ENVIRONMENTAL NGOs AND SCIENCE POLICY: A COMPARATIVE ANALYSIS OF BULGARIA AND THE UNITED STATES

BRENT S. STEEL

REBECCA WARNER

ALEX JOHNSON

Oregon State University

ABSTRACT

While the demand for science-based environmental policy in Western nations has been increasing, it is also now recognized as important in many post-communist regimes as well, especially those that have joined or will join the European Union. All of these countries suffer the consequences of very serious environmental problems that threaten the current health and long-term livelihood of their respective populations and ecosystems. Using interview and survey data gathered from environmental NGOs in Bulgaria and the United States during 2005, this study compares how environmental NGOs define, use, and communicate science to influence the policy process.

INTRODUCTION

In recent decades many policymakers, interest groups, and interested citizens have emphasized the importance of science-based environmental policy at local, regional, national, and international levels of governance [1, 2]. Implicit in this call for science-based policy is the idea that science and scientists can and should facilitate the resolution of environmental and natural resource issues by providing scientific information to more effectively inform policy and management [3]. While the demand for science-based environmental policy in Western nations has been increasing, it is also now pronounced as important in many postcommunist regimes as well, especially those in central and eastern Europe joining or hoping

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to join the European Union [4]. During the period of Soviet control, there was little to no opportunity for citizens or nongovernmental organizations to oppose or protest environmental degradation and the resulting negative consequences for human health [5]. Non-specialists and citizens were "routinely denied access to information about pollution levels or violations; their knowledge is generally limited to the highly selective coverage presented through the mass media" [6]. With the collapse of the Soviet Union, most of its one-time eastern and central European allies initiated some form of democratic reform and adopted some type of market-based economic practices. While the degree of relative success associated with these political and economic reforms varies considerably across the region, all of these countries suffer the consequences of very serious environmental problems that threaten the current health and long-term livelihood of their respective populations and ecosystems [7]. Therefore, many observers have called for developing scientific knowledge of environmental problems in post-communist countries and then using this knowledge to help mitigate the poor environmental conditions [8].

In the U.S. context, nongovernmental organizations (NGOs) are often considered an important actor in the dissemination of scientific information, both to the public and policy makers [9]. For example, Sheila Jasanoff has argued that environmental NGOs play an important role by bridging the divides between lay and expert knowledge, the work of activists and professionals, and local and global concerns [10]. While NGOs can use local knowledge to help inform environmental policy, they also can be the transmitters of scientific information and resources to local environments that are more secluded. This transfer benefits local communities directly (gaining knowledge to improve their situation), but also has the potential to inspire trust and cooperation among community members, and between communities and the state.

This "transmission belt" role is played most effectively by NGOs when they are well-situated between citizens, the state, and the agencies funding their work. Being well organized and funded with knowledgeable staff gives NGOs better access to experts and government officials. By maintaining an independent position vis-à-vis the state, NGOs can provide a critical voice to the environmental policy discussion, holding states accountable for their actions. Having good connections in communities establishes trust and can encourage greater public spiritedness and more informed environmental policy [9].

Western donors—including the United States and the European Union—have provided much funding to develop the environmental NGO(ENGO) sectors in postcommunist countries to facilitate not only democratic governance, but also to assist in the mediation of the very serious environmental conditions evident after the fall of communism. This study will contrast the situation in one post-communist country, Bulgaria, with the United States to provide a comparative perspective concerning the role of ENGOs in the transmission of scientific information. A comparison between Bulgaria and the United States should provide an

interesting contrast between a country with a well-developed ENGO sector and another in the process of "convergence" to Western-style political and economic systems [11]. And, as Frankel and Cave remind us, the use of science in the policy process ". . . does not take place in a vacuum; it is socially embedded activity which reflects the culture, traditions, and resources of the country and institutions in which it takes place" [47, p. 7]. By comparing the role of ENGOs in the transmission and use of science in two very different political, economic, and cultural contexts, we can potentially develop new insights into the use or nonuse of science and scientists when managing natural resources and formulating policy.

We will begin this study by first discussing the various contrasting roles of science and scientists in the environmental policy process, followed by a literature review concerning the role of ENGOs in postindustrial and postcommunist policy processes in general, and the U.S. and Bulgaria contexts more specifically. Next we discuss our research methods and then present findings based on survey research and interviews conducted in 2005. The focus of our fundings will include how ENGOs define science, how they communicate science, and their assessment of the level of ecological literacy among various groups in each country.

