-2004. Two Landsat 7 images were submitted to the State Land Resource Department of the Autonomous Republic of Crimea. Thus, all new BINU support materials, including a mini-CD, were distributed to the beneficiary, the recipients, potential stakeholders, and the BINU Working Group members.

In 2004 we conducted two meetings, including the BINU National Workshop (April 23, 26-27, 2004, Kyiv) and the BINU International Workshop (June 14-18, 2004, Yalta) as well as consultations with the beneficiary, the recipients, and the stakeholders. Site visits or meetings with representatives from 22 organizations took place in Kyiv, Yalta, Simferopol, and Vinnytsia for the purpose of the BINU Project results dissemination. A list of the organizations is available upon request. For the BINU National Workshop held on April 26-27, 2004, ULRMC organized a national meeting on Biological Indicators for National Use and conducted a roundtable discussion to share information and to review progress of the project implementation.

The following national institutions were involved in calculating NCI: the State Statistics Committee of Ukraine, the Institute of Economics of the National Academy of Sciences of Ukraine (NASU), and the National University Kyiv-Mohyla Academy (NUKMA). As a result of this work the Institute of Economics drafted two scientific publications related to NCI, and the State Statistics Committee of Ukraine suggested using a new national level approach to calculating a modern integrated index based on the NCI idea.

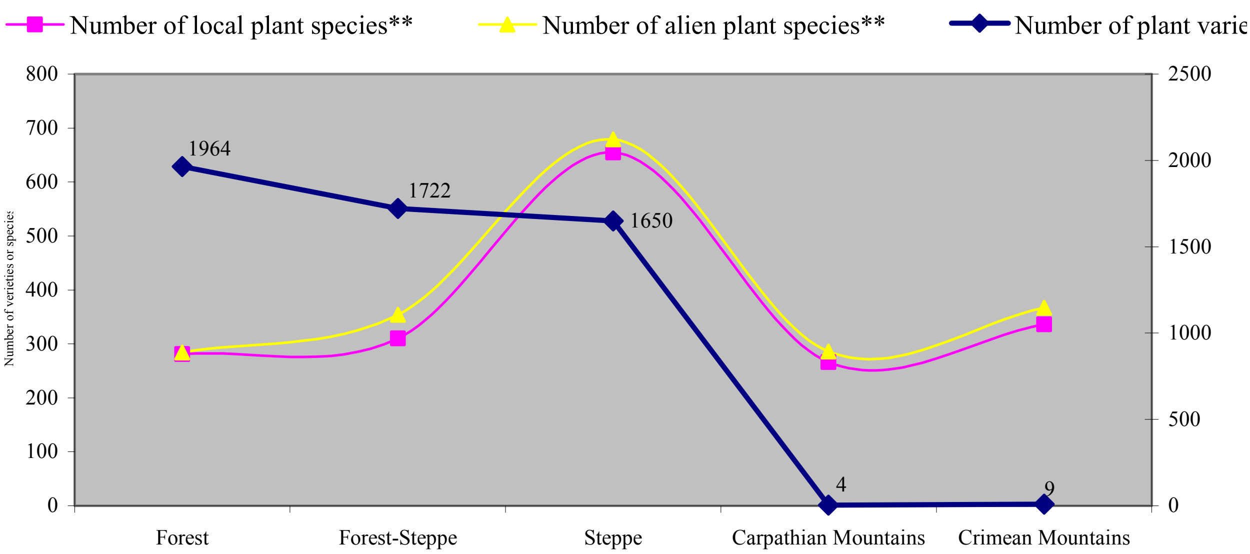
The Ukrainian language BINU web-page -http://www.ulrmc.org.ua/services/binu/index_ua.html, and the English language BINU web-page - http://www.ulrmc.org.ua/services/binu/index.html, were improved to update project developments.

