

DEVELOPING MILITARY ENVIRONMENTAL LITERACY IN THE SOUTH AFRICAN ARMY THROUGH A DEDICATED MILITARY ENVIRONMENTAL MANAGEMENT COURSE

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Abstract

It is important for soldiers to be military environmentally literate to prevent unacceptable behaviour in the environment in which they conduct their missions. This is especially true during peacekeeping and disaster relief missions, but holds equally true for combat situations. Military environmental literacy refers to the nature and level of the attitude toward, knowledge about, and behaviour in and toward the environment in which the military operates. The construct of military environmental literacy consists of three components: military environmental attitude (a general feeling of favour or disfavour toward the military environment, i.e. the environment in which the military operates); military environmental knowledge (the ability to identify a number of concepts and behaviour patterns related to the military environment, i.e. the environment in which the military operates); and military environmental behaviour (a demonstration of how one acts toward or in the military environment in which the military operates). The MEL of South African soldiers was measured in a study reported on in 2017, as well as in a test–retest survey in 2018. A specially developed valid and reliable questionnaire to test military environmental literacy was used in both surveys. The study reported on here, argued that exposing soldiers to a dedicated military environmental management course could influence their military environmental literacy positively.

Keywords: military environmental course, military environmental literacy, environmental attitude, environmental knowledge, environmental behaviour

A case for military environmentally literate soldiers

In their book on United States (US) Army environmental considerations for operations, Mosher et al. ask the crucial question, “[w]hy should commanders care about environmental issues?”¹ Concerns such as soldiers’ health and safety, mission success, the amplification of environmental issues during long deployments, and the importance of ‘doing the right thing’ are offered as reasons for taking environmental matters into consideration during all phases of military activity.

Modern-day defence forces are progressively subjected to raised environmental concerns, evidenced by mounting corpuses of national and international environmental legislation that regulates all military activities. There is growing recognition of the environmental dimension of global security, and militaries worldwide are coming under increasing pressure to perform their activities in an environmentally responsible manner and to abide by national and international environmental legislation, both in times of war and during peacetime.²

The effects of military activity on the environment tend to be variegated. Mosher et al. explain that the long duration of occupations and post-conflict involvements of the US military placed emphasis on the importance of environmental considerations in military conduct. They advance the following reason: in conflict zones where the environment poses a threat to soldiers, longer stays exacerbate the threat.³ Bonds concur, and reports that, during the Iraq and Afghanistan wars open-air burn pits used to dispose of solid waste caused health problems for US soldiers and Iraqi and Afghan civilians alike. He also noted that it was an environmentally literate soldier with a PhD in Environmental Engineering who first alerted leadership to the problems associated with the US Army's mode of waste management.⁴

The actions of US soldiers with respect to the local environment had become increasingly important because of the lasting consequences of such actions on the local population, while improvement of the local environment could have generated goodwill among the local population toward the US occupying forces.

It is important to note that poorly handled environmental impacts are not bound by borders and can easily cloud good relations with countries bordering the conflict zone. In 2012, when American soldiers inadvertently burnt copies of the Koran in Muslim Afghanistan, the US military suffered severe reprisals, protests, and deaths among soldiers. They learnt the hard way that the total local environment, including the cultural environment, should be respected at all times.⁵ More importantly, the event tarnished the image of Americans among both the Afghan population and the neighbouring Muslim nations, negatively influencing the reaching of American military objectives in that conflict.

To modern militaries, also in the South African (SA) context, environmental concerns are significant at all levels of military planning and execution. To deal with the increasing complexity of environmental concerns in a mission-diverse military environment, military environmentally literate soldiers are needed.

But what is military environmental literacy (MEL), and how can it be tested? More importantly, what can be done to develop the MEL of soldiers; hence, avoiding the negative effects attributed to environmentally illiterate soldiers discussed above? This article wants to elucidate these questions by presenting research results from a study reported on in 2017 and a follow-up survey done in 2018. Both sets of results indicate a positive relationship between MEL and the completion of a dedicated military environmental course offered annually to members of the South African Department of Defence (DoD).

Environmental literacy and the military

Despite the lack of a precise definition of environmental literacy (EL), a widely accepted working definition provided by Roth⁶ has been adopted by most researchers in the field.⁷ Roth defines EL as an individual's knowledge about and attitude toward the environment and environmental issues, skills and motivation possessed in working toward the resolution of environmental problems, and active involvement in working toward the maintenance of dynamic equilibrium between the quality of life and the quality of the environment.⁸

According to Esterhuysen a specific military culture, ethos and professional conduct have become established in the military.⁹ The military culture differs significantly from civilian conduct and practice, and poses unique problems, offers opportunities and requires specific skills in managing the environment in the military. Consequently, the military environment requires a unique definition to encompass MEL effectively. Godschalk distinguishes between military-integrated environmental management applied by the DoD and integrated environmental management adopted and applied by civilian enterprises.¹⁰ Appropriately, the term 'military environmental literacy' distinguishes between military-specific environmental literacy and its civilian counterpart.

For the purposes of the research reported here, MEL was defined as the nature and level of the attitude toward, knowledge about, and behaviour in and toward the environment within which the military operates. From this definition, it is clear that MEL comprises three components, namely attitude towards military environmental issues, knowledge about the military environment, and behaviour in the military environment.

Environmental attitude can be defined as "a psychological tendency expressed by evaluating the natural environment with some degree of favour or disfavour".¹¹ The operational definition of **military environmental attitude (MEA)** is that it is *a general feeling of favour or disfavour toward the military environment, i.e. the environment within which the military operates*.¹²

Chao describes environmental behaviour (EB) as to "act toward the environment",¹³ while Kollmuss and Agyeman refine matters by defining pro-environmental behaviour as "behavior that consciously seeks to minimize the negative impact of one's actions on the natural and built world".¹⁴ Bamberg and Möser expand and describe pro-environmental behaviour as –

[A] mixture of self-interest (e.g. to pursue a strategy that minimises one's own health risk) and of concern for other people, the next generation, other species, or whole ecosystems (e.g. preventing air pollution that may cause risks for others' health and/or the global climate).¹⁵

Military environmental behaviour (MEB) was therefore defined in the current study as *a demonstration of how one acts toward or in the military environment in which the military operates*.¹⁶