CONTRASTING PERSPECTIVES ON SCIENCE, SCIENTISTS, AND POLICY

Many contemporary policy makers, citizens, ENGOs, and scientists would agree with Levien [12] that science and scientists can and should play an important role in the environmental policy process. He argues there are three ways that this can occur. First, scientists can provide a clear understanding of the basic dimensions of environmental problems. Second, scientists can then describe and identify options for the appropriate solution of those problems, some of which might not be considered by policy makers. Finally, scientists can contribute to the resolution of environmental problems by estimating the broader economic, social, environmental, and political consequences of proposed solutions through time and space, and across population groups [12, pp. 47-48].

Accordingly, scientists have been called upon to predict the impact of human caused activities on the world's climate, oceans, air, species, and other environmental components. Sarewitz et al. have described these expectations as "justified in the large part by the belief that scientific predictions are a valuable tool for crafting environmental and related policies" [2, p. 11]. While scientists are often very optimistic about their role to inform the policy process, they also tend to be cautious concerning their efforts to provide correct predictions [13]. At the same time, these same scientists are strong advocates of science and the scientific method and believe that ". . . science still deserves to be privileged, because it is still the best game in town" [14].

Perspectives on the proper involvement of scientists in the policy process are potentially related to how science is defined and understood. The "traditional" or

"mainstream" model of science is an outgrowth of the Enlightenment and the philosophy of positivism. This model conceives science as ". . . objective, rigorous, logical, productive, and unbiased" [15, p. 307]. The role of scientists in this model is only to provide relevant expertise about scientific data and research that *others* in the policy process can use to make decisions. Science is the preferred source of information and it has a special status in environmental management because of its independence and its more "objective" interpretation of the world. Therefore, in order to maintain their credibility, scientists must not blur the line between science and policy preferences. This leads to a "separatist" role for scientists where they are ideally removed from management and policy and just provide expert advice only [16].

A newer emerging perspective on the involvement of scientists in policy and management questions their separatist role [17, 18]. It does *not* challenge science's objectivity or its relevance for policy. Rather, it proposes that scientists should become more integrated into management and policy processes, and that they should engage in practical and applied research for management. Research scientists need to come out of their laboratories to directly engage in public environmental policy and management. There is a need for more science in these processes and decisions, the model argues, but this can only be accomplished if research scientists themselves become more actively involved. This emerging "integrative" model—also called "post-normal science"—calls for personal involvement by individual research scientists in bureaucratic and public decision making, providing expertise and even promoting specific strategies that they believe are supported by the available scientific knowledge [17, 18].

In a recent case study of scientists, natural resource managers, and ENGOs involved in U.S. environmental policy, Steel et al. [19] found that ENGOs and environmental managers generally viewed science as a powerful source of information for making policy decisions, and the preferred role for scientists in the environmental policy process reflected the post-normal model. Most study participants wanted scientists interpreting research results for managers and then helping managers to integrate this research in management decisions. Similarly, another U.S. case study by White and Hall found that while some citizen stakeholders involved in Pacific salmon recovery view science with some skepticism, they continue to maintain a traditional view of its ability to inform management: "On the one hand, citizen stakeholders appeared much more astute about science and its use than often depicted. Citizens routinely suggested that decisions should be based on scientific knowledge" [15, p. 317].

A central goal of this research project is to explore the thinking of Bulgarian ENGOs on science and what role they see science playing in designing environmental policy. In the U.S. context, many observers argue that ENGOs play an important "transmission" role in the communication of scientific research—connecting science and scientists with the general public and policy makers [9]. Jasanoff has argued this should be the case in transitional societies: "At the heart

of environmental decision-making is an attempt to connect knowledge about the world . . . with actions designed to advance particular visions of natural and social well-being. It is this link between knowledge and action that provides environmental NGOs their primary point of political intervention" [10, p. 580]. One could argue that this is a particularly important issue for many postcommunist countries as well, which are dealing with serious problems of pollution and the general transition to market economies and democratic institutions. This is especially relevant for countries such as Bulgaria, which is now moving toward harmonization with E.U. environmental policies as part of the process of accession in 2007. The European Union's environmental policy is comprised of approximately 200 legal instruments including areas such as water and air pollution, waste and chemical management, radiation protection, and nature conservation. All member states are required to conduct environmental impact assessments in most public and private-sector development projects. Certainly this will place the role of science and scientists at the center of Bulgarian efforts to transition into the E.U. framework. However, are Bulgarian ENGOs in a situation to have the capacity to serve as "transmitters" of scientific information?