Experience that prompts the greatest interest included: (i) the first agro-landscape/agro-ecosystem map based on MODIS 2002 and NDVI useful for GIS and indicators mapping published in two scientific magazines, including that of the Ukrainian Academy of Agrarian Sciences; later it was mentioned on the web-pages of the organisation My Land, which is in the network of the Land Management Committee of Ukraine, and on the web-page of the National Safety Institute (the former ERRIU); the Ukrainian Agrarian University found this very interesting for teaching students as well, (ii) NCI approaches and calculation that initiated a respective draft article, prepared by the Institute of Economics of NASU, and stimulated the development of a new national level approach to calculating a modern integrated index based on the NCI idea suggested by the State Statistics Committee of Ukraine (is available at ULRMC upon request), (iii) identification of natural remnants using remote sensing data (Landsat 7) and publication of NDVI in a scientific magazine of the Tavriya National University, (iv) the approach to applying LPI was approved on ULRMC's suggestion by military ecologists on the example of the Yavorivsky military polygon where international military trainings are held, and it requires environmental assessment, (v) the National

Figure 3 Plant biodiversity by natural-agricultural zones in Ukraine

* Agrosphere Firm - http://www.agrosfera.ua/semena_last.php; ** Provided by Dr.R.Burda (NASU)

Source: UNEP-GEF BINU, 2004



Safety Institute (the former ERRIU) substantiated the index *Anthropogenic pressure: the Red Data Book species response to the anthropogenic pressure (or RDB-response index*), (vi) the Institute of Hydrotechnics and Melioration has applied the BINU indicator approach for its own purposes in the Djankoi Rayon in the Crimea, and (vii) zoologists of the Institute of Zoology of the National Academy Sciences of Ukraine have used the Project data for the study of mammals of agro-landscapes.

We also consider that in the near future there will arise a great interest to the complex results received by the Project, these are the results of laying "point" habitats of the Red Data Book species on the digital map of the agro-ecosystem of Ukraine.

Unique, not well-known data on plant species and the distribution of feral weeds in respect to all regions of natural and agricultural zoning (7 zones, 20 provinces and 25 administrative regions) have also been received. The abundance of feral weeds species has been estimated by regions. Experts also have provided (a) comparison matrixes of the regions' species composition according to Jaccard's coefficient of community and (b) data on the distribution of these plants within

Ukraine's nature preserves (significant for zoning and monitoring of spontaneous phytobiota or weeds). A list of 41 invasive species has been developed for the purposes of the Project. ULRMC also has received summaries of "crop weed" species[2] quantities for 80 years (1927 – 2003). Data on alien species behaviour in the vegetation cover of nature preserves have been obtained, and a bibliography on the distribution of specially protected vascular plants in administrative regions has been developed. G. Kolomytsev, a student of the Kyiv National University, used ULRMC's archives of the Earth remote sensing data, including agricultural landscapes for 14 years (1988 - 2002) to produce original data in the GIS format on changes in the habitats of indicator birds within the Kyiv oblast.

Other interesting, less known important results that we also relate to are the trends in 128 indicator species population in Ukraine in the section of the natural and agricultural zones, from 1950 to 2002 (see Annex 1). There is no information whether someone attempted to do this earlier. We proved that in terms of bird species characteristic of open landscapes (for example, larks) there occur similar crisis phenomena as in other countries of the Europe. Besides, important data about the number of species associated with agro-landscapes (plants, mammals) have been compiled for the purposes of the Project. The Project also helped to observe (on the example of plants) that wild and associated (including alien!) biodiversity are related more closely as it seemed to at first sight. Wild and associated biodiversity meet the requirements of the natural-agricultural zone transitions, while crop diversity ("genetic diversity") is lagging behind such transition (see Fig. 1).

Examples of indicators use are demonstrated in a special leaflet (see Annex 1), and Annex 2.