A further distinction is drawn between self-reported and observed behaviour and the implications for interpreting results from the two types of behaviour measurement. Gifford and Nilsson highlight the fact that the vast majority of EB studies address self-reported and not observed behaviour.¹⁷ Self-reporting of EB is relatively undemanding and inexpensive, and it can accommodate the diverse components of behaviour, such as energy-saving measures and respect for the cultural and religious environment, something not always possible with observed behaviour, especially in the military. Jenner et al., Chen, Pahilan and Orlander as well as Dobbinson et al. have all compared the results of self-reported and observed behaviour and found that self-reported behaviour usually overstates observed behaviour.¹⁸ Huffman et al. found a weak correlation between observed and reported behaviour,¹⁹ while Dobbinson et al. reported similar trends over time when comparing self-reported and observed behaviour of the same phenomenon.²⁰ The MEL surveys (2017 and 2018) measured self-reported and not observed EB, the reasons being ease of measurement, time economy, cost-effectiveness and ability to capture diverse behaviours associated with military actions. Since most research focuses on self-reported EB, comparison of results with a large corpus of research is possible. An important caveat is that, according to the literature quoted above, self-reported behaviour overstates actual behaviour.

Dodd et al. distinguish between “objective or actual knowledge (what a person actually knows about a product, issue or object) and subjective or perceived knowledge (what a person thinks he/she knows).”²¹ In the current research, objective or actual knowledge was assessed through the military environmental questionnaire. **Military environmental knowledge (MEK)** was consequently defined as *the ability to identify several concepts and behaviour patterns related to the military environment, i.e. the environment in which the military operates.*²²

The construct of MEL thus constitutes the combination of affective, behavioural and cognitive components (MEA, MEB and MEK) and will be used as such in this article.

The military environmental literacy questionnaire and survey

Smit developed a valid and reliable questionnaire to test MEL in the SA Army.²³ The production of the final questionnaire was a procedure that commenced with a literature search and review, and continued with initial questionnaire development, focus group input, panel evaluation, pretesting, piloting and statistical analysis, and final item selection. During each of these steps, the utmost care was taken to ensure the academic and statistical integrity of the process. Eventually, the exercise rendered a ten-page, organisation-specific, valid and reliable questionnaire for testing MEL in an SA Army context (see Table 1).

The final questionnaire was accompanied by a letter of introduction. The main body of the questionnaire consisted of five sections and a consent form. The letter of introduction sketches the nature and purpose of the research, deals with confidentiality issues, explains the purpose of the consent form and requests the participants to take part in the research by completing the items in the questionnaire.

Table 1: The structure and content of the final military environmental literacy questionnaire (Adapted from Smit, 2017)²⁴

STRUCTURAL ELEMENT		CONTENT
Letter of introduction		Explanatory information for the participants to enable them to make an informed decision about participation in the survey
Quantitative	Attitude scale	Eliciting responses regarding attitude 15 Likert-type items
	Behaviour scale	Eliciting responses regarding self-reported behaviour 13 Likert-type items
	Knowledge scale	Eliciting responses to military environmental knowledge items 14 multiple-choice items
Qualitative	Open-ended items	Allow to motivate their responses and establish an environmental narrative Six open-ended items (<i>first, two items, which correspond to the attitude section in the quantitative part of the questionnaire; then two, which correspond to the behaviour section; and finally, two, which correspond to the knowledge section</i>)
Biographical and service history section		Eliciting biographical and service history information 16 open-ended items
Informed consent form		Explanation of the implications of participation in the research Signature required from a participant to respond

The attitude section of the main questionnaire investigates the attitude of participants toward the environment in which the military operates. The main aim of this scale is to elicit responses from participants regarding their attitude toward the military environment and military environmental issues. The **attitude** section consists of 15 items, which examine attitude toward environmental concerns, such as:

- protection of the environment;
- the cultural environment;
- planning of operations;
- protection of wildlife;
- waste production;
- environmental management plans;
- environmental laws;
- pollution;
- recycling;
- soil erosion;
- damage to the environment;
- the rights of local inhabitants; and
- the environmental image of the SA Army.

The **behaviour** section investigates the self-reported behaviour of the participants. The main aim of this scale is to elicit responses regarding participants' behaviour in the military environment while executing their task. The scale comprises 13 items dealing with themes such as:

- the procedure followed after an oil spill;
- energy conservation;
- littering;
- regulations regarding the environment;
- respect for the cultural environment;
- destruction of the natural environment;
- recycling;
- conduct when selecting alternative transportation routes; and
- respect for the traditions and customs of local populations.

In the **knowledge** section, participants address a series of multiple-choice items. The aim of this scale is to test the knowledge and awareness of participants regarding environmental concerns with which they are confronted at their workplace. This scale consists of 14 items and engages with themes, such as:

- international conventions;
- important military environmental acronyms;
- environmental rights;
- environmental laws;
- procedures for storing hazardous materials;
- handling refuse;
- storing fuel;
- disposing of batteries;
- recycling of wastes;
- troop movements;
- cultural issues among local populations;
- conduct during shooting exercises; and
- the handling of unexploded ammunition.

A section with open-ended items is included in the questionnaire to afford participants the opportunity to motivate their answers and to establish a military environmental narrative that supplies qualitative data to complement the quantitative data of the rest of the questionnaire; thus, enabling triangulation. The items in this fourth section investigate themes, such as:

- the importance of environmental protection;
- the level of environmental awareness of participants;
- whether good environmental practices can improve mission success;
- conduct at work;
- the environmental education and training the participant received from the SA Army; and
- the need for further information about the environment in which the military operates.

The biographical and service history section elicits responses to 16 personal items.

The form used to secure consent for participation in the survey accompanies the final questionnaire as a separate sheet. The consent form spells out the purpose of the survey, procedures and potential risks and discomforts, potential benefits and rewards (if any) for participants, the terms of confidentiality, participation and withdrawal, identification of the researcher and the research assistant(s), and the rights of research subjects. All participants are required to sign the form, with the supervisor (researcher or research assistant) co-signing.