There also may be a problem with the availability of relevant science for ENGOs to communicate as well. Bulgaria's economy is poor and there have been few resources to support scientific research when there are many other pressing needs. According to Frankel and Cave, this situation has been common across eastern Europe [4]. Another potential problem is that many eastern European countries adopted the Soviet "tripartite" system with most basic research taking place in institutes of the Academy of Sciences. There was little to no peer review and block grants were distributed often based on political connections and favoritism, thus tainting the research conducted. While this system has been mostly replaced since 1989, there may well be some lingering cynicism about science and some scientists [4]. On the other hand, some postcommunist countries, including Bulgaria, remain highly elitist with high levels of distrust of citizens and elected officials alike [20, 21].

Because of the lack of funding, the end of the Soviet style science system, and the general lack of priority given to science, some scientists have turned to foreign sources of support [22]. While such funding provides scientists with autonomy from the old system, the research produced is much more ad hoc and donor driven, thus potentially making it less useful to policy makers and resource managers.

ENGOs IN THE ENVIRONMENTAL POLICY PROCESS

As previously discussed, Jasanoff has argued that ENGOs are critical in the transmission of scientific information in the environmental policy process because they can ". . . bridge the lay-expert, activist-professional, and local-global divides" [10, p. 581]. However, as Tong's recent work concerning the role of ENGOs in transitional societies suggests, it is much more complicated in formerly

authoritarian and transitional societies [23]. Therefore, in this section we discuss the literature on the role of NGOs in postindustrial (i.e., U.S.) and postcommunist societies to shed some light on how these organizations may involve themselves in the environmental policy process in general, and more specifically how they may communicate scientific information.

ENGOs in the United States

Historically a tight community of natural resource agencies and commodity interests largely determined the direction of natural resource and environmental policy. This narrowly circumscribed policy process has been described as an "iron triangle" or a "subgovernment" [24]. Beginning in the 1960s and 1970s, however, new groups and interests have entered the process, often challenging the status quo and sometimes leading to considerable policy unpredictability in the environmental and natural resource policy arena [9]. Mitchell and his colleagues have argued that ". . . administrative law in the United States has now moved toward a system of interest representation . . . whereby all interested parties are granted standing" [25, p. 20].

ENGOs often serve as important mechanisms for pressing the public's concerns in scientifically and technically complex policy areas such as environmental policy in the United States [26, 27]. The advocacy role taken by environmental groups is frequently framed in the context of the information-sharing function interest groups perform in modern, postindustrial democracies generally [9].

According to Freudenberg and Steinsapir, the U.S. environmental movement has evolved into not only the traditional national organizations such as the Sierra Club and the Natural Resources Defense Council, but also into literally thousands of grassroots-based organizations [26]. These organizations have three levels of organization including "community-based groups, regional or statewide coalitions, and national organizations," which reflect the federal nature of the country [26]. These groups are also typically membership driven and rely on these members and volunteers to pursue their policy preferences.

Rather than operating exclusively in the realm of conventional lobbying and electoral mobilization of their membership, ENGOs increasingly are concerned with the gathering and distribution of complex scientific and technical information pertinent to the environmental policy process [9]. In recent decades environmental groups have directed their efforts toward "influencing specific legislative and administrative actions" and "groups had to know how the political system worked, how to identify decision makers and how their minds worked" [28, p. 144].

In terms of the number and strength of environmental groups and the movement in general, most observers would agree with Dunlap and Mertig that by 1990, "The U.S. environmental movement has proven to be exceptionally successful and enduring" [29, p. 1]. Much of the growth in ENGO membership was after the first Earth Day in 1970, as evidenced by a 38% increase in membership between

1969 and 1972. Additional membership growth continued during the 1980s and 1990s, until there were over 3 million members by the twentieth Earth Day in 1990 [25]. And as Dunlap found in his 2000 Earth Day Gallup Poll, most Americans see the movement as having been very successful with 76% of respondents saying they had either a "moderate" or "great amount" of success [30].

