

Evaluating the Australian Defense Force Environmental Awareness Training at Shoalwater Bay Training Area, Queensland, Australia

W. Wu, X. H. Wang, and D. Paull

Abstract—This paper contributes to the field of Environmental Awareness Training (EAT) evaluation in terms of military activities. Environmental management of military activities is a growing concern for defence forces worldwide and the importance of EAT is becoming widely recognized. As one of Australia's largest landowners, the Australian Defence Force (ADF) is extremely mindful of its duty as a joint environmental manager. It has an integrated Environmental Management System (EMS) to assist environmental management and EAT is an essential part of the ADF EMS model. This paper examines how EAT was conducted during the exercise Talisman Saber in 2009 (TS09) and evaluates its effectiveness, using Shoalwater Bay Training Area (SWBTA), one of the most significant military training areas and a significant protected area in Australia, as a case study. A questionnaire survey conducted showed, overall, that EAT was effective from the perspective of a sample of participants. Recommendations are made for the ADF to refine EAT for future exercises.

Keywords—Australian Defence Force, effectiveness evaluation, Environmental Awareness Training, Shoalwater Bay Training Area

I. INTRODUCTION

AWARENESS building and training are amongst the most important aspects of effective management and sustainable development of an organization, whether it be at international, national or sectoral levels, and their benefits have been described extensively [1]-[4]. Numerous studies have discussed awareness training issues in a variety of fields, such as business, environmental management, engineering, education and tourism [5]-[8]. The majority are related to the necessity of awareness building and training, people's attitude to awareness training, and contents and procedures of training. The concept of environmental training and education originated from the "1972 United Nations Stockholm Conference on the Human Environment" [3]. As a significant outcome of the United Nations Conference on Environment and Development (i.e., The Earth Summit) held in Rio de Janeiro in 1992, Agenda 21 used one chapter to highlight the importance of

environmental education [1], [3]. Environmental Awareness Training (EAT) and education are essential components of the whole environmental education system. Reference [9] reviewed implementation issues surrounding EAT and emphasized the importance of evaluation for examining training effects and benefits.

Previous studies that have evaluated awareness training have generally used methods such as interviews, questionnaire surveys, and case studies. Many aspects of awareness training have been evaluated, including: the assessment of people's knowledge and values; their behaviour; analyses of costs versus benefit; the examination mechanism; and, the collection of awareness training feedback. The evaluations found not only positive effects (e.g., [2], [5], [7], [10]) but also negative effects of awareness training (e.g., [9]). Pre-test and post-test ideologies have been applied in research designs in order to facilitate the analysis of change to effect-related elements before and after the awareness training [1], [5], [7], [9].

Kirkpatrick's Four-Level model (i.e., reaction, learning, behavior, results) is considered to be the most widely accepted approach for training evaluation [11]. In fact, this method has been directly adopted (e.g., [2], [9]) or indirectly involved in many of the studies mentioned previously. In addition, a practical method called the Planning/Process/Product (PPP) evaluation model was adopted by [5] to assess the overall effectiveness of an environmental awareness education programme for nature conservation. The continuous evaluation method has proved to be an effective tool in this regard. Similarly, a fixed effects model based on continuous time series data collection has the capacity to evaluate a training program on product quality [2].

Generally speaking, there is a paucity of published research about awareness training evaluation [2], [5], [9], especially evaluation for EAT of military activities. Environmental management of military activities is of significant concern to defence forces all over the world, especially in military training areas [12]-[15]. As one of the country's largest landowners, the Australian Defence Force (ADF) recognizes its vital role and responsibilities in sustainable environmental management while conducting military activities [16]-[18]. The present study examines how effective EAT was for a multinational military exercise, Talisman Saber in July 2009 (TS09) at Shoalwater Bay Training Area (SWBTA), Queensland, Australia.

SWBTA is one of the most significant military training areas in Australia [16], [19]. Covering 454,500 hectares, it straddles

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both marine and terrestrial ecosystems on the east coast of Queensland (Fig. 1). For more than 40 years, it has provided an exceptional venue for single, joint, and combined exercises [20]-[22]. Of importance, the maritime component of SWBTA includes parts of the Great Barrier Reef Marine Park (GBRMP) and the Great Barrier Reef World Heritage Area (GBRWHA) [22]. It is a complex region to protect due to its sensitive and interconnected marine and terrestrial ecosystems, diverse natural resources, and cultural significance [21], [23], [24].