This questionnaire was used to survey 25 units spread throughout South Africa that were proportionally representative of the formations of the SA Army. At the time of the survey, the SA Army had 34 463 members. A total of 1 090 questionnaires were analysed for this survey, representing a sample proportion of 3,2% of all personnel and a 90,6% response rate. The final results of this study were reported on in 2017.²⁵

The annual military environmental management course

Soldiers in the SA Army regularly receive military environmental management (MEM) education and training as part of their general training. Soldiers with a specific interest in MEM can apply to enrol for an annual, comprehensive, five-week-long MEM course. This course is presented by senior environmental managers from the DoD with vast experience in both the theoretical as well as practical aspects of MEM. The course consists of seven modules dealing with such diverse topics as –

- sustainability;
- environmental management in the DoD;
- environmental law and policy;
- integrated environmental management;
- staff work and planning;
- occupational health and safety; and
- communication skills.²⁶

The assumption is that, having completed such a military-specific environmental course, the MEL of the graduates would have been positively affected. This assumption is corroborated by research done by Smit, Karatekin as well as Sarıkaya and Saraç.²⁷

In 2018, the MEL questionnaire was used to survey the soldiers attending the course, prior to the course and again on completion of the course according to the test–retest method.²⁸ Fourteen participants took part in this survey. This constitute a response rate of 87,5% of the total population.

Survey logistics and ethical considerations

In both the surveys, carefully selected and trained research assistants distributed and collected the questionnaires. Potential participants were informed, both verbally and in writing, that participation is entirely voluntary and that non-participation would not disadvantage them in any way. During the 2018 test–retest survey, participants were asked to complete the questionnaire prior to the start of the course. They were not informed that they would be asked to complete the questionnaire on completion of the course again. At the end of the course, participants were asked to complete the survey again. In both cases, all participants had to complete an informed consent form before completing the questionnaire.

Obtaining ethical clearance is an essential element of survey research that involves the invasion of participants’ privacy, and so ethical considerations are crucially important.²⁹ Permission and ethical clearance for both surveys as part of a wider study were sought and granted by the Chief of the South African Army, as well as by the Research Ethics Committee of Stellenbosch University.

The influence of the MEM course in developing the MEL of SA Army soldiers

Researchers such as Özden (2008), Xiao, Dunlap and Hong (2013), and Conroy and Emerson (2014) postulate that education is a useful indicator of environmental literacy with increased levels of education indicative of positive environmental attitudes, behaviour and knowledge.³⁰ Surprisingly enough, this was not the case in the survey conducted by Smit.³¹ In the research by Smit, both the results for general education level and geography education rendered inconclusive results. The explanation put forth by Smit and Van der Merwe is that, because MEL is such a focused, military-specific construct, and because the MEL questionnaire measured this construct, the results were expected.³² In summary, MEL is a military-specific construct where general education does not render the same results as civilian EL.

The results for the annual MEM course, a course focused on military personnel and the military environment, produced different results. These results were investigated and are discussed in the remainder of this article. MEA results from the survey reported on in 2017 and for the 2018 test–retest are discussed first, followed by the MEK and MEB results. The article will conclude with the MEL results for both surveys and the implications for MEM.

Military environmental attitude (MEA) in the SA Army

Following the general practice in environmental attitude studies, an overall indicator of environmental attitude, the arithmetic averages of Likert-code values for the 15 items

recorded in Section A of the questionnaire were calculated.³³ Histograms were used to illustrate the results graphically as recommended by McKillup.³⁴ It is important to note the agreement level being indicated toward the lower end of the scale (ideally 1) and disagreement by the higher values (5 maximum). The lower values indicate an increasingly strong positive attitude toward the environment and the environmental issues raised about the domains in which the military operates.

MEA according to the environmental course determinant (2017 results)

Figure 1 contrasts the attitude of participants who had completed an environmental course with the attitude of those who had not. The *F*-test assessed the hypothesis that the attitudes are similar, regardless of whether participants had completed environmental courses or not. The *F*-statistic ($F_{1,1085} = 8.9, p < 0.01$) indicates that this was not the case, and the hypothesis could be rejected.³⁵

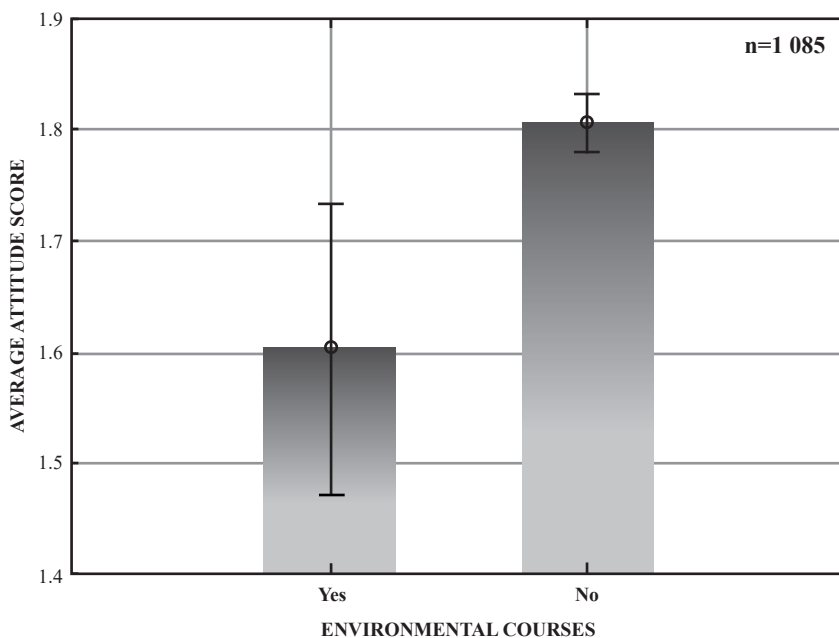


Figure 1: Average attitude score on completion of environmental courses

(Adapted from Smit, 2017)³⁶

A mean attitude score of 1.6 for participants who had completed an environmental course and a mean score of 1.8 for those who had not, underscored the statistically significant difference that exists, namely participants who had completed an environmental course have a better environmental attitude than those who had not. This is noteworthy because it confirms that military environmental courses do improve

the attitude of members and that DoD management could further improve the MEA of soldiers through the existing programme. Given that less than 4% of participants had attended an environmental course, the result is exceptional and points to an urgent need to enhance access to these courses.

MEA according to the environmental course determinant (2018 results)

In the test–retest survey of 2018, the MEA results for both the survey conducted prior to the course and after the course, registered a result of 1.5. This indicates that there was no difference in the MEA of participants prior to taking the course and after completing the course. Although this does not correspond to the 2017 results, what is important here is that a result of 1.5 is an extremely positive result, far better than any result in the 2017 survey. This indicates a group with an already very favourable attitude towards military environmental issues. To improve their attitude further will be extremely difficult, and not really necessary. This point can be elaborated further by analysing the research of Lang who found that incoming college students at Bloomsburg University of Pennsylvania chose majors that were consistent with their world-views.³⁷ This implies that people who choose to engage with environmental education, already have a favourable attitude towards environmental issues. In this regard, it is important to remember that the soldiers choose to attend this environmental course and are not nominated to do so.