ENGOs in Postcommunist Countries

Beginning with Mikhail Gorbachev's policy of perestroika and glasnost in 1985, ENGOs started to emerge in many areas of the former Soviet Union and other communist countries. According to Potravnyi and WeiBenburger, the first ENGOs to appear were small-scale local organizations formed to solve specific, local environmental problems [5]. More recently, ENGOs at the national and regional levels have begun to appear and have organized public education programs, public demonstrations, mass media outreach, and lobbying efforts. In central Europe ENGOs have "established legal services to assist citizens, other ENGOs and local communities in exercising public participation rights and gaining access to justice" [31]. However, as Tong has argued, while ENGOs in postindustrial societies such as the United States operate in a general framework of interest groups politics, their role in former authoritarian transitional societies is often "stifled" with little ability to influence the public or policy makers alike [23, p. 167].

In 1996 the Regional Environmental Centre (REC) conducted a comprehensive evaluation of environmental ENGOs operating throughout central and eastern Europe. REC surveyed 3,020 NGOs active in the region, and it received 1,872 (61%) responses to a questionnaire seeking information about the structure, finances, and political strategies of these organizations [32]. Survey results indicate that these nascent organizations spend an enormous amount of time searching for funding, hiring and training staff, and obtaining equipment in their efforts to promote environmental protection. The obvious lack of appropriate infrastructure and funding were identified as major impediments to the fulfillment of their environmental goals.

The overwhelming majority of organizations indicated that they were established in the 1990s after the collapse of Communism. Over half of the organizations surveyed were operating in small towns, and the vast majority did not have paid staff, operating only with a few volunteers. The ENGOs with the largest budgets, most employees and volunteers, and highest levels of perceived success were found in the Czech Republic, Hungary, Poland, Romania, Slovenia, and Slovakia. These are countries that have had experience with democratic institutions in the past and are closest geographically to the European Union [32]. Roughly half of the ENGOs operate on annual budgets of less than $1,000, and over half indicated they could not exist without external support.

As for the Bulgarian context, Soviet influence in the post-WWII era was less resented than in other central and eastern European countries. Unlike many of

these other countries, Bulgaria experienced a "Quiet Revolution" in its transition to a more democratic and free market country [33]. The Bulgarian Socialist Party (BSP, formerly the Communist Party) retained power after the first democratic elections and has continued with electoral success since then (e.g., the BSP is currently the largest parliamentary party and leads a coalition government after the 2005 elections). This contributes to a very slow process of "decommunization" and the development of a democratic culture and constitutional system [11, 34]. In addition, widespread economic, political, and judicial corruption, continuing mob-style murders of economic elites, the emergence and strong electoral success of a right-wing party ("Ataka"), and the less than independent relationship between government and the media, all contribute to less than desirable conditions for the emergence of an ENGO sector [20, 35].

The development of the ENGO sector since 1989 has been mostly a top-down approach "led by donor demands and visions and not by the Bulgarian citizens" [20, p. 11]. This has contributed to ". . . indifferent attitudes in the Bulgarian business sector, as well as by widespread apathy and mistrust among the Bulgarian population" and the political elite [20].

One long-term field study of Bulgarian ENGOs conducted over 1992 to 1999 by Cellarius and Staddon concluded that they are generally under-funded, have few if any members, are generally not supportive of membership or public oriented, and ". . . operate in statutory and fiscal constraints that seem to undercut their ability to act independently of the state" [36]. In a previous study, Cellarius also argues that there is an "urban bias" in the distribution of ENGOs and that many of these organizations could be more accurately described as professional associations instead of grassroots-based environmental organizations [37].

In regard to the strategies used by ENGOs to influence policy, Cellarius and Staddon found that ". . . it sometimes happens more on an ad hoc basis, for example when a particular individual or group is invited to participate because of personal connections or reputation as an expert on a given issue" [36, p. 209]. However, they did find that some ENGOs did resort to non-traditional forms of participation such as street protests, media campaigns, etc. The degree to which science and scientists were used in these efforts was not reported in this study.

Given this background, what can we say about the use of science and scientists by ENGOs to influence environmental policy in Bulgaria when compared to the United States? Do they identify science as an important component of policy? How about what model of science is supported—normal versus post-normal? In addition, how do ENGOs communicate scientific research? As Bulgaria heads toward membership in the European Union, it is expected to "converge" and become more "Western" in its economic, political, and social institutions and procedures. As discussed previously, ENGOs are considered important actors in environmental policy processes in their role as "transmitters" of scientific information to both the public and policy makers.