Priorities for further work

Our experience shows that it is effective and perspective to use the modern ITs, such as the Internet, GIS, and RS while working with indicators and indication. The Project initiated a search system on its we-page, which could be accessed by the beneficiary, the recipients of the project, and other users. This search system allows for selecting materials for the reports of different levels concerning both agro-biodiversity and biodiversity as a whole. It can be relatively easily supplemented by biodiversity indicators of other key ecosystems, such as forest, wetlands, aquatic and coastal ecosystems, etc. This allows for the integration into the global system of information exchange about indicators, in particular at the level of FAO, ECNC, OECD, and EEA

At the same time, we have done additional work to ensure that in the future the given search system will work with a specialized database rather than with the filled out Information Fact Sheets. This would allow for the remote users to receive more complex, specially developed reports with diagrams and maps, and not only the Information Fact Sheets. This is a very perspective direction for further improvement of the system for biodiversity monitoring in Ukraine as well as the enhancement of the reporting system not only in the framework of the Convention on Biological Diversity but other Conventions.

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[2] Ukrainian botanists prefer to use the term "segetal community".

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Annex 1

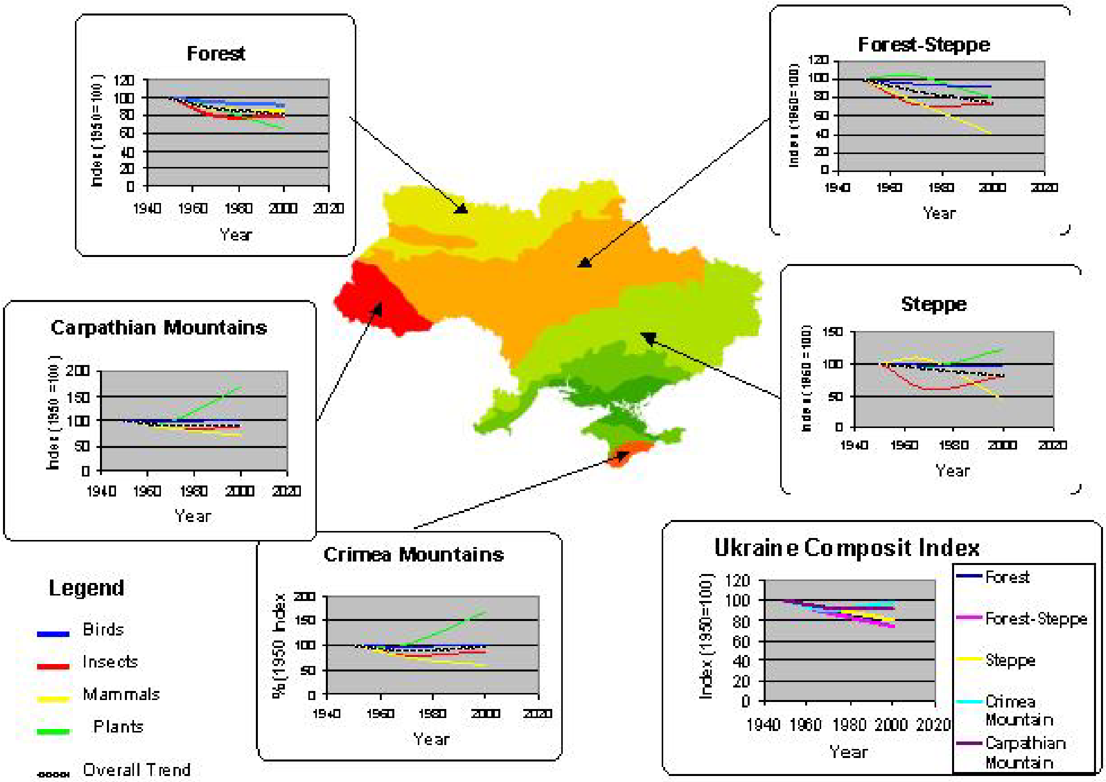
(http://www.ulrmc.org.ua/services/binu/prmaterials/Biodiversity_Agriculture.pdf)

Biodiversity and Agriculture in Ukraine:
Example 1

Agriculture is the most important land use in Ukraine, occupying 72% of the total land area. To analyze wild agricultural biodiversity trends in Ukraine, the BINU project has divided the country (our area of research) into five different agricultural zones corresponding with five well known natural ecosystems. Trends in wild