Military environmental knowledge (MEK) in the SA Army

The knowledge component of EL reflects the cognitive strand of EL.³⁸ In the context of MEL, MEK refers to the ability to identify correctly environmental and management concepts and expected behaviour related to the military environment. Researchers employ two approaches to investigate environmental knowledge, namely subjective and objective knowledge.³⁹ Subjective knowledge is a participant's own estimation of knowledge about an issue – also known as 'perceived knowledge'. Objective or actual knowledge relates to real, measurable knowledge about an issue.⁴⁰ Regarding environmental knowledge, an 'issue' is some kind of environmental matter. The present survey tested objective knowledge levels to ascertain what participants really knew as opposed to what they thought they knew.

Studies of objective environmental knowledge performance conducted among various groups of adults in different countries have produced knowledge scores as low as 36% and as high as 83% (see Table 2). Generally, the higher knowledge scores are attained in developed countries, but there are exceptions. Educated target populations scored highest with an average of 60,2% for all the studies plotted in Table 2. From results, it appears that Malaysia is the most environmentally knowledgeable nation. The knowledge scores of soldiers were interpreted in the light of these results.

Interpreting these results, researchers used different scoring matrices to indicate qualitatively what constitutes good, average or bad environmental knowledge scores.⁴¹ Ehrampoush and Moghadam considered scores of ≤ 50% as 'bad', 50–84% as 'moderate' and > 85% as 'good'.⁴² Kaplowitz and Levine employed the American

National Environmental Education and Training Foundation (NEETF) score norm of $\geq 70\%$ as ‘adequate’ environmental knowledge and all else as ‘inadequate’^{43, 44}. To Karatekin, $\leq 40\%$ is ‘bad’, 41–70% is medium and $\geq 70\%$ is ‘good’ environmental knowledge.⁴⁵ Rating the applicability of these knowledge scales is not easy but it is noteworthy that Coyle describes the NEETF questionnaire as testing only “basic environmental knowledge”.⁴⁶ This may explain NEETF’s high 70% cut-off level for ‘adequate’ environmental knowledge, with participants failing the test if they score below this point. If the NEETF grading system were applied for all the studies reported in Table 2, only four universities, one group of schoolchildren and one group of adult participants would have passed the knowledge test.

Table 2: Average environmental knowledge scores from international studies

(Adapted from Smit, 2017)⁴⁷

KNOWLEDGE SCORE	GROUP	COUNTRY	SOURCE
55% 63% 69% 71%	Schoolchildren (aged 17–19)	Chile United States England Switzerland	Survey in four countries ⁴⁸
36% 39% 41% 42% 51% 54% 56% 60% 71% 72% 74% 76 %	Students	Mexico Israel USA Spain Brazil Turkey Jordan Finland Malaysia United States United States Singapore	49 50 Survey in three countries ⁵¹ 52 53 54 Survey in two countries ⁵⁵ 56 57
58% 58% 74%	Adults	USA Ohio, USA Malaysia	58 59 60
83%	Teachers	Malaysia	61
Mean: 60,2%			

Given this terminological confusion, a scale was developed to accommodate the advanced military environmental concepts involved in the study of MEL. A measure that combines the rating scales of Ehrampoush and Moghadam⁶² and Karatekin⁶³ was developed with scores of $\leq 40\%$ interpreted as ‘below standard’, 41–60% as ‘adequate’, 61–79% as ‘good’ and $\geq 80\%$ as ‘excellent’ MEK.⁶⁴

In the knowledge scale of the MEL questionnaire, 14 multiple-choice items assess the MEK of participants. Combined or average results for the knowledge scale representing the objective MEK of participants⁶⁵ and graphically displayed in histograms⁶⁶ form the cornerstone for analytical discussions in this section.

MEK according to the environmental course determinant (2017 results)

The annual military environmental course presented to a small group of soldiers targets military-integrated environmental management and provides contextualised military environmental education and training.⁶⁷ The assumption reported on in this subsection is that having completed such courses, the soldiers' environmental knowledge had improved. This would be consistent with a study by Culen and Mony, which found that youths exposed to environmental education activities scored higher on environmental knowledge scales, compared to those without exposure to such activities.⁶⁸

Figure 2: contrasts the knowledge of participants who had completed an environmental course with those who had not. The *F*-test assessed the hypothesis that their knowledge was similar, regardless of whether participants had completed environmental courses or not.

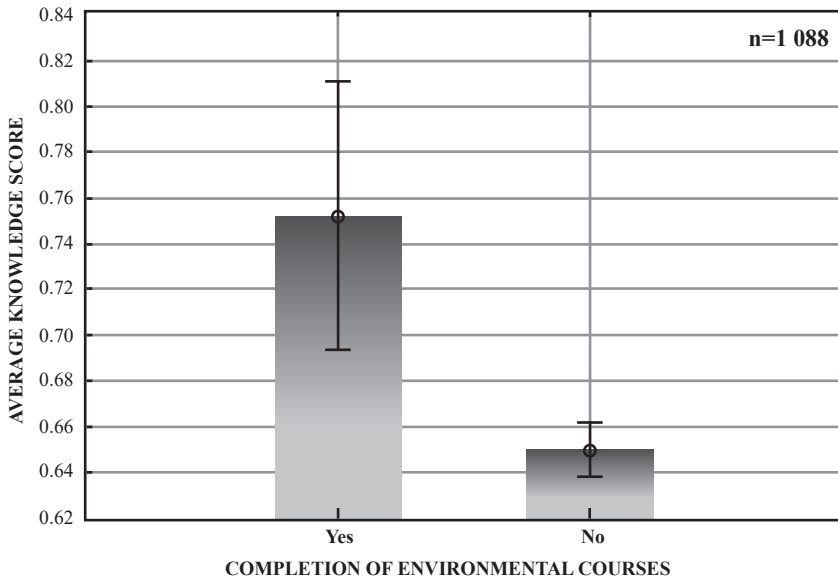


Figure 2 Average environmental knowledge score on completion of environmental courses

(Adapted from Smit, 2017)⁶⁹

The F -statistic ($F_{1,1088} = 11.3, p < 0.01$) shows that this was not the case and that the hypothesis could be rejected. A mean knowledge score of 75% for participants who had completed an environmental course and a mean score of 65% for those who had not underscore the statistically significant difference.⁷⁰

MEK according to the environmental course determinant (2018 results)

The test–retest results for the 2018 survey indicate an excellent 86% MEK among participants prior to attending the military environmental course. This increased slightly to 87% in the post-test. Although this is a similarly small increase to the results of the MEA, the initial knowledge level of 86% was remarkably high, making a substantial increase highly unlikely.

