

What Role Do Bio-Indicators Play in the Public's Understanding of Climate Change and Global Warming?

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Abstract: *The demand for public understanding of climate change and global warming are essential steps in making solutions or adaptations to global warming and climate change. Current discussions about the public understanding of science suggest that factors such as cognitive dissonance and the trust-gap hypothesis pose challenges in communicating science to public audiences. This article will focus on two main points. Firstly, to what extent bio-indicators play an important role in the understanding of the public about climate change and global warming. Secondly, what is the role scientists have in order to provide excellent information and knowledge to the public by researching or studying the effects of CC and GW on bio-indicators and how scientists are trying to create a link between amateur naturalists, phenology and the public.*

Keywords: Climate change, global warming, bio-indicators, Phenology, public understanding of climate change.

Global climate change, often characterized as global warming, is one of the bigger environmental issues (Bierbaum, 2005). Climate change or global warming are two phrases frequently used by scientists, researchers and the general public, but the meaning of both phrases is nearly the same. As Hynson (2008) says, climate change can be described as a gradual change in climate around the earth or as a change which occurs in average weather, like temperature or wind form. According to the IPCC (2011), climate change refers to any change occurring in the earth's climate as a result of different factors, like human activities or natural factors. For instance, the most obvious examples of climate change (CC) which can be easy to notice are drought phenomena, increasing natural storms, sea levels and many more; all of these examples come with the occurrence of climate change. On the other hand, global warming (GW) refers to an increase in the average temperature of the lower atmosphere, as a result of which, climate change occurs (Morris, 2007). It might be clear that the causes of climate change and global warming are different; however, the most common factors are associated with human activities, such as burning oil, coal, deforestation, misusing natural resources and many more. All of these activities cause the production of greenhouse gases, such as carbon dioxide (CO₂), methane (CH₄), water vapour and fluorinated gases (Morris, 2007). As a result of emitting gases into the atmosphere, the chemical components of the atmospheric layers are changed or the gaseous elements observed by chemical components of the atmosphere let the heat from the Sun into the atmosphere, but do not allow the heat to escape back into space. In other words, the atmosphere's role is changed from receiver or observer to working as a barrier, according to John (2003). As a result, human activities can be counted as a major factor in raising the Earth's temperature in the two last decades. CC and GW are not the only phenomena to occur, but CC and GW have a direct impact upon human life and living organisms. For this reason, these issues have become more interactive with many researchers and scientists in the last three decades and have caused them to carry out a lot of

surveys and research about the effects of CC and GW on human and living organisms, such as bio-indicators.

Nowadays, scientists are widely using bio-indicators. The uses of bio-indicators by scientists are to detect and monitor the effects of climate change and global warming on biota, in order to provide high quality data for the public about the effects of climate change and global warming on organisms and our lives. Generally, there are many reasons for using bio-indicators by scientists; an important one is their cost-effectiveness, as it is possible to check the impact of human activities on organisms, instead of examining all the organisms (Rainio, 2003). The definition of bio-indicators can be organisms used to check environmental situations. Generally, bio-indicators are used for two main approaches; firstly, to determine the changes that occur in the natural environment. Secondly, in order to monitor the effects of climate change on organisms, such as animals and plants (biobasics.gc.ca). Furthermore, researchers and scientists used bio-indicators to get an effective impact on public opinion about problems like CC and GW.

Nowadays, there are many international and national organizations and groups working on these issues, and international acceptance is greater than before. As Tony Blair wrote in "Foreword to the climate change program", (2006) "...climate change is probably the greatest long term challenge facing the human race". As a result of that, the demand for the public understanding of climate change and global warming are essential steps to making solutions or adaptations. Current discussions of the public understanding of science suggest that factors such as cognitive dissonance and the trust-gap hypothesis pose challenges in communicating science to public audiences (Zia and Todd, 2010).