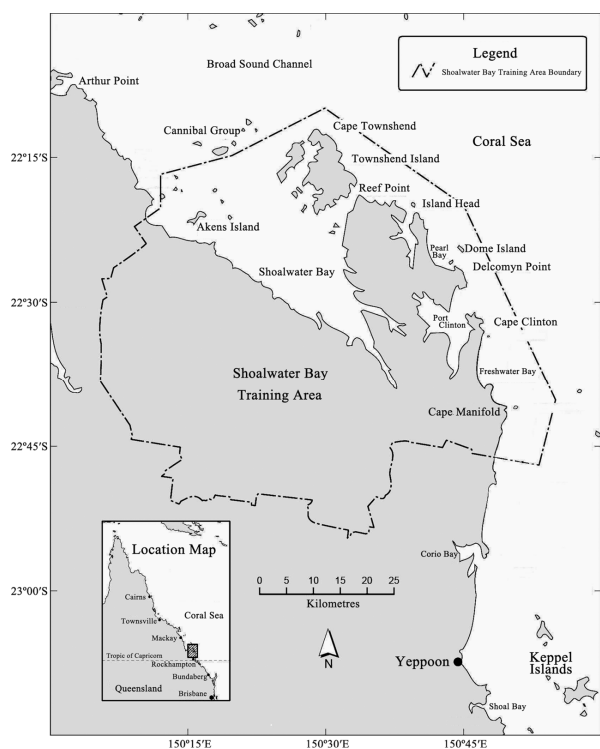


Fig. 1 Shoalwater Bay Training Area, Queensland, Australia (from [21], modified from:

http://www.gbrmpa.gov.au/_data/assets/pdf_file/0017/1952/defence.pdf

In order to effectively manage military activities and protect the environment, an integrated Environmental Management System (EMS), based on the International Organization for Standardization 14001 (ISO 14001), has been adopted by the ADF since 2001 [17], [22], [25]. In accordance with Clause 4.4.2 of the ISO 14001 requirements [26], EAT is an essential component of ADF EMS and belongs to the “Implementation to Achieve Objectives” module within the ADF EMS model (Fig. 2). Effective EAT is one of the key aspects for successful EMS implementation and environmental management [1], [9]. As for management of military activities in such a fragile environment as SWBTA, a number of executive guidelines and measures have been developed corresponding to the application of each ADF EMS module (Fig. 2). These environmental management activities have been discussed by [21] using TS as an example. Commencing in 2001 and jointly organized by Australia and the United States of America (USA), TS is one of the best known training exercises conducted every two years and SWBTA has become a central focus for the exercise [27]-[29]. This paper describes how EAT was conducted for

TS09 and evaluates its effectiveness through the combination of participant observation by Wu during TS09 and the administration of a questionnaire survey.

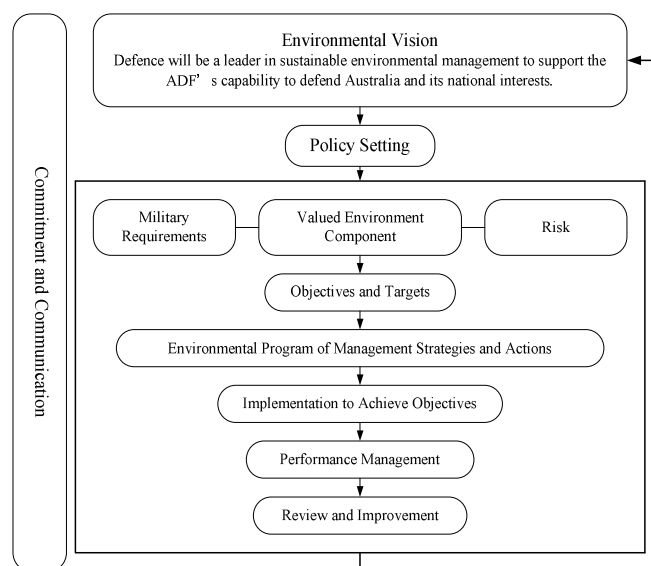


Fig.2 Australian Defence Force Environment Management System model (adapted from [21] and <http://www.defence.gov.au/environment/ems.htm>)

II. METHODS

In order to examine the effectiveness of the ADF EAT, a questionnaire survey was administered to a sample of exercise participants during TS09. Questionnaires were randomly distributed to various participating units within SWBTA and 64 responses were obtained. The questionnaire contained eight primary questions focused on ADF EAT issues relevant to SWBTA as follows:

- (1) Which defence force the respondents came from (DEFFOR);
- (2) The number of times respondents had participated in TS exercises (TIMES);
- (3) EAT contents respondents received (EATCON);
- (4) EAT methods (EATWAY);
- (5) Whether respondents' knowledge level of environmental issues was affected by EAT (KNWLEV);
- (6) Whether EAT helped respondents with environmental protection activities (HELPRO);
- (7) How respondents rated the overall effectiveness of EAT (EFFECT); and
- (8) Suggestions by respondents for future improvements to EAT (IMPRVE).