Because of the highly specific military content of the military environmental course, the course improved the MEK of participants to a greater extent than generic education would have done. In the 2017 survey, a 10% difference between participants who had completed the course and those who had not, was recorded. Although a similarly large increase was not achieved in the 2018 survey, the extremely high initial knowledge of the participants probably negated the possibility of a notable increase. This is a significant result, since it indicates a possible avenue for improving the MEK of SA Army soldiers.

Military environmental behaviour (MEB) in the SA Army

Environmental behaviour (EB) comprises the action component of EL, and the term ‘environmental action’ is sometimes used in the literature as a synonym for environmental behaviour.⁷¹ The behaviour scale of the MEL questionnaire used similar Likert-type response items as for the measurement of attitude; hence, the same statistical techniques were used here.

MEB according to the environmental course determinant (2017 results)

Karakaya, Avgin and Yilmaz conclude that focused environmental education programmes could positively influence EB.⁷² Figure 3 contrasts the self-reported behaviour of participants who had completed an environmental course with those who had not. The F -test assessed the hypothesis that behaviour was the same, regardless of attendance of environmental courses. The F -statistic ($F_{1,1088} = 2.6, p = 0.10$) supported

the hypothesis, and it could be accepted.⁷³

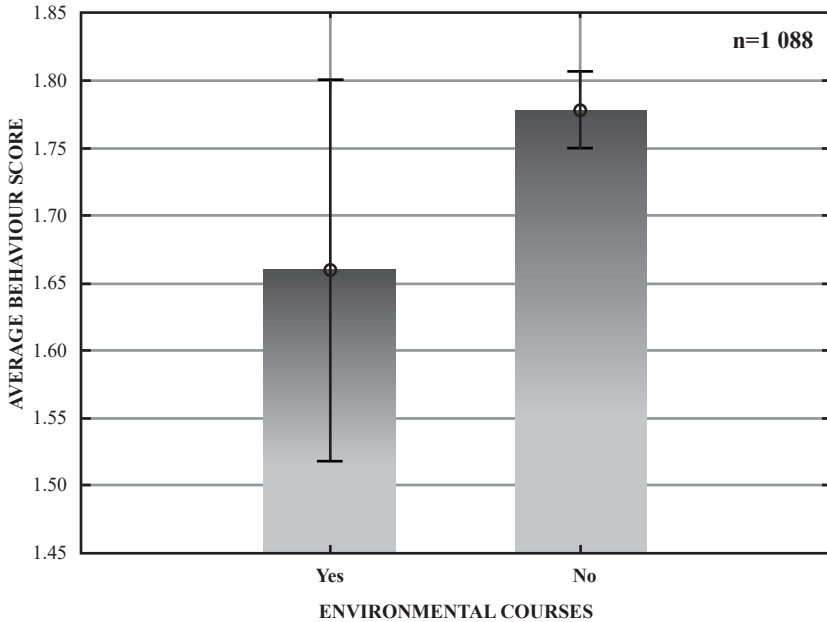


Figure 3: Average behaviour score on completion of environmental courses

(Adapted from Smit, 2017)⁷⁴

There was indeed no significant difference between the self-reported behaviour among participants who had completed environmental courses, and those who had not. The mean reported behaviour for participants who had completed an environmental course was 1.7, while those who had not completed such a course recorded a mean score of 1.8 on the five-point Likert-type scale. The small difference between the two groups was not statistically significant.

This result differed from the findings about MEA and MEK, namely that the positive attitude and better knowledge gained from military environmental education and training had not translate into positive EB. Kollmuss and Agyeman allege that environmentally conscious environmental attitudes have a limited effect on pro-EB.⁷⁵ This view is shared by Gifford who identified 30 psychological barriers to behaviour change.⁷⁶ Gifford and Nilsson concur and report 18 personal and social factors mediating and moderating conscious environmental behaviour.⁷⁷ To complicate matters further, Klineberg, McKeever and Rothenbach suggest that the use of different components of environmental behaviour to measure EB influences results.⁷⁸

To conclude, environmentally conscious behaviour is a complex construct influenced

in different ways by an array of context-specific independent variables, making the capture of its educational and other behavioural determinants exceedingly difficult.

MEB according to the environmental course determinant (2018 results)

Participants in the 2018 survey scored an average of 2.0 on the Likert-type scale for MEB during the pre-test. After the intervention, a marked improvement to an average score of 1.6 was recorded. This is an interesting result, which indicated that, although participants had a positive attitude towards and good knowledge of military environmental issues prior to completing the course, they did not display a high level of pro-environmental behaviour in the military environment. This is corroborated by the work of Gifford⁷⁹ and Gifford and Nilsson.⁸⁰

The statistically significant improvement of MEB recorded in the 2018 survey indicates the importance of a focused military environmental course in bringing about meaningful change in the EB of soldiers. The 2017 survey did not record a statistically significant increase in MEB, something also encountered by other scholars of EL.

Determinants of MEA, MEK and MEB had been investigated and were discussed in the previous sections. Attention now shifts to MEL, the construct derived from a combination of these three components of MEL.

Composite military environmental literacy

A **single, composite EL score** can be calculated, although this is not common practice,⁸¹ because the scientific basis for doing so is still being developed.⁸² The usefulness of a composite EL score is, however, to be found in its practical application (for instance to compare similar EL studies or repeat surveys of the same population). McBeth et al. calculated a composite EL score based on results from the National Environmental Literacy Project as a baseline for middle-grade learners in the United States.⁸³ McBeth et al.⁸⁴ also developed a scoring system for composite EL results in which they contend that scores below 40% indicate a low level of EL, between 40% and 70% a moderate level, and above 70%, a high level of EL. McBeth and Volk reported a moderate level of EL for both Grade 6 and Grade 8 participants,⁸⁵ and in a follow-up study, McBeth et al. investigated the influence of a dedicated environmental programme on the EL of Grade 6 and 8 participants and compared it to the 2008 results.⁸⁶ Although the results showed an improvement in the participants enrolled in the environmental programme, the composite EL results remained moderate for both grades. Karatekin used a five-part environmental literacy questionnaire and the same scoring system⁸⁷ as McBeth et al. to test EL levels of pre-service teachers in Turkey and also found a moderate level of EL.⁸⁸

To meet the stated objective of the MEL study to provide a baseline for future studies, a composite MEL score was calculated using the method developed in 2008 by McBeth et al.⁸⁹ The questionnaire developed for the MEL study purposely balanced the measurement of the attitude, behaviour and knowledge scales that ranged from 13 to 15 items each, negating the necessity of transforming the scores. However, two of

the scales (attitude and behaviour) used Likert-type questions, while environmental knowledge was scored as a percentage. To calculate a composite MEL score, the Likert-type scores were converted to percentages using the formula: percentage = (Likert-type score minus 1)/4 x 100. The converted Likert-type scores ranged between 0% (value 1) and 100% (value 5). The composite MEL scores were calculated as an average of the three subscales, with the attitude and behaviour scores reversed, where MEL = (100 minus attitude score) + (100 minus behaviour score) + knowledge)/3. These composite MEL scores can be used in comparative studies.