In the era of developments and scientific revolution, the public awareness of CC and GW issues has considerably improved in the last two or three decades. In other words, as a result of how CC and GW have influenced human life,

public awareness has become greater than before. According to some surveys carried out by different countries, such as the United Kingdom, the United States and Europe, the ratio of public awareness about CC and GW has increased significantly. For instance, the result shown in a survey carried out by IFAK (institute for market and social research) (2006) in Germany, said that around ninety per cent of those people who participated in this survey have already heard of these issues (www.bosch-thermotechnik.de). In England, only one per cent has not heard about climate change and global warming (Whitmarsh, 2009). Although public awareness has increased about CC and GW, it seems that awareness of the international framework for tackling CC and GW not more. For instance, as shown in MORI, (Social research institute) around half of all Britons have never heard about the Kyoto protocol, the international agreement for tackling or reducing greenhouse gases, ratified between Japan, Europe and developed countries such as the United States. However, it might be clear to see that the proportion of public awareness is different from one country to another. Scientists play an important role by providing research and information about climate change and the effects on bio-indicators. As Fortner et al. (2010) argued, the public and governments look to the scientific community to give accurate information and predictions of possible future scenarios on this and related issues. Furthermore, governments in most countries, many groups and organizations are working to transfer scientists' knowledge and information to the public by using mass media. Mass media is a major factor in transferring knowledge and information to the public because mass media can transfer or deliver information faster than other methods. As Sampi et al. (2009) say, "...mass media campaigns are among tools most commonly used to attempt to influence public opinion of particular issues". For instance, on 28 April, 2005, the Japanese government commenced to put into operation the Kyoto agreement by using a mass media campaign on the TV, radio and magazines. The result of this campaign has shown an increasing public awareness toward these issues, from 9.6% to 51.6%. China has produced huge numbers of publications and audio-video products on climate change and an information database to publicize knowledge about climate change through the mass media (www.China.org.cn). In contrast, although mass media is used in many countries, it cannot deliver in-depth information or knowledge about an item. As Harris and Harris and Cynthina (2008) says, although the mass media are a major source of environmental information, it can rarely explore the background to an item in any depth, such as in the United Kingdom, where, according to MORI research, it has been shown that 70% of Britons are unable to name the gas that most contributes to GW. In other words, mass media can quickly influence public opinion but it is not an influence on public opinion, in terms of giving deep information about CC and GW impact on organisms and our life.

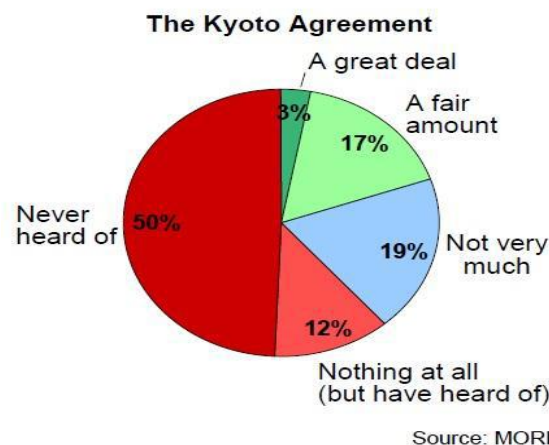


Figure 1: showing results of MORI (Social research institute) survey about the Britons' knowledge about the Kyoto Agreement

In contrast, it might be not wrong to say that the public awareness of CC and GW has a strong link with the terms of public understanding of science. Public understanding of science is the basic component that scientists used as a factor to affect public opinion in various approaches. Scholars argue that it must be informed information to public completely and imperative about these issues, because humans cause to occur problems such as CC and GW, (Turmbo, 1996). On the other hand, the public has an important role in providing solutions and making adaptations for these problems. For this reason, many countries, especially developed countries such as the United Kingdom, the United States and Europe, started to provide knowledge and information to the public. According to the United States' government, the 'Public' are able to "accurately interpret complex Scientific information". Thus, they started to create a strong link between the public and scientists. For this reason, scientists and researchers carried out many studies on some environmental components in order to interact with public opinion, such as collecting the data that were recorded by some people in many countries about natural events, like amateur naturalists, (people who like to record natural events), and the phenology network that monitors the seasonal time activity of some kinds of organisms, in order to identify the changes that happened during a period of time. All of these methods are used by scientists and researchers in order to interact with public opinion.