In regard to political constraints and opportunities, postindustrial countries such as the United States have democratic systems in which ENGOs' political activities are legally protected and often encouraged, although their policy preferences may not always be accommodated. Transitional postcommunist societies, such as Bulgaria, have a legacy of closed authoritarian political systems and have just recently embarked on the road to more open political processes. This political transition leads to new opportunities for ENGOs to emerge and engage in the political process. However, as discussed above, much of the support for the ENGO sector has come from foreign donors in a "top down" approach. Therefore, their role in transmission of information to the public and policymakers may be diminished. In addition, there continues to be a legacy of apathy, cynicism, and elitist attitudes toward the general public to overcome in Bulgaria making it potentially difficult for organizations to find resources to support their activities once the foreign donors are gone [20]. Therefore, we expect our research results to indicate less frequent activity in transmitting scientific information and more elitist attitudes toward the use of science and scientists in the policy process by Bulgarian ENGOs when compared to U.S. ENGOs.

METHODS

In order to gather data on ENGO activities and orientations toward science and the environmental policy process, 125 ENGOs were randomly selected from lists available at the National Environmental Directory in the United States (environmentaldirectory.net), and BlueLink (www.bluelink.net) and the NGO Catalogue (www.ngorc.net) in Bulgaria. For each location, ENGOs leaders were then contacted by both e-mail and mail (if no e-mail access) and provided electronic/paper versions of the survey. This initial contact was followed by two additional e-mail/mail reminders and a final telephone reminder (if available). We received responses from 73 Bulgarian and 69 American ENGOs, leading to response rates of 58.4% in Bulgaria and 55.2% in the United States. In addition to the survey, semi-formal interviews were conducted with approximately 40 ENGO directors and scientists in Bulgaria concerning the role of science and scientists in the environmental policy process.

FINDINGS

A major goal of this research was to examine how ENGOs define and view science. If ENGOs view science from a more positivistic perspective as a relatively objective source of information, they may well be more likely to disseminate the results of scientific research to citizens and policy makers (i.e., "transmitter" role). However, if ENGOs view science as only one source of information or even question its validity, they may be reluctant to transmit such information (unless it supports their political goals). In order to determine orientations toward science, each ENGO director was asked their level of agreement or disagreement

with a series of statements, which underlie many of the assumptions implicit in positivism, broadly construed. The six statements provided in the survey were developed on the basis of interviews and an exploratory survey with various government and university research scientists, philosophers of science, and social scientists in the United States. Agreement with these six statements can be generally interpreted as a belief in many of the important principles inherent in a positivistic perspective of *science.* They do not indicate a position on the appropriate role of science or scientists in the policy process.

Table 1 displays mean scores for the six statements concerning science and scientists for both Bulgarian and U.S. ENGOs. The Bulgarian results indicate that the directors of ENGOS lean toward a positivist view of science. Bulgarian ENGO directors tend to agree that the "use of the scientific method is the only certain way to determine what is true or false about the world," "science provides objective knowledge about the world," "it is possible to eliminate values and value judgments from the interpretation of scientific data," "science provides universal laws or theories that can be verified," and "scientists are generally more objective than others involved in natural resource management decisions." The only statement that did not receive widespread agreement was "the advance of knowledge is a linear process driven by key experiments," with the mean score indicating mostly neutral responses.

In comparison to Bulgarian ENGOS, mean scores for the United States are lower for all six indicators, although mean scores are only significantly lower for three statements, U.S. ENGO directors tended to agree with: "use of the scientific method is the only certain way to determine what is true or false about the world," "science provides objective knowledge about the world," and "science provides universal laws or theories that can be verified." For two statements, U.S. ENGOs were generally in disagreement and this disagreement was significantly lower than the Bulgarian ENGOs: "the advance of knowledge is a linear process driven by key experiments," and "it is possible to eliminate values and value judgments from the interpretation of scientific data."

In general, the data indicate that ENGOs in both locations lean toward a positivist perspective with Bulgarian ENGOs more likely to have such a viewpoint and U.S. ENGOs a little more cautious, especially for the ability to eliminate values and value judgments from the process. This interpretation is supported by *t*-test results for an additive index we constructed by summing the six items (range 6 to 30). There is a statistically significant difference between ENGOs in the two countries for the index with a Bulgarian mean score of 20.49 compared to 18.91 in the United States.