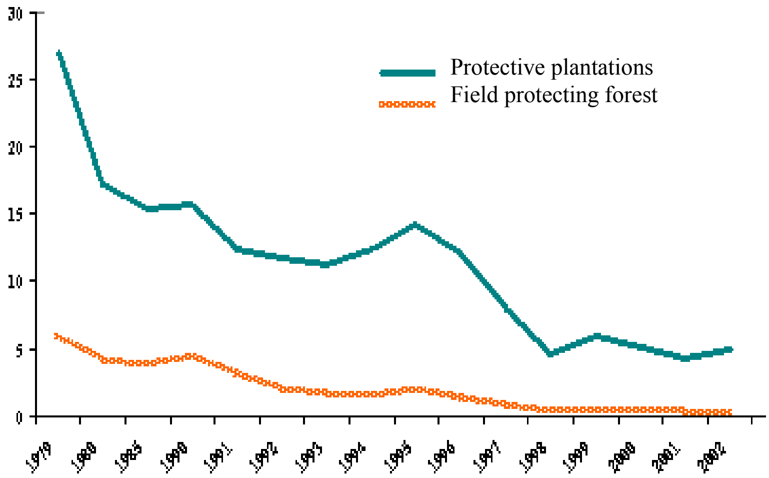
Figure 1 Biodiversity Trends By Agricultural Region and Species Type In Ukraine Based on Expert Evaluation

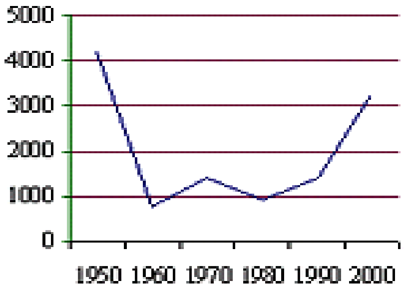
Source: ULRMC, UNEP-GEF BINU, 2004



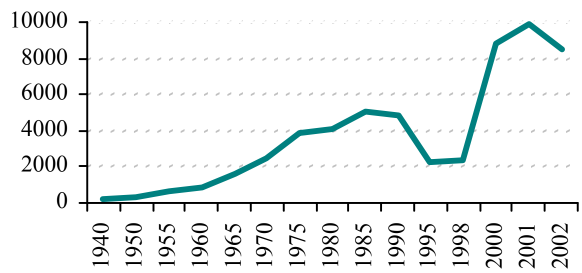
species populations associated with agricultural ecosystem in these natural zones can be used as indicators of agroecosystem "health" and biodiversity. Figure 1 shows trends in wild plant and animal species populations from 1950-2003 in each of the natural-agricultural zones (n=208), as well as a summary of population trends in Ukraine as a whole, and since 1950 (our base year) biodiversity as a whole has been decreasing in Ukraine. Biodiversity has declined in all parts of the trophic pyramid throughout Ukraine, except in the mountains and Steppe regions, where **plant** biodiversity seems to have **increased**. These trends are not just due to natural causes, but are also due to changes in agricultural practices. In the Steppe region, where the most intensive agriculture is practiced, and in the Forest-Steppe region, where forest and steppe species co-

Figures 2a, 2b, 2c
Trends in Agricultural Practices in Ukraine (1940-2002), see text





(2c) Application of pesticides in Ukraine, in thousand tones (1940-2002), see text
Source: R. Lytvyn [5], State Statistics Committee, UNEP GEF-BINU



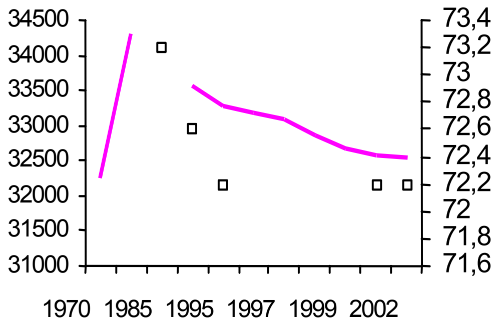
mingle, the overall downward trend has been the most dramatic. What does this mean for biodiversity and what does it mean for agriculture?