For the purpose of statistical analysis, responses to the eight primary questions were treated as variables, with each being encoded by an abbreviation corresponding to the questionnaire (Table I). Two types of variables were considered in this study, including nominal (i.e., DEFFOR, TIMES, elements of EATCON and EATWAY) and ordinal (i.e., elements of KNWLEV and HELPRO, and EFFECT), following the methods of [30]-[32].

Four elements were considered for EATCON and EATWAY respectively, namely, INDUCT, EI, SOP and SO for EATCON,

and PRESET, BRIEFS, DVDCAR and FACSHT for EATWAY. The EATCON and EATWAY related questions were multiple-choice, and to a certain extent reflected the popularity of environmental awareness knowledge being received and the EAT platform according to participants' responses. KNWLEV was assessed by seven elements, being LEGCOM, OBJTAR, POLSTR, EMP, IMPAWR, COVSTR, and EMSIMP. These elements were selected from the ISO 14001 standard requirements and the ADF EMS modules. The EAT significance and contents was also taken into consideration. HELPRO was analyzed from two aspects, i.e., role and responsibility clarification (ROLRES), and behavior regulation and personal performance improvement (BEHPER). EFFECT was divided into five scales in the questionnaire (i.e., Poor, Below average, Average, Very good, and Excellent).

Respondents' relevant knowledge level and EAT's positive impact on their behavioral performance were examined in the questionnaire because of their previously noted value in measuring training success (see [9]). The survey focused on self-assessment and judgment about participants' knowledge level changes, behavioral performance, and overall EAT effectiveness, rather than evaluating the concrete actions affected by EAT, because "people are more accurate at remembering past feelings than past actions" [9]. In the present study, it was considered that respondents' performance on the questionnaire would reflect the EAT effect, which was also suggested by [9].

The Statistical Package for the Social Sciences (SPSS), also known as Predictive Analytics SoftWare (PASW) GradPack 18 was used for data analysis. Descriptive statistics were used to report the survey results for each question. Relevant statistical methods were adopted according to the questionnaire design and variable scaling pattern, which have been used in numerous relevant studies (e.g., [33]-[36]). Cross tabulation and Chi-square test were performed to examine the associations between frequency distributions among variables. Two kinds of Chi-square test statistics were adopted according to different cross tabulations. For example, Fisher's Exact Test was computed if tables with two rows and two columns (i.e., 2x2 tables) had cell(s) with expected value(s) less than five. Chi-square tests for other kinds of cross tabulations were expressed by Pearson Chi-square values [37], [38]. A few categories of variables were combined to facilitate Chi-square tests, including "USDF and Other" of DEFFOR, "Twice and 3+" of TIMES, "Helpful and Very Helpful" of HELRPO, and "Poor, Below Average and Average" and "Very Good and Excellent" of EFFECT. In addition, nonparametric correlation analysis was used to test the relationship between variables with ordinal values, using Spearman's rho (ρ) as the correlation coefficient.

TABLE I
 VARIABLES AND THEIR DESCRIPTIONS

Variable	Description
(1) DEFFOR	Defence force respondents came from
(2) TIMES	Times participated in Talisman Saber exercises
(3) EATCON	Contents of environmental awareness training received
Nil	Respondents had not participated in environmental awareness training and education prior to the exercise
EATCON	Environmental induction training
INDUCT	Environmental Instructions
EI	Military Standard Operating Procedures
SOP	Standing Orders
SO	Environmental awareness training methods
(4) EATWAY	Environmental awareness presentation (e.g., slide demonstration)
PRESET	Unit and group briefings
BRIEFS	DVD and awareness cards
DVDCAR	Environmental fact sheets
FACSHT	Knowledge level affected by environmental awareness training
(5) KNWLEV	Legislative compliance
LEGCOM	Defence environmental leadership commitments, objectives and targets
OBJTAR	Environmental policies and strategies
POLSTR	Environmental Management Plans
EMP	Awareness of environmental impacts of military activities
IMPAWR	Environmental controlling instruments (e.g., EI, Standing Orders)
CONSTR	Environmental Management System implementation processes
EMSIMP	Helpfulness of environmental awareness training to participants' involvement in environmental protection activities
(6) HELPRO	Clarify role and responsibility
ROLRES	Regulate behavior, improve personal performance
BEHPER	Overall effectiveness of environmental awareness training conducted by the ADF
(7) EFFECT	Future improvements of the ADF environmental awareness training
(8) IMPRVE	More environmental training specialists
MORSPE	Training content extension
CONEXT	Trainee examination mechanism
EXAMEC	Training efficiency
EFFNCY	