MEL according to the environmental course determinant (2017 results)

Smit et al., Karatekin et al. as well as Karakaya et al. all found a positive correlation between environmental education and training and EL.⁹⁰ In all three studies exposure to environmental education and training opportunities led to better EL. The military environmental course, presented each year to a small group of soldiers, focuses attention on military-integrated environmental management and provides contextualised military environmental education and training.⁹¹ Only 4% of the participants in the 2017 survey had completed a military environmental course and their results for both attitude and knowledge were better than those who had not completed such a course. The good knowledge and favourable attitude apparently did not make any difference to the behaviour of the participants in the 2017 survey as no significant difference was found between the two groups for the behaviour scale.⁹²

The composite MEL results (yes 81%; no 75%) point to a significant difference in MEL between the two groups with soldiers who had completed the military environmental course outscoring those who had not (see Table 3).⁹³

Table 3: Attitude, behaviour, knowledge and MEL for the 2017 survey⁹⁴

	Attitude	Behaviour	Knowledge	MEL
No military environmental course completed	1.8	1.8	65	75
Completed military environmental course	1.6	1.7	75	81

Of note in this regard is that the MEL of soldiers comprised the construct tested by the MEL questionnaire, and therefore represented the most important result from the surveys. MEA, MEK and MEK are only components of this construct and form the substructure of MEL.

MEL according to the environmental course determinant (2018 results)

In the 2018 survey, a marked improvement in MEL was observed. The pre-test result of 83% was well above the 75% recorded by participants who had not completed the military environmental course according to the 2017 survey (see Table 4). The improvement to 87% correlated well with the improvement recorded in the 2017 survey.

Table 4: Attitude, behaviour, knowledge and MEL scores before and after the military environmental course

	Attitude	Behaviour	Knowledge	MEL
Before	1.5	2.0	86.1	83
After	1.5	1.6	87.1	87

Conclusion

The two independent surveys – conducted at different scales, temporally removed from each other, and using different methodologies – rendered similar results. According to the results, a focused, dedicated MEM course could significantly improve the MEL of soldiers, something general education cannot accomplish. These results resonate well with examples from literature.

Given the potential negative impact of military activities on the environment, as well as the known complexities of the factors influencing environmentally conscious behaviour, it is imperative that soldiers be regularly exposed to structured education and training programmes aimed at enhancing MEL.

The present five-week course should be made available to more soldiers, possibly by presenting it bi-annually. It should also be considered dividing the course into smaller components that can be presented to soldiers at different junctures in their career path. Early intervention is especially valuable so that soldiers at the lowest levels can realise the impact of their activities on the military environment. In the final instance, the importance of sound MEL should be brought to the attention of the senior management of the South African National Defence Force (SANDF). Since the SANDF is a command-driven organisation, the agreement and approval of the most senior officers is non-negotiable to enhance the good MEL of the SA Army.

As the importance of having environmentally literate soldiers is incontestable, it is imperative that soldiers be exposed to such interventions to ensure good MEL. The good news is that an SA military environmental course of this nature exists and the positive influence of this course on the MEL of SA soldiers is proved by this research. The bad news is that only about 4% of SA soldiers are exposed to this intervention. This is a situation that calls for rectification if the MEL of soldiers is important – and it is.

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ENDNOTES

- ¹ DE Mosher, BE Lachman, MD Greenberg, T Nichols, B Rosen & HH Willis. *Green warriors: Army environmental considerations for contingency operations from planning through post-conflict*. Santa Monica, CA: Rand Corporation, 2008, 3.
- ² D Jensen & S Halle (eds). *United Nations Environment Programme report. Greening the blue helmets: Environment, natural resources and UN peacekeeping operations*. Nairobi: United Nations Environment Programme, 2012.
- ³ Mosher *et al. op. cit.*
- ⁴ E Bonds. "Legitimizing the environmental injustices of war: Toxic exposures and media silence in Iraq and Afghanistan". *Environmental Politics* 25/3. 2015. 395–413.
- ⁵ AJ Rubin. "Afghan protests over the burning of Korans at a US base escalate". *The New York Times*. 22 February 2012. A5.
- ⁶ CE Roth. *Environmental literacy: Its roots, evolution, and directions in the 1990s*. Columbus, OH: ERIC/CSM Environmental Education, 1992.
- ⁷ A Walsh-Daneshmandi & M MacLachlan. "Towards effective evaluation of environmental education: Validity of the Children's Environmental Attitudes and Knowledge Scale using data from a sample of Irish adolescents". *The Journal of Environmental Education* 37/2. 2006. 13–23; H Chu, EA Lee, HR Ko, DH Shin, MN Lee, BM Min & KH Kang. "Korean Year 3 children's environmental literacy: A prerequisite for a Korean environmental education curriculum". *International Journal of Science Education* 29/6. 2007. 731–746; S Pe'er, D Goldman & D Yavetz. "Environmental literacy in teacher training: Attitudes, knowledge, and environmental behaviour of beginning students". *The Journal of Environmental Education* 39/1. 2007. 45–59.
- ⁸ Roth *op. cit.*
- ⁹ A Esterhuysen. "Institutional culture: The South African military and its search for organisational stability". In Vreÿ F, Esterhuysen A & Mandrup T (eds). *On military culture*. Claremont: UCT Press, 2013.
- ¹⁰ KB Godschalk. "Green soldiering: Integrated environmental management as a major contribution towards military mission achievement". Paper delivered at the 14th International Logistics Congress, Sun City, 1998.
- ¹¹ TL Milfont & J Duckitt. "The environmental attitudes inventory: A valid and reliable measure to assess the structure of environmental attitudes". *Journal of Environmental Psychology* 30. 2010. 80–94.
- ¹² HAP Smit. "Military environmental literacy in the South African Army". Unpublished PhD dissertation. Stellenbosch University, 2017. 4.
- ¹³ Y Chao. "Predicting people's environmental behaviour: Theory of planned behaviour and model of responsible environmental behaviour". *Environmental Education Research* 18/4. 2012. 437–461.
- ¹⁴ A Kollmuss & J Agyeman. "Mind the gap: Why do people act environmentally and what are the barriers to pro-environmental behaviour?" *Environmental Education Research* 8/3. 2002. 239–260.