Figure 1 indicates a general downward trend in biodiversity since 1950 but a tendency toward recovery in the last two decades. In our opinion, the rapid decrease from 1950-1970 corresponds with the extensive agriculture of the former USSR and appears to be nature's response to negative management practices such as tillage frequency, reduced fallow areas, reduced shelterbelt creation, chronic use of chemicals, etc. (Figures 2a - c)[3].

Figure 3 is another illustration of the intensification of agriculture during soviet times, and it contents two graphs. The squares represent land area in Ukraine devoted to agriculture from 1990-2003. The lines represent the per cent of agricultural area that was tilled from 1970 to 2003. The break in the line indicates missing data in our analysis. The figure shows a decrease in the total area devoted to agriculture until about 1995 followed by a leveling off of agricultural land use. In contrast, there was a sharp increase in the percent of agricultural land that was tilled in the 1970's and 80's, followed by a gradual decrease from about 1990 to 2003. The increase in tilled area corresponds to the decrease in fallow area in figure 2b. In our opinion this trend may be related to the change in biodiversity of indicator species of plants and animals associated with the agrolandscapes shown in Figure 1. Trends in biodiversity of microorganisms also correspond with agricultural land use

[3] We think that other historical developments in 40's-50's such as changes of borders of Ukraine did not affected the dynamics of observed agricultural trends.

Figure 3 Tillage area (left, line, th. hectares) and total agriculture area (right, dots, %)
Source: State Statistics Committee, UNEP-GEF BINU



management. During the last 10 years the average weighted content of humus in Ukraine has decreased from 3.24% to 3.14%. This decrease in humus content has been accompanied by a decrease in soil microbial diversity, which has implications for future crop productivity [1].

The Ukrainian Soil Protection Service of Ministry of Agrarian Policy (USPS-MAP) has provided ULRMC with new data on humus content of soils in Ukraine (see Figure 4), an important factor in soil quality. In general, the soils with the highest humus content are found in central and eastern Ukraine. Low *s*oil humus content is an important indicator of poor land management which, together with other pressures, can provoke *habitat loss*.

Species habitats can be lost for many reasons. The BINU Project participants - Buravlov at al. [2] - identify the primary pressures on biodiversity based on an analysis of the Red Data Book (RDB) data of Ukraine as (1) loss of habitat from deforestation, wetland drainage and a variety of land-use changes, (2) agricultural