A second objective of this research was to explore the mechanisms by which ENGOs communicate this scientific information to others. The data displayed in Table 2 report how frequently ENGOs disseminate the results of scientific research concerning natural resources and the environment. The 10 types of communication activities reported include normal/traditional outlets such as

Table 1. Attitudes About the Scientific Process

	Bulgaria Mean (SD)	United States Mean (SD)	t-Test
Question: Please indicate your level of agreement or disagreement with the following statements concerning the scientific process.			
a. Use of the scientific method is the only certain way to determine what is true or false about the world.	3.21 (1.17)	3.19 (1.47)	.008
b. The advance of knowledge is a linear process driven by key experiments.	2.97 (.96)	2.64 (.94)	4.35*
e. Science provides objective knowledge about the world.	3.86 (.94)	3.67 (1.11)	1.27
f. It is possible to eliminate values and value judgments from the interpretation of scientific data.	3.26 (.92)	2.54 (1.01)	20.08***
h. Science provides universal laws or theories that can be verified.	3.84 (.87)	3.74 (1.10)	3.59
I. Scientists are generally more objective than others involved in natural resource management decisions.	3.51 (.92)	3.04 (1.09)	7.69**
Additive Index Mean =	20.49	18.91	
SD =	(3.53)	(4.46)	5.32*
Cronbach's Alpha =	.65	.74	
N =	69	68	

Note: Scale used: 1 = Strongly Disagree, 2 = Mildly Disagree, 3 = Neutral, 4 = Mildly Agree, 5 = Strongly Agree.
  Significance levels: *$p \leq .05$; **$p \leq .01$; ***$p \leq .001$.

journal publications and presentations at professional meetings as well as more post-normal activities such as translating results for managers and the use of field trips and on-site demonstrations. For Bulgarian ENGOs, 4 of 10 activities were identified as being "sometimes" used or more (mean score 3.0 and higher). These include presenting research results at professional meetings, translating results for the mass media, communicating research to nonscientists through their own publications, and presenting information at public hearings. For the U.S. ENGOs,

Table 2. Communicating the Results of Scientific Research

	Bulgaria Mean (SD)	United States Mean (SD)	t-Test
Question: How frequently does your organization engage in the following activities annually when disseminating the results of scientific research concerning natural resources and the environment?			
a. Publish research results in academic journals	2.73 (1.37)	1.62 (.69)	34.9***
b. Present research results at professional meetings.	3.64 (1.27)	2.10 (1.16)	56.52***
c. Present information at public planning hearings for natural resource agencies.	3.01 (1.36)	3.90 (.96)	19.83***
d. Translate research results into a format that mass media (newspaper, television, etc.) can readily use.	3.32 (1.18)	3.91 (.95)	10.54***
e. Translate research results into a format that elected officials or staff can readily understand and use.	2.65 (1.40)	3.72 (1.04)	26.53***
f. Translate research results into a format that natural resource managers can readily understand and use.	2.72 (1.30)	3.26 (1.45)	5.39*
g. Provide expert scientific testimony on pending legislation in judicial proceedings.	2.06 (1.04)	2.47 (1.28)	4.35*
h. Communicate research results directly to non-scientists through organization publications.	3.23 (1.27)	3.54 (1.27)	2.02
I. Communicate research results directly to non-scientists through the Internet.	2.89 (1.30)	3.67 (1.08)	14.78***
J. Communicate research results directly to non-scientists through field trips or on-site demonstration.	2.47 (1.20)	3.04 (1.06)	8.94**
	N = 70 to 73	N = 66 to 69	

Note: Scale used: 1 = Never, 2 = Infrequently, 3 = Sometimes, 4 = Frequently, 5 = Very Frequently.

Significance levels: $*p \leq .05$; $**p \leq .01$; $***p \leq .001$.

7 of 10 activities were identified as being used sometimes or more. These were presenting at public hearings, translating results for mass media, translating results for use by elected officials and resource managers, communication through their own publications and the Internet, and the use of field trips and on-site demonstrations. The least frequently used activities were the more traditional methods of research communication through academic journals and professional meetings.

