Hue University Journal of Science: Natural Science
Vol. 134, No. 1S-1, 117–125, 2025 (Special Issue: IFGTM 2025)

pISSN 1859-1388
eISSN 2615-9678

Evaluating effectiveness of Sea Turtle Conservation Program in Vietnam

Tran Thi Minh Hang[1]*, Luu Thi Tram Anh[1], Nguyen Manh Khai[1,2]

[1] Faculty of Environmental Sciences, University of Science, Vietnam National University, Hanoi, Vietnam
[2] VNU Key Laboratory of Green Environment, Technology and Waste Utilisation (GreenLab), University of Science, Vietnam National University, Hanoi, Viet Nam

* Correspondence to Tran Thi Minh Hang <hangttm@hus.edu.vn>

(*Received: 10 May 2025; Revised: 12 September 2025; Accepted: 12 September 2025*)

Abstract. Vietnam is home to five rare sea turtle species that nest and inhabit its coastal areas (*Chelonia mydas*, *Eretmochelys imbricata*, *Lepidochelys olivacea*, *Caretta caretta*, and *Dermochelys coriacea*). However, these species are increasingly threatened by environmental pollution, illegal hunting, and climate change. This study employs a survey-based approach to evaluate the effectiveness of Vietnam's Sea Turtle Conservation Program. A set of five criteria was proposed and finalised by using a two-round Delphi survey, including (1) management methods, (2) stakeholder participation and contributions, (3) education, communication and community awareness, (4) scientific contributions, and (5) program sustainability. The results indicate that the program is effective, with all evaluation indicators scoring above 76%, especially the program management and stakeholder participation. However, the program still depends heavily on international funding, as domestic and private sector contributions remain limited; consequently, its scientific output is inadequate, relying on outdated and difficult-to-access data. The study proposes several solutions relating to the implementation regime, awareness raising, and sustainable financing to ensure the program's long-term sustainability and impacts.

Keywords: conservation program, effectiveness evaluation, sea turtle, sustainable conservation

1 Introduction

The global decline in the population of mammals, birds, reptiles, amphibians, and fish has raised concerns that Earth may be experiencing its sixth mass extinction [1]. Sea turtles serve as a prime example. The factors contributing to this decline include overexploitation (overfishing, overhunting, and poaching) [2], bycatch, natural habitat loss due to rapid human development in coastal areas [3–6], marine pollution [7, 8], diseases [7], the introduction of invasive alien species [9, 10], and notably, the increasingly severe impacts of climate change [11]. Decades-long conservation efforts aiming at mitigating some of these threats appear to have contributed to population increases in certain specific species [1].

Aligned with the goal of sea turtle protection, the IUCN in Vietnam collaborated with Con Dao National Park, Hon Cau Marine Protected Area, Nui Chua National Park, Bai Tu Long National Park, and Ly Son Marine Protected Area to implement a sea turtle conservation volunteer program as part of the broader national sea turtle conservation initiative in 2014. Over the past seven years, the program has garnered significant public attention, attracting over 10,000 online applications via its official website to join the volunteer program. The core activities of the program involve volunteers working alongside forest rangers to prepare nesting beaches, repair hatcheries, and conduct beach patrols and clean-ups. Beyond providing a substantial workforce for conservation activities in Marine Protected Areas (MPA) and national parks, volunteers also act as communication ambassadors, disseminating the message of sea turtle conservation within the community to raise awareness and shift public attitudes towards sea turtles and their conservation. The program quickly became a popular movement, attracting many individuals from diverse professional backgrounds [12].

To date, the program has been implemented for 10 years and has achieved several positive results; however, it still faces inherent limitations. Evaluating the program's management and operational effectiveness is crucial for identifying solutions to these shortcomings and further developing its strengths. This study aimed to: (1) identify indicators for assessing the effectiveness of sea turtle conservation programs in Vietnam, encompassing environmental, ecological, economic, and social factors, drawing upon previously researched management effectiveness assessment frameworks; (2) pilot and apply these assessment indicators in practice, thereby analysing the benefits and limitations of this conservation program; and (3) propose solutions to enhance the effectiveness and long-term sustainability of sea turtle conservation programs in Vietnam.

2 Methods

A set of five criteria was proposed to evaluate the effectiveness of the