It should be noted that 'Valid Percent' [39] was accepted while doing statistical analyses (e.g., charts for descriptive statistics), which meant a denominator was calculated based on excluding missing values (no response) among the total 64 sample set. In addition, participant observation in terms of EAT was used as a tool to complement the statistical analyses, as suggested by [9]. During TS09, Wu was given approval by the ADF to participate in pre and post exercise environmental monitoring and checks and worked with the Environmental Management Group (EMG) [21] to observe how they conducted environmental management. As observed for a three-day period, the EMG members were divided into different field teams to conduct routine environmental

monitoring and inspection (e.g., fuelling operation, waste discharge, vegetation, fire, security facilities, and coastal zones). The inspection points extended to various areas of SWBTA. With the help of Personal Digital Assistant (PDA), EMG members could take photos and record information for environmental monitoring and data collection. A feedback meeting was held every day to debrief monitoring processes, environmental status and problems, and discuss responding measures. Data collected from PDA were transferred to Geographic Information System (GIS) (i.e., ArcView), including photos and information regarding environmental status and problems. EMG members were required to monitor problems regularly until they were solved. The small group Wu worked with consisted of one environmental personnel from the ADF and one from the USDF, and they were responsible for the monitoring of military operations in a land region of SWBTA (e.g., security facilities, fuelling procedures). Consequently, relevant information obtained from field participation could be integrated into the analysis and explanation of statistical results to assist in EAT evaluation.

III. RESULTS AND DISCUSSION

A. Background Information

1. Defence Forces (DEFFOR) and The Talisman Saber Experience (TIMES)

Descriptive statistics showed that 37 (57.8%) of the respondents came from the ADF, 22 (34.4%) were from the United States Defence Force (USDF) and five (7.8%) from other organizations including three from the Queensland Police Service, who worked collaboratively with the community and provided operational assistance for security issues during TS09. The majority of respondents (n=45, 70.3%) participated in TS for the first time, 14 (21.9%) for the second time, and five (7.8%) for the third or more times. The large number of new TS participants reinforced the importance of conducting EAT.

The association between DEFFOR and TIMES was significant ($\chi^2 = 11.106$, $df = 1$, $p < 0.05$). There was a similar count of "Once" (n=20, 54.1%) and "Twice and 3+" (n=17, 45.9%) for the ADF participants. Not surprisingly, new participants are required to accumulate practical experiences through military exercises. As TS is conducted on the Australian land, it is more convenient to assemble troops with TS experiences. They are familiar with relevant situation of this exercise and can pass on their knowledge and experience to new participants. The combination of experienced and new participants is also beneficial for collaboration with the USDF and TS objective achievement [40]. All five participants with the TS experiences of three or more times were from the Australian side. They might be military commanders and/or environmental personnel with long-term responsibility for this exercise.

Almost all respondents from the USDF and Other (92.6%) participated in TS for the first time, including all investigated persons from other organizations, and the remainders (7.4%) were from the USDF. The USDF have numerous personnel participating in diverse exercises at national and international

levels to improve their combat capability [41]. It might be difficult for them to assemble the same personnel for the same exercise every two years. Probably the minority with TS experiences of more than once were commanders and/or coordinators having stable cooperation with the ADF in terms of TS. For example, as known from Wu's participant observation, a USDF environmental officer of the TS09 EMG group had participated in TS for the second time. And this was considered as an advantage in coordinating with the ADF and facilitating environmental management during TS. For participants from other organizations (Other), because they only provided other relevant assistance such as security and/or communication, it was clearly not obligatory to specify particular person for every TS exercise.

2. Environmental Awareness Training (EATCON and EATWAY)

When asked whether they had received EAT for TS09, the majority of respondents answered "Yes" (n=58, 90.6%). Amongst six individuals (9.4%) who responded "No", were four from neither the ADF nor the USDF, with three belonging to the Queensland Police Service and one without identification. The remaining two were ADF personnel who had participated in TS more than three times. According to TS public environmental reports, every participant is required to receive compulsory EAT before the exercise [29], [40], [42]. It is therefore not clear why there were negative responses to this question. As a result, a total of 58 valid samples were available for the following analysis.

More than 50% of respondents had received INDUCT (63.8%) and SOP (58.6%) training, with SO (41.4%) and EI (34.5%) being received by less than half of respondents. Other EAT contents specified included "petroleum platoon fire & spill response training", knowledge about woods, and Environmental Clearance Certificate (ECC). ECC is an internal assessment rule outlined in the TS Exercise Plans, which is undertaken if environmental impact is not serious [21]. During Wu's field participation of TS09, it was observed that ECC was commonly used, such as approved tree-cutting for safety purpose to avoid bushfires. In fact, these specific issues could also be attributed to the elements of EATCON mentioned in the questionnaire.