When we examine *t*-test results we find statistically significant differences between Bulgarian and U.S. ENGOs for 9 of the 10 activities. U.S. ENGOs are significantly less likely than Bulgarian ENGOs to publish in academic journals and to present results at professional meetings. However, for the more engaging communication activities espoused by post-normal science—e.g., translating results for managers, and the use of field trips, etc.—we find U.S. ENGOs significantly more likely to participate. These differences may be explained by a variety of factors. First, fewer resources are available to Bulgarian ENGOs. They have fewer volunteers and paid employees to be involved in a wide range of activities. Bulgarian ENGO workers, like those in many postcommunist countries, probably have less experience with transmission activities. Considerable research has shown that foreign donors often use markers such as presentations at professional meetings to indicate success. Therefore, they may be more likely to fund these types of activities at the expense of grassroots actions. Finally, high levels of distrust and cynicism evident in Bulgaria for government and citizens alike may result in ENGOs not focusing their energies with these constituencies [20]. All of these factors were mentioned in our interviews with Bulgarian ENGO representatives, especially the latter.

In order to investigate ENGO perspectives on the need for transmitting scientific information to various policy actors and managers, we asked directors the following question: "From your perspective, what is the level of understanding of ecological science for each of the groups below?" The groups included elected officials, government managers, industry groups, and the general public. As we see in Table 3, mean scores for Bulgarian ENGOs indicate that they view most groups as having a limited understanding of ecological science with industry having the highest score and the public having the lowest score. For the U.S. ENGOs, we find the lowest mean score for elected officials and the highest score for the general public. Similar to Bulgaria, most groups are viewed as having a limited understanding of ecological science, however the mean score for the general public approaches "moderate understanding." The only statistically significant difference between the two countries is for the general public with U.S. respondents being much more positive than Bulgarians. Given Bulgarian ENGO perceptions of the public in this regard, one might expect greater attempts at public transmission of ecological information in the future.

Table 3. Level of Understanding of Ecological Science

	Bulgaria Mean (*SD*)	United States Mean (*SD*)	*t*-Test
Question: From your perspective, what is the level of understanding of ecological science for each of the groups below?			
a. Elected Officials	2.06 (.99)	1.96 (.55)	.530
b. Government Managers	2.35 (.73)	2.39 (.89)	.103
c. Industry Groups	2.40 (.78)	2.32 (.88)	3.58
d. General Public	1.94 (.67)	2.72 (.82)	38.44***
	N = 72	*N* = 69	

Note: Scale used: 1 = No Understanding, 2 = Limited Understanding, 3 = Moderate Understanding, 4 = High Level of Understanding, 5 = Very Level of Understanding.
Significance levels: *$p \le .05$; **$p \le .01$; ***$p \le .001$.

CONCLUSION

This study has compared how Bulgarian and U.S. ENGOs define, use, and communicate science to influence natural resource and environmental management and policy. Our findings suggest that Bulgarian ENGOs, when compared to U.S. ENGOs, have more positivistic orientations toward science and are more likely to believe in the objectivity and value free nature of science and scientists. However, they are significantly less likely to transmit the results of scientific research to the mass media, participate in public hearings, and to translate research for use by managers and elected officials. U.S. ENGOs are much more engaged in "post-normal" science activities, which is consistent with a "'transmitter" role. Bulgarian ENGOs were more likely to report engaging in professional meetings and publishing in academic journals, activities that are more consistent with basic (traditional) science and conceivably do little to influence the policy process.

Consistent with the literature, we also found that Bulgarian ENGOs are very cynical concerning the general public's ability to understand ecological science. This pattern was pronounced in our interviews of Bulgarian ENGO directors as well. While most ENGOs in the United States frequently rely on membership and volunteerism to facilitate projects, volunteerism and memberships have been

discouraged by some Bulgarian ENGOS because they lack the organizational capacity to facilitate such efforts. Some ENGOs commented in our interviews that they did not want membership because organizational goals and activities would be compromised and the general public would not be able to contribute effectively. However other challenges to volunteerism and membership also exist. One Bulgarian scientist observed that a significant challenge is that Bulgarian cultural heritage and tradition does not promote such activities. A lack of tradition coupled with the lack of resources among ENGOs to manage and contact volunteers has hindered the development of a culture of participation among the citizens of Bulgaria.

One final observation we identified in our interviews was that Bulgarian ENGO suspicion of government (because of perceived corruption and non-responsiveness) has led to many groups appealing directly to the European Union. One Bulgarian ENGO representative observed that ENGOs commonly refer to their appeal to other institutions as "going to Brussels." Since going through Bulgarian institutions to contribute scientific information is so difficult, appealing to European institutions has become a common practice. Perhaps Bulgaria's accession to the European Union in 2007 will provide Bulgarian ENGOs greater opportunities to engage in the transmission of science to the public, government, and other policy actors. However currently, in comparison to the United States, there is little such activity taking place.

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