- ¹⁵ S Bamberg & G Möser. “Twenty years after Hines, Hungerford, and Tomera: A new meta-analysis of psycho-social determinants of pro-environmental behaviour”. *Journal of Environmental Psychology* 27. 2007. 14–25.
- ¹⁶ Smit, “Military environmental literacy ...” *op. cit.*, p. 5.
- ¹⁷ R Gifford & A Nilsson. “Personal and social factors that influence pro-environmental concern and behaviour: A review”. *International Journal of Psychology* 49/3. 2014. 141–157.
- ¹⁸ EA Jenner, BC Fletcher, P Watson, FA Jones, L Miller & GM Scott. “Discrepancy between self-reported and observed hand hygiene behaviour in healthcare professionals”. *Journal of Hospital Infection* 63. 2006. 418–422; DCR Chen, ME Pahilan & JD Orlander. “Comparing a self-administered measure of empathy with observed behaviour among medical students”. *Journal of General Internal Medicine* 25/3. 2009. 200–202; SJ Dobbinson, K Jamsen, HG Dixon, MJ Spittal, M Lagerlund, JE Lipscomb, NL Herd, MA Wakefield & DJ Hill. “Assessing population-wide behaviour change: Concordance of 10-year trends in self-reported and observed sun protection”. *International Journal of Public Health* 59/1. 2014.157–166.
- ¹⁹ AH Huffman, BR van der Werff, JB Henning & K Watrous-Rodriguez. When do recycling attitudes predict recycling? An investigation of self-reported versus observed behavior. *Journal of Environmental Psychology* 38. 2014. 262–270.
- ²⁰ Dobbinson *et al. op. cit.*
- ²¹ TH Dodd, DA Laverie, JF Wilcox & DF Duhan. “Differential effects of experience, subjective knowledge, and objective knowledge on sources of information used in consumer wine purchasing”. *Journal of Hospitality and Tourism Research* 29/1. 2005. 3–19.
- ²² Smit, “Military environmental literacy ...” *op. cit.*, p. 5.
- ²³ *Ibid.*, p. 5.
- ²⁴ *Ibid.*, p. 94.
- ²⁵ *Ibid.*
- ²⁶ L Laubscher. “The annual military environmental management course”. Personal communication, 12 November 2018. Email: lappies.laubscher@gmail.com.
- ²⁷ HAP Smit. “Shaping the environmental attitude of Military Geography students at the South African Military Academy”. *Journal of Geography in Higher Education* 33/2. 2009. 225–240; K Karatekin. “Comparison of environmental literacy levels of pre-service teachers”. *International Journal of Academic Research* 5/2. 2013. 5–14; R Sarikaya & E Saraç. “An analysis of pre-service teachers’ attitudes towards environmental issues in terms of various variables”. *Universal Journal of Educational Research* 6/1. 2018. 99–109.
- ²⁸ FE Olu-Ajayi. “The effect of mentoring on secondary schools science students’ attitude towards environmental practices in urban location”. *PEOPLE: International Journal of Social Sciences* 4/3. 2019. 1730–1740.
- ²⁹ C Bless, C Higson-Smith & SL Sithole. *Fundamentals of social research methods: An African perspective*. Cape Town: Juta, 2013.

- ³⁰ M Özden. “Environmental awareness and attitudes of student teachers: An empirical research”. *International Research in Geographical and Environmental Education* 17/1. 2008. 40–55; C Xiao, RE Dunlap & D Hong. “The nature and bases of environmental concern among Chinese citizens”. *Social Science Quarterly* 94/3. 2013. 672–690; SJ Conroy & TLN Emerson. “A tale of trade-offs: The impact of macroeconomic factors on environmental concern”. *Journal of Environmental Management* 145. 2014. 88–93.
- ³¹ Smit, “Military environmental literacy ...” *op. cit.*
- ³² HAP Smit & JH van der Merwe. “Military environmental literacy in the South African Army”. *Scientia Militaria* 46/1. 2018. 59–77.
- ³³ DS Levine & MJ Strube. “Environmental attitudes, knowledge, intentions and behaviours among college students”. *The Journal of Social Psychology* 152/3. 2012. 308–326; CJ Wigley. “Dispelling three myths about Likert scales in communication trait research”. *Communication Research Reports* 30/4. 2013. 366–372.
- ³⁴ S McKillup. *Statistics explained: An introductory guide for life scientists*. 2nd ed. New York, NY: Cambridge University Press, 2012.
- ³⁵ Smit, “Military environmental literacy ...” *op. cit.*
- ³⁶ *Ibid.* 144.
- ³⁷ KB Lang. “The relationship between academic major and environmentalism among college students: Is it mediated by the effects of gender, political ideology and financial security?” *The Journal of Environmental Education* 42/4. 2011. 203–215.
- ³⁸ Pe’er *et al.* *op. cit.*
- ³⁹ N Berber, C Taylor & S Strick. “Wine consumers’ environmental knowledge and attitudes: Influence on willingness to purchase”. *International Journal of Wine Research* 1. 2009. 59–72.
- ⁴⁰ Dodd *et al.* *op. cit.*
- ⁴¹ These scholars quantify categories and ranges of scores into discrete normative categories of ‘good’, ‘average’ and ‘bad’.
- ⁴² MH Ehrampoush & MHB Moghadam. “Survey of knowledge, attitude and practice of Yazd University of Medical Sciences students about solid wastes disposal and recycling”. *Iranian Journal of Environmental Health, Science and Engineering* 2/2. 2005. 26–30.
- ⁴³ Kaplowitz & Levine *op. cit.*
- ⁴⁴ K Coyle. *Environmental literacy in America: What ten years of NEETF/Roper research and related studies say about environmental literacy in the US*. Washington, DC: The National Environmental Education and Training Foundation, 2005, p. 2.
- ⁴⁵ Karatekin *op. cit.*
- ⁴⁶ Coyle *op. cit.*
- ⁴⁷ Smit, “Military environmental literacy ...” *op. cit.*, p. 165.
- ⁴⁸ L de Chano. “A multi-country examination of the relationship between environmental knowledge and attitudes”. *International Research in Geographical and Environmental Education* 15. 2006. 15–28.
- ⁴⁹ Pe’er *et al.* *op. cit.*