The associations were only found between SO and DEFFOR ($\chi^2 = 6.061$, $df = 1$, $p < 0.05$), and SO and TIMES ($\chi^2 = 5.395$, $df = 1$, $p < 0.05$), respectively. SO has been introduced by [21]. For the ADF, the frequency with the SO training was similar to that without the SO training. Whereas participants without SO training were more than those received for another category (i.e., USDF and Other). Perhaps the result depended on different exercise areas and missions by different groups (e.g., mainly ADF personnel, mainly USDF personnel, joint team) [43]. A few troops with these different kinds of compositions were also observed during field inspections following EMG members. Respondents with the SO training were less than those without it for the category of "Once", whereas the result was on the contrary for "Twice and 3+". It can be explained combining the findings of Section 3.1.1 with the analysis of the association of SO and DEFFOR. Compared with the "USDF

and Other”, there were more ADF personnel with “Twice and 3+” experiences of TS. And the SO training might be more required for the ADF dominant groups regarding different training objectives.

Regarding environmental awareness training methods (EATWAY), DVD and cards (DVDCAR) was the preferred way of training out of the four patterns outlined in the questionnaire (77.6%), followed by the environmental awareness presentation (PRESET) with 72.4%. This is consistent with direct observation conducted during pre and post environmental monitoring and checks in TS09. Upon entering SWBTA, a brief EAT via DVD presentation was immediately conducted and the trainee was informed to hold an awareness card during the exercise, which described schematic environmental protection principles.

It could also be explained by findings of another survey. The ADF conducted a questionnaire survey during TS07 focusing on DVD issues, aiming to assess the efficiency of the TS07 Environment, Health and Safety Awareness Program. A small sample consisting of the ADF and USDF participants was obtained and preliminarily reviewed without further analysis by the ADF (the reason is not clear). The necessity of viewing the DVD and carrying awareness cards was emphasized at the beginning of the questionnaire. In particular, there was also the maritime awareness video for personnel operating the marine environment. Overall, respondents preferred the DVD as they considered that the DVD addressed relatively sufficient environmental information which was easy to understand. It should be noted that one of the aims of TS07 DVD survey was to facilitate the preparation for TS09 Environmental Awareness Program development. The positive responses would be used and strengthened for the next exercise. Therefore, the consideration of the DVD issues might be the same during TS09 EAT, which was justified by the findings of the survey in this study.

Unit and group briefing (BRIEFS) was another commonly used EAT pathway (62.1%). And it was described in TS related environmental reports (e.g., [29], [42]) and observed in the field. Consistent with findings of the TS07 DVD survey, it illustrated that it was impossible for the DVD to provide all required information in detail. Meanwhile, the relatively low frequency of environmental fact sheets (FACSHT) (34.5%) indicated its supplementary role for EAT. Web page was also identified as a way for delivering EAT. There is a limited access to internet during military exercises, and participants can prepare relevant EAT lessons in advance. It could also be explained by the TS07 DVD survey, which found respondents preferred the DVD compared with online media. Chi-square tests indicated no association between EATWAY and DEFFOR, or EATWAY and TIMES.

In brief, the diversity of EAT contents and platforms might be due to different military branches, specific features of exercises and different EAT purposes. Besides general environmental awareness education, the ADF focuses on specific EAT contents regarding many issues during the exercise such as military activities, objectives, and environmental impact areas. Another possibility lies in

different information bases of different organizational strata. For example, the study of [9] found that different strata did not have the same information base before EAT. In the TS case, different hierarchies might have different levels of information according to their diverse responsibilities. The difference needs to be considered when conducting EAT, and a pre EAT assessment on the state of environmental awareness of participants was suggested by [9], in order to ensure the efficiency of EAT.

B. Knowledge Level and Behavioral Performance Affected by the ADF EAT

1. Knowledge Level of Environmental Issues Affected by EAT

Except for the equal response percentage (50%) in terms of IMPAWR, the knowledge level of environmental issues was mostly unchanged after EAT (e.g., 64.9% for EMPIMP, 62.1% for LEGCOM, 61.4% for CONSTR, 60.3% for EMP, and 58.6% for OBJSTAR and POLSTR). This demonstrates that EAT’s intent to improve the participants’ knowledge level was not obviously successful. The potential reasons might be that participants did not receive relevant EAT pertaining to this question, or some of the EAT contents related to mentioned environmental issues that they received were not so detailed that they could not make a comprehensive assessment.