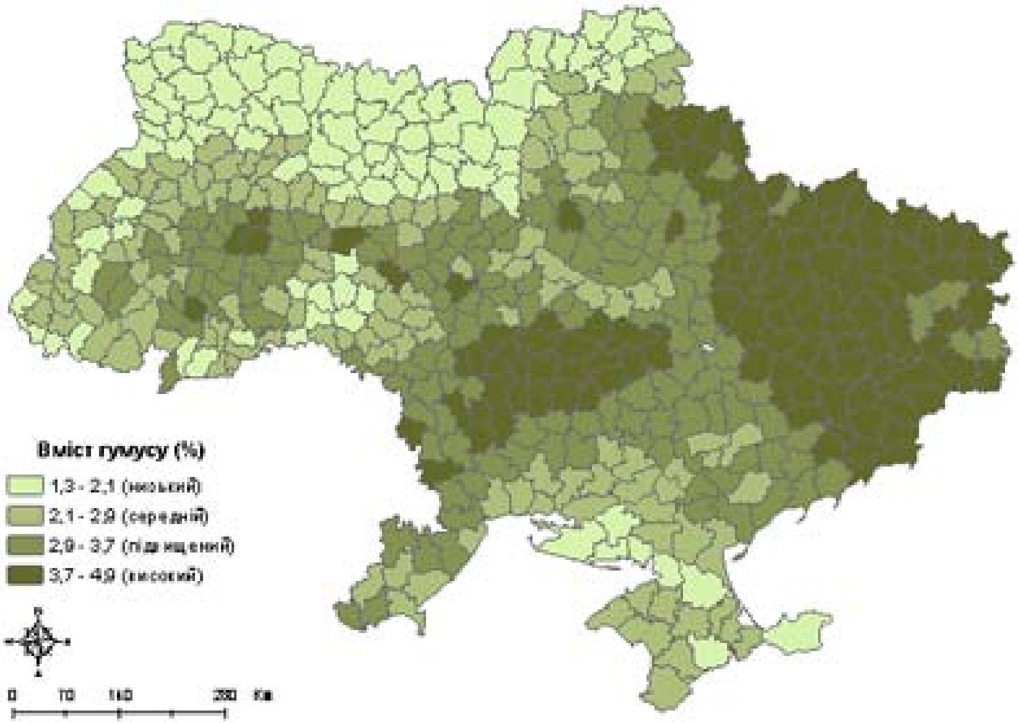
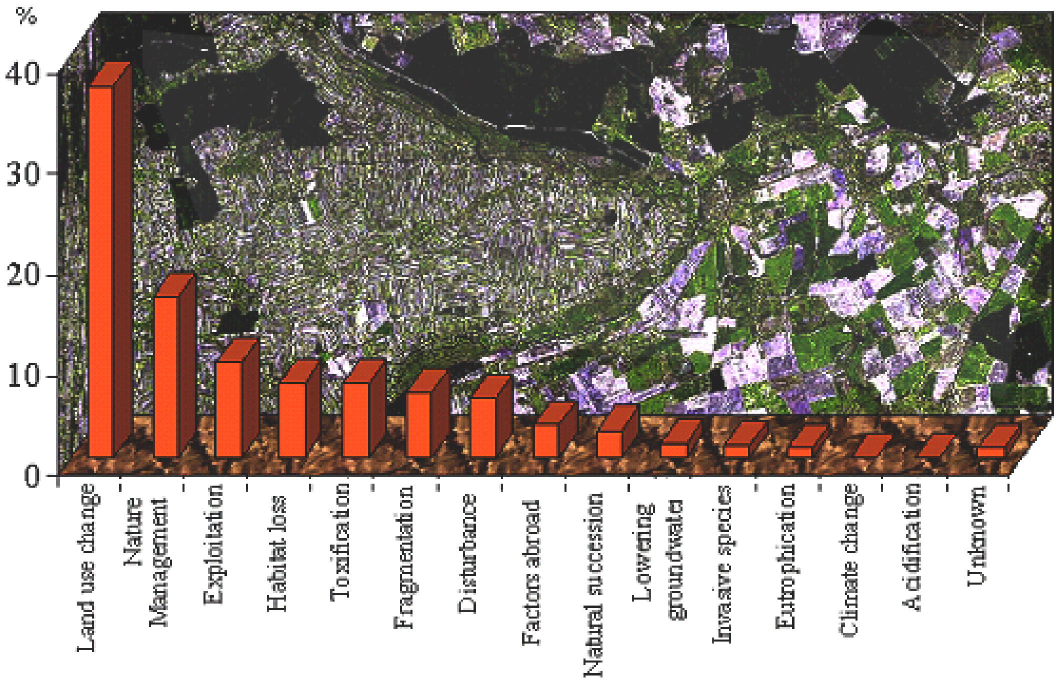


Figure 4 Average humus content by weight (as of 1 January 2002). Source: the Ukrainian Soil Conservation Service of the Ministry of Agrarian Policy of Ukraine, UNEP-GEF BINU. See also [3].-

intensification such as monoculture agro-ecosystems, clean tillage, overuse of chemicals and overgrazing, (3) pollution resulting in eutrophication and industrial contamination of soil, air and water, and (4) unsustainable exploitation of resources with practices such as unmanaged hunting and gathering of wild species, poaching, and commercial fishing and mining. All of these pressures are directly or indirectly

Figure 5 Dominant Causes of Change for Indicator Species in Agro-ecosystems in Ukraine (1950-2003)
Source: UNEP-GEF BINU, 2004



related to modern agricultural practices. Since Agriculture occupies 72% of the land area in Ukraine it is clear that agriculture is an important key to maintaining biodiversity and healthy ecosystems here.