- ⁵⁰ HI Al-Dajeh. "Assessing environmental literacy of pre-vocational education teachers in Jordan". *College Student Journal* 46/3. 2012. 492–507.
- ⁵¹ MA Vicente-Molina, A Fernández-Sáinz & J Izagirre-Olaizola. "Environmental knowledge and other variables affecting pro-environmental behaviour: Comparison of university students from emerging and advanced countries". *Journal of Cleaner Production* 61. 2013. 130–138.
- ⁵² PM Tikka, M Kuitunen & SM Tynys. "Effects of educational background on students' attitudes, activity levels, and knowledge concerning the environment". *The Journal of Environmental Education* 31/3. 2000. 12–19.
- ⁵³ Karatekin *op. cit.*
- ⁵⁴ TG Ivy, KS Road, CK Lee & GK Chuan. "A survey of environmental knowledge, attitudes and behaviour of students in Singapore". *International Research in Geographical and Environmental Education* 7/3.1998. 181–202.
- ⁵⁵ N Esa. "Environmental knowledge, attitude and practices of student teachers". *International Research in Geographical and Environmental Education* 19/1. 2010. 39–50.
- ⁵⁶ DS Levine & MJ Strube. "Environmental attitudes, knowledge, intentions and behaviours among college students". *The Journal of Social Psychology* 152/3. 2012. 308–326.
- ⁵⁷ MD Kaplowitz & R Levine. "How environmental knowledge measures up at a Big Ten university". *Environmental Education Research* 11/2. 2005. 143–160.
- ⁵⁸ Karatekin *op. cit.*
- ⁵⁹ M Morrone, K Mancl & K Carr. "Development of a metric to test group differences in ecological knowledge as one component of environmental literacy". *The Journal of Environmental Education* 32/4. 2001. 33–42.
- ⁶⁰ SA Haron, L Paim & N Yahaya. "Towards sustainable consumption: An examination of environmental knowledge among Malaysians". *International Journal of Consumer Studies* 29/5. 2005. 426–436.
- ⁶¹ AM Said, F Ahmadun, LH Paim & J Masud. "Environmental concerns, knowledge and practices gap among Malaysian teachers". *International Journal of Sustainability in Higher Education* 4/4. 2003. 305–313.
- ⁶² Ehrampoush & Moghadam *op. cit.*
- ⁶³ Karatekin *op. cit.*
- ⁶⁴ *Ibid.*
- ⁶⁵ *Ibid.*; Vicente-Molina *et al. op. cit.*
- ⁶⁶ McKillup *op. cit.*
- ⁶⁷ Laubscher *op. cit.*
- ⁶⁸ Culen & Mony *op. cit.*
- ⁶⁹ Smit, "Military environmental literacy ..." *op. cit.*, p. 172.
- ⁷⁰ *Ibid.*
- ⁷¹ S Zecha. "Environmental knowledge, attitudes and actions of Bavarian (southern Germany) and Asturian (northern Spain) adolescents". *International Research in Geographical and Environmental Education* 19/3. 2010. 227–240.
- ⁷² F Karakaya, SS Avgin & M Yilmaz. "Environmental literacy dimensions of pre-service teachers". *Üniversitepark Bülten*, 6/1. 2017. 95–108.
- ⁷³ Smit, "Military environmental literacy ..." *op. cit.*

- ⁷⁴ *Ibid.*, p. 158.
- ⁷⁵ Kollmuss & Agyeman *op. cit.*
- ⁷⁶ R Gifford. “The dragons of inaction: Psychological barriers that limit climate change mitigation and adaptation”. *American Psychologist* 66/4. 2011. 290–302.
- ⁷⁷ Gifford & Nilsson *op. cit.*
- ⁷⁸ SL Klineberg, M McKeever & B Rothenbach. “Demographic predictors of environmental concern: It does make a difference how it’s measured”. *Social Science Quarterly* 79/4. 1998. 734–753.
- ⁷⁹ Gifford *op. cit.*
- ⁸⁰ Gifford & Nilsson *op. cit.*
- ⁸¹ W McBeth. “Environmental literacy scores”. Personal communication, 1 February 2016. Email: mcbeth@uwplatt.edu.
- ⁸² T Marcinkowski. “Calculation of environmental literacy scores”. Personal communication, 16 February 2016. Email: marcinko@fit.edu.
- ⁸³ W McBeth, H Hungerford, T Marcinkowski, T Volk & R Meyers. “National Environmental Literacy Assessment Project, Year 1: National baseline study of middle grades students. Final research report”. 2008. <http://www.oesd.noaa.gov/NAEE_Report/Final_NELA%20minus%20MSELS_8-12-08.pdf> Accessed on 1 March 2014.
- ⁸⁴ *Ibid.*
- ⁸⁵ W McBeth & TL Volk. “The National Environmental Literacy Project: A baseline study of middle grade students in the United States”. *The Journal of Environmental Education* 41/1. 2010. 55–67.
- ⁸⁶ W McBeth, H Hungerford, T Marcinkowski, T Volk & K Cifranick. “National Environmental Literacy Assessment, Phase Two: Measuring the effectiveness of North American environmental education programs with respect to the parameters of environmental literacy. Final research report”. <http://www.oesd.noaa.gov/NAEE_Report/Final_NELA%20minus%20MSELS_7-02-11.pdf> Accessed on 1 March 2014.
- ⁸⁷ Karatekin *op. cit.*
- ⁸⁸ McBeth *et al.*, “National Environmental Literacy Assessment, Phase Two ...” *op. cit.*
- ⁸⁹ McBeth *et al.*, “National Environmental Literacy Assessment Project, Year 1 ...” *op. cit.*
- ⁹⁰ Smit *op. cit.*; Karatekin *op. cit.*; Karakaya *et al. op. cit.*
- ⁹¹ Laubscher *op. cit.*
- ⁹² Smit, “Military environmental literacy ...” *op. cit.*, p. 165.
- ⁹³ *Ibid.*, p. 165.
- ⁹⁴ *Ibid.*