There was no association between KNWLEV elements and the defence force that participants came from (DEFFOR) or their TS experiences (TIMES). Two respondents from the ADF admitted that they had not received EAT even though they had participated in TS more than three times. The reason was not clear. Significant associations were illustrated between KNWLEV issues and EATCON elements, including OBJTAR and EI ($\chi^2 = 4.363$, $df = 1$, $p < 0.05$), EMP and EI ($\chi^2 = 8.194$, $df = 1$, $p < 0.05$), IMPAWR and EI ($\chi^2 = 7.632$, $df = 1$, $p < 0.05$), and IMPAWR and SOP ($\chi^2 = 4.549$, $df = 1$, $p < 0.05$). Produced by the ADF, Environmental Instruction (EI) aims to apply the provisions of the *Environment Protection and Biodiversity Conservation Act of 1999 (EPBC Act 1999)* to defence operations [21]. The *EPBC Act* is the most significant and authoritative legislation with respect to environmental protection and biodiversity conservation in Australia [44]. Consistent with EI, the TS Environmental Management Plan (EMP) highlights the importance of environmental maintenance. And environmental protection obligations are also emphasized as defence objectives and targets to achieve environmental management leadership (OBJTAR) [45]. SOP has similar characteristics to EI and is an essential document for environmental management of military activities [21]. Awareness of environmental impacts caused by military activities (IMPAWR) was also an essential part of EI and SOP training. Therefore, participants with EI training were more likely to identify their improved knowledge level on OBJTAR, EMP, and IMPAWR than those without receiving EI. Respondents that have received SOP training were also more likely to identify IMPAWR as “Improved” than those have not. The combination of awareness training contents and knowledge level changes were also discussed in previous studies (e.g., [2],

[5], [9]. The findings of this section considered EI and SOP as effective EAT contents, which could be encouraged for the maximum dissemination.

For KNWLEV and EATWAY, significant associations were found between IMPAWR and PRESET ($\chi^2 = 5.524$, $df = 1$, $p < 0.05$), OBJTAR, POLSTR and FACSHT ($\chi^2 = 4.363$, $df = 1$, $p < 0.05$), respectively. This suggests that environmental awareness presentation (e.g., slide demonstration) was a good way for EAT to improve participants' knowledge level about awareness of military impacts on the environment. This result could be explained by the efficiency of presentation, and it is easy for participants to intuitively receive the EAT knowledge and understand potential environmental impacts. Presentation was used as an awareness training method in many studies, such as [2], [5], [7]. It has the similar advantages to the DVD method, which is consistent with previous analyses regarding the TS07 DVD survey. In the study of [2], presentations and videos were used for quality awareness training program. All participants passed the test of training and could apply the knowledge to their work, indicating the practicability of these training methods. Although identified by less than half of the respondents (34.5%), FACSHT was associated with improved knowledge levels of OBJTAR and POLSTR. Because TS related fact sheets (e.g., Combined Exercise Fact Sheet and Environmental Management Fact Sheet) contain summary information that help participants understand defence objectives and targets (OBJTAR), environmental policies and management strategies (POLSTR) of the exercise in a convenient way [46], [47]. Similar to PRESET, FACSHT could also be considered as a useful method for the improvement of relevant knowledge level.

2. Helpfulness of EAT to Participants' Involvement in Environmental Protection Activities (HELPRO)

There was a similar trend in the frequency distribution of responses for two issues of HELPRO; the majority reported "Helpful" (i.e., 62.1% for ROLRES and 49.1% for BEHPER), followed by "Very helpful" (i.e., 25.8% for ROLRES and 29.8% for BEHPER) and "No help" (i.e., 12.1% for ROLRES and 21.1% for BEHPER). The sample could indicate that from the respondents' points of view, EAT helped to clarify their responsibility and regulate behavior while enhancing environmental protection.

The result is consistent with Wu's participant observation made during TS09. Environmental awareness (e.g., their slogan "Safety First") was always emphasized during the exercise. Participants were able to comply with relevant guidelines based on EAT they received; as a questionnaire response stated, "we always operate to SOP's (i.e., Standard Operating Procedures) and RCGS (i.e., Range Control)". For example, due to the hazard of fuel spills refueling operations were a strong focus of the EMG's monitoring during TS09. During routine environmental checks for various refueling locations within SWBTA, it was observed that participants responsible for refueling operations were qualified to carry out the activity. Three Waste Transport Stations (WTS) used for TS09 were also observed in a good condition during field inspections. Specific observed examples reflected the EAT's utility in

raising participants' environmental awareness and improving their practices.

There was no association between HELPRO elements and DEFFOR or TIMES. For HELPRO and EATWAY, Chi-square tests illustrated the association between ROLRES and DVDCAR (Fisher's Exact Test: $p < 0.05$). It was consistent with the EATWAY related descriptions in Section 3.1.2, and the result could be explained in a similar way related to IMPWAR and PRESET in Section 3.2.1. For example, participants that had received DVDCAR training during TS09 were more likely to consider EAT helpful in ROLRES than those had not. As the most commonly used pathway, DVDCAR could be considered as a good tool to strengthen the EAT efforts. This was also justified by the TS07 DVD survey discussed in Section 3.1.2.