Furthermore, as Ydstie (2004) says, people usually know some basic information about climate, such as the first day of each season in the year, and they are familiar with the changes that will occur, according to each season. As a result of that, there are a lot of people who would like to record natural events, 'amateur naturalists'. An amateur naturalist can be reckoned as one of the components that scientists use, in terms of monitoring climate change and global warming. Amateur naturalists are often used by those people who would like to record some natural events like plants' flowering and migratory birds. It has an important role in providing long term recorded information to scientists and, in some situations, it provides a boost for some research about climate change and global warming, to determine the effects of CC and GW on plants and animals.

For instance, according to the British natural calendar in the UK, around fifty thousand people are now involved with the nature's calendar survey. As Jensen (2004) claims, the data collected by those amateur naturalists in the UK has now become a big archive. In addition, it has important links between amateur naturalists and scientists. According to Ydstie (2004), climate researchers in Britain enlisted the help of amateur naturalists in that country to participate by sending in recorded data about various natural events. Many people in different countries record natural events for different approaches. However, it seems that they do not have a valuable effect on the public understanding of climate change and global warming. As Jensen (2004) argued that, even with some people working as an amateur naturalist, the rest of them, or the majority of people do not have information about it. In other words, the amateur naturalist's role commonly appears with the scientists' approach to understanding the effects of climate change on plants and animals. However, it does not work very well to affect public opinion. Furthermore, nowadays, many countries commenced to create a strong link between the public and those people who work as amateur naturalists, in order to encourage public opinion about these issues (Jensen, 2004). Phenology or a phenology network is another component scientists used in this term. The short definitions of phenology can be, 'timing of seasonal activities of plants and animals with climate conditions or the relationships between biological phenomenon and climatic conditions' (Walther et al., 2002). A scientist often uses birds, butterflies and wild animals to monitor the effects of climate change and global warming on the seasonal activities of these organisms, because it can be easy to identify the changes and effects. Thus, it might be paid considerable attention to by the public. As Annette (2002) argued that, recently, a biotic seasonal change increased and became more obvious, so as to be noticed by the public, such as melting ice and freezing, especially in northern latitudes. These changes hardly influenced animals and plants in this area, especially in the birds' migration system. For example, some timed their arrival earlier or later than usual and also changes in lowering plants and many more (Walther et al., 2002). Generally, there are many phenology groups working in different countries, especially in Europe and the United Kingdom. For instance, Deutscher Wetterdienst (German Weather Service) collected phenology data by using some volunteers interested in nature (Annette, 2002). In the United Kingdom, according to nature's calendar survey, everybody have permeation to record natural events on this web site which is widely used by researchers and studies. As a result of that, phenology data plays an important role in determining the effects of climate change on animals and plants, as shown by various studies on butterflies and birds and providing long term data. At the same time, it plays an important role in providing good information for environmental education and the public about CC and GW. For example, The Global Program offers phenology data for students, in order to be able to gain an excellent understanding of links between climate change and organisms. On the other hand, a country like the United Kingdom included phenology in the lists of climate change indicators (Annette, 2002, p. 381). Although phenology data in many countries became more valuable in terms of determining the effects of climate change on organisms, it

seems that a phenology network or phenology data cannot have much influence on the public's understanding of CC and GW. As Annette (2002) argued, the effects of phenological data on public opinion about CC and GW depends upon the quality of phenological observed data. In many countries, these data are collected by volunteer groups and they use manual methods to record the data. As a result of that, the quality of phenological data is not good. It might be factual to say phenology data are used as a minor important source by researchers who study global climate changes on the community. Thus, the phenological data or phenology roles in their effect on public opinion and ideas on understanding climate change and global warming are not valuable.