Our Figure 5 indicates the relative importance of different pressures on indicator species in Agro-ecosystems in Ukraine from 1950-2003. By far the greatest impact in both Ukraine and the world has been caused by *land use change*. In Ukraine, poor management of natural areas, exploitation, habitat loss and environmental toxicity are also important drivers. The background ULRMC photograph (which is very popular now in Ukraine) shows the border between Poland on the left and Ukraine on the right. The photograph illustrates a dramatic difference in the landscape mosaic between Ukraine and Poland in 1988 (Landsat 4 TM), and the same situation exists today, but smaller parcels are increasing around big cities [6]. The landscape in Ukraine is characterized by many big, uniform agricultural fields. In Poland the fields appear to be much smaller and diverse. We can expect greater biodiversity in areas with diverse agricultural landscapes than in areas with uniform landscapes. At the same time, large migratory and semi-migratory animals need large habitats, so some species may not adapt well to small agricultural fields. Maybe the meeting of the two landscapes provides the greatest benefit for biodiversity, because the landscape uniformity is disrupted? The BINU Project is currently researching the relationship between landscape patterns and biodiversity using more remote sensing data and terrestrial statistics.

During the soviet period, farms were consolidated into large tracts on which farmers grew corn, wheat and sugar beets using intensive tillage and chemical-based fertilizers and pesticides. In recent years, privatization of farms has led to smaller fields, less intensive practices, and a greater variety of crops being grown. This land-use change has resulted in a notable increase in the population trend index for plants since 1990 in some of the agricultural zones and an apparent slowing of population losses in other groups of organisms (Figure 1). However, agricultural landscape wildlife populations (i.e. biodiversity) in Ukraine are still decreasing. Some other examples demonstrated this.

There are 541 plants and 382 animals Red Data Book (RDB) listed as rare, threatened or endangered in Ukraine. Many of them are associated with agriculture, which covers about 72% of Ukraine. As part of the BINU project, Dr. Prydatko, A.Ischuk and Yu.Shepta from ULRMC performed a GIS analysis using MODIS 2002 data. They found that 45% of the RDB plants and 47% of the RDB animal habitats in Ukraine listed in the 1994-1996 RDB intersect today's agricultural areas (n>12000). Therefore, it is not enough to develop new protected areas, but also to manage active agriculture areas for biodiversity. New Ukrainian farmers must take an active role in protecting biodiversity. This means they must know what biodiversity is, and work to protect and restore wild habitats on the farm where possible, minimize the use of tillage and harmful farm chemicals, reduce erosion and runoff pollution, and ensure that other resources on the farm are not over-exploited.

But how do they accomplish this task? The government needs to continue to develop policies and strategies that will encourage farmers to practice eco-friendly farming. The list of the underlying causes of wild indicator species decline in agro-ecosystems in Ukraine can help to manage the situation. **We know where the targets are!** For example, the dominant driver of biodiversity change in Ukraine (land use change) is essentially the same as the dominant driver of biodiversity change in the world, i.e., "land use" [4]. The second driver identified for Ukraine is "nature management," which is also a part of *land use* and which can and should be a part of *agricultural management*. Without a doubt more farmers need access to this information. Providing a permanent information exchange for farmers concerning the state of agro-biodiversity may be a tool to help stop biodiversity loss by 2010, the priority target date established at the UN Convention on Biological Diversity level. Government policies and eco-friendly farming practices developed in other countries may serve as a model for Ukraine to help stop biodiversity loss by the 2010 target date.

Acnowlegements

We are grateful to Tonnie Tekelenurg (Netherlands Environmental Assessment Agency) who graciously provided us with valuable comments.

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For the UNEP-GEF BINU Project - http://www.ulrmc.org.ua/services/binu/index.html. Kyiv, Ukraine, 2004.

Annex 2

The GIS analyse result: intersection of agroecosystem polygons in Ukraine by the Red Data Book species habitats (points), n=12195.
Authors: Dr.V. Prydatko (idea, GIS), A.Ischuk (GIS), Yu.Shtepa (RS analyse).
UNEP-GEF BINU Project