A significant association was found between BEHPER and EI (Fisher's Exact Test: $p < 0.05$), and it could also be explained similarly to previous EI related analyses in Section 3.2.1. Respondents with EI training were more likely consider EAT helpful in behavioral regulation and performance improvement during TS09 environmental protection than those not. As [9] stated, participants "need to be provided with the information they need in order to recognize environmental issues and situations, make the right decisions, and take appropriate action". A similar description can be found in [5]. For example, respondents of the TS07 DVD survey considered that greater details about the habitats of Dugong would give better instruction and awareness for avoiding damage to them during military activities.

In addition, nonparametric correlation analyses were conducted between elements within KNWLEV and HELPRO. All elements of respondents' knowledge levels had positive relationships with their roles and responsibilities' clarification in TS environmental protection activities (ROLRES) ($p < 0.05$ or $p < 0.01$). Several issues (e.g., LEGCOM, IMPAWR, and CONSTR) presented positive correlations with respondents' behavior regulation and performance improvement during TS09 (PERBEH) ($p < 0.01$). If knowledge levels of relevant environmental issues were improved through EAT, it might be helpful for respondents to clearly understand their roles and responsibilities, and effectively regulate their behavior in environmental protection. Other studies (e.g., [3], [9]) also found that personnel with good knowledge and skills would be more aware of the importance of their roles and responsibilities and the effects of their behaviors on the environment. These results supported the findings of the present study.

Meanwhile, the interaction between ROLRES and BEHPER could be found as they were highly correlated and complementary to each other ($p < 0.01$). It was possible for respondents to regulate their behavior in environmental maintenance when they clarified their responsibilities. And their improved personal performance might have certain connection with their responsibilities' clarification, which was also stated in previous studies.

C. Overall Perspective of the ADF EAT Effectiveness (EFFECT)

The majority of respondents appraised EFFECT to be “Excellent” (19%), “Very good” (39.7%) or “Average” (37.9%), whereas only a very small group considered it to be “Poor” (1.7%) or “Below average” (1.7%). From the respondents’ perspective, the ADF EAT for TS09 was therefore considered to be effective.

Similarly to Section 3.2, Chi-square tests found that EFFECT bore no significant association to DEFFOR or TIMES. For EATCON and EATWAY elements, EFFECT was found associated with EI ($\chi^2 = 8.757$, $df = 1$, $p < 0.05$), PRESET ($\chi^2 = 6.644$, $df = 1$, $p < 0.05$), and FACSHT ($\chi^2 = 12.392$, $df = 1$, $p < 0.05$), respectively. Besides identification of improved KNWLEV and BEHPER, participants receiving EI training were more likely to rank high score for the overall EAT effectiveness than those not. PRESET and FACSHT were also associated with a high ranking of EFFECT. The result could be explained in a similar way as stated previously. It could therefore anticipate the extension of PRESET and FACSHT as EAT methods in the future, which provided references for the ADF policy making regarding EAT at SWBTA.

Significant positive correlations existed between some KNWLEV elements (i.e., LEGCOM, POLSTR, and IMPAWR), HELPRO elements (i.e., ROLRES and BEHPER) and EFFECT, respectively ($p < 0.05$ or $p < 0.01$). Participants’ perspective of the EAT effectiveness might be affected by their judgments on knowledge level changes (“Unchanged” or “Improved”) and the EAT’s helpfulness in improving behavioral performance. It is possible for respondents to consider EAT effective if their knowledge levels of these elements are improved through EAT. Higher level identification of the EAT’s helpfulness in behavioral regulation might also increase the probability of providing a higher score for the EAT’s effectiveness.

D. Future Improvements to the ADF EAT (IMPRVE)

There were 10 non-responses for this question (IMPRVE) with a respondent rate of 82.8%, and a sample of 48 available for analysis. As a multiple-choice question, five categories were available (Table I). The most commonly selected response was “Training content extension” (CONEXT) (37.5%), followed by “More environmental training specialists” (MORSPE) and “Training efficiency” (EFFNCY) (22.9%); and “Trainee examination mechanism” (EXAMEC) (14.6%). Other responses (OTHCOM) (20.8%) included comments on the EAT contents such as improvement of common induction and on-site briefing. Some suggested that the EAT timing should be earlier in order to enhance environmental awareness of military activities.

As for future improvements to the ADF EAT, Chi-square tests illustrated that the identification of CONEXT was significantly associated with all EATCON elements, i.e., INDUCT ($\chi^2 = 8.833$; $df = 1$; $p < 0.01$), EI ($\chi^2 = 4.427$; $df = 1$; $p < 0.05$), SOP ($\chi^2 = 11.063$; $df = 1$; $p < 0.01$), and SO ($\chi^2 = 6.325$; $df = 1$; $p < 0.05$). It indicated that participants without receiving relevant EAT were more likely to expect the extension of EAT

contents. It is easy to understand that the more EAT respondents had received, the less likely they would be to choose the CONEXT option. Additionally, a Chi-square test showed that CONEXT was associated with ROLRES (Fisher’s Exact Test: $p < 0.05$). Probably respondents made their selection of future training content extension according to their attitude to the EAT’s helpfulness in their role and responsibility clarification to a certain extent.