In order to examine or evaluate the role of bio-indicators, amateur naturalists and phenology networks in term of their effectiveness on public opinion, it should be taken from the results of some surveys which have been carried out by some scientists and researchers in the United Kingdom. According to Whitemarsh (2009), people usually get information about CC and GW from some important sources like mass media. The most important source to transfer and deliver scientists' ideas and information in the United Kingdom is mass media Whitemarsh says. According to Whitemarsh (2009), the survey result showed that people who participated in this survey, with just 8.8 per cent, responded that climate change and global warming impacted upon wildlife and vegetation, (see table 1). It is an understandable answer to explain the question of "...to what extent do bio-indicators play an important role in the understanding of the public of climate change and global warming". In other words, people usually familiar with phrases like CC and GW but who at the same time do not have enough information about the impact of climate change and global warming on our lives and organisms. For instance, according to another survey carried out by the MORI Social Research Institute in the UK, the results showed that almost half of those people who participated in this survey had never heard about bio-diversity and 17.5% of them knew a great deal or fair amount about it. Generally, it can be easy to note that public awareness about CC and GW has increased rapidly in many countries, especially in developed countries. However, public understanding of the impact of CC and GW is not more or it is not valuable in order to have an important role in providing solutions or making adaptations for the problems like that. In other words, bio-indicators play a weak role in terms of their effect on the public in understanding environmental issues like CC and GW.

Table 1: showing the result of the survey carried out by Whitmarsh

"What impacts, if any, do you think climate change/global warming may have?" (open-ended) (categories of 20 responses or fewer are excluded)	% of total survey respondents ^a	% of survey respondents by questionnaire version		
		Climate change	Global warming	Sig.
Changes/extremes in weather ^a	22.6	19.5	25.3	n.s.
Flooding ^a	21.6	20.6	22.4	n.s.
Sea level rise/loss of land ^a	21.2	19.5	22.8	n.s.
Impact on agriculture/food supply ^b	13.6	18.1	9.6	$p < .01$
Melting ice caps/icebergs ^a	10.9	7.2	14.1	$p < .01$
Climatic impacts ^a	9.7	4.0	14.7	$p < .001$
Impacts on wildlife/vegetation/flora and fauna ^c	8.8	10.5	7.4	n.s.
Human health/spread of disease ^b	8	8.3	7.7	n.s.
Temperature increase/heat ^a	7.8	7.9	7.7	n.s.
Extinction of species ^c	7.3	7.2	7.4	n.s.
Drought/water shortages ^a	7.1	7.2	7.1	n.s.
Catastrophe/destroy earth ^a	4.9	4.0	5.8	n.s.
Long-term/future impacts ^a	4.6	4.7	4.5	n.s.
Uncertainty—unsure/lack of knowledge ^d	4.2	4.3	4.2	n.s.
General impacts—all other ^a	18	16.2	19.6	n.s.
Human impacts—all other ^b	14.4	15.9	13.1	n.s.
Non-human impacts—all other ^c	7.1	7.6	6.7	n.s.
Uncertainty—all other ^d	5.9	4.3	7.4	n.s.

Source: Whitmarsh (2009)

In conclusion, it might be easy to say that one of the emerging environmental issues today and for the next millennium is global climate change (GCC), often characterized as 'global warming'. The causes of these issues are certainly human activities as in producing greenhouse gases. On the other hand, public care of CC and GW has become a hot topic, because of public opinion or the public understanding of global warming and climate change and it can be counted as a basic core for making solutions and adaptations to these problems. Furthermore, in the two last decades, public awareness of CC and GW was recorded in great number in many countries, especially in the United Kingdom, the United States and Europe. According to some surveys carried out by these countries, the people had already heard about CC and GW but they do not have enough information about the effects on our lives and organisms. In other words, it seems that scientists worked very hard on this situation by providing a lot of research on the effects of CC and GW for the public; however, the effects of scientists' studies on the public's understanding of these problems until now are not effective influences. In addition, the role of bio-indicators in terms of impact upon public understanding of CC and GW is not a strong effect or it may be true to say that the bio-indicators' role in this term is very weak.

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