IV. CONCLUSION

EAT’s importance is commonly recognized. This paper examined how the ADF EAT was conducted during the military exercise TS09 at SWBTA and evaluated its effectiveness through a questionnaire survey complemented by participant observation. Statistical analyses (e.g., descriptive statistics, cross tabulation and Chi-square test, correlation analysis) were applied to assist in data processing.

As for the survey sample in this study, the overall ADF EAT was considered as effective for TS09 (96.6% for “Average” and above) from respondents’ perspective. EAT was believed helpful in responsibility clarification (87.9% for “Very helpful” and “Helpful”) and behavioral performance (78.9% for “Very helpful” and “Helpful”) while involving in environmental protection during TS09. Future improvements were also identified by respondents for environmental managers, including extending the EAT contents; increasing the EAT specialists; promoting the EAT efficiency; and reinforcing examination mechanism. There were also comments such as “it covers nearly everything as it is”, “it is a good program”. According to Wu’s participant observation, as an USDF environmental officer stated, environmental awareness was considered in a good condition during the exercise. These issues could illustrate participants’ support for EAT and reflected its effectiveness to a certain extent.

No significant associations were indicated between the EAT effectiveness related issues (e.g., KNWLEV, HELPRO, and EFFECT) and background related information (e.g., DEFFOR, TIMES). The minority of EATCON and EATWAY elements were found associated with KNWLEV, HELPRO, and EFFECT. It might be explained that respondents independently identify the EAT effectiveness related issues according to their perspectives in the survey, rather than taking the EAT contents and patterns into efficient considerations. A few positive correlations were found among HELPRO and KNWLEV elements and EFFECT. Generally speaking, higher level judgment on the overall EAT’s effectiveness (EFFECT) could be expected in terms of higher knowledge level (KNWLEV) and better identification of EAT’s helpfulness in environmental protection (HELPRO). Furthermore, EAT might be more helpful in promoting participants’ responsibility clarification and behavioral performance when their knowledge levels were improved.

Compared with program objectives and strategy, the study focused on outcome evaluation as “it is important to identify and measure training outcomes” [2]. This study also provided a methodological direction for the EAT evaluation. It can be used as a reference for environmental managers to assess the ADF

EAT conducted at SWBTA. For example, environmental managers can evaluate the EAT's effectiveness based on exercise its helpfulness to exercise participants' involvement in environmental protection and their knowledge level changes. The EAT's effectiveness can also be assessed according to the choice of EAT contents and methods. Whereafter managers can take measures to improve EAT according to relevant information, such as extending EAT contents, strengthening specific EATCON (e.g., EI and SOP) and EATWAY (e.g., PRESET, DVDCAR, and FACSHT) analyzed in Section 3.2. As one typical example, DVDCAR was the most commonly used EAT pathway in the survey, and it was proved to be effective and should be reinforced in the future with reference to statistical analyses. Meanwhile, various EAT contents and methods should be gradually consummated and cooperated with each other, expecting more improvements of environmental knowledge and the helpfulness of EAT in behavior regulation and environmental performance. The ADF EAT would be beneficial from all these factors regarding its effectiveness.

However, this paper is only a preliminary study using TS as an example. There are limitations in this study and further research is needed. There is a lack of similar studies of EAT evaluation in military sectors as identified. The questionnaire of the TS07 DVD survey for Environment, Health and Safety Awareness Program was designed differently from the one used in this paper. Therefore, it is difficult to make comparisons based on the present study. Furthermore, it was a one-time survey with restriction to data collection. The short time of field trip and the access to SWBTA were also limited factors. Continuous evaluation method, suggested by [5], should be implemented to comprehensively monitor and ensure the overall EAT effectiveness at SWBTA. Long time series data need to be collected via periodic investigation [2]. And it can help to supplement relevant database, improve data quality, refine evaluation model (e.g., predicted accuracy improvement; proper variables augment), and predict changing trend of relevant variables [33]-[35]. These measures can be used for future EAT evaluation.

Besides the TS exercise, the questionnaire survey and statistical analysis methods demonstrated in this paper can also be applied in other military activities conducted at SWBTA for comparative study; or used for EAT implementation and evaluation in other similar military training areas if applicable. To sum up, efficient EAT evaluation provides the ADF a reference for relevant policy making, EAT and management improvement at SWBTA in the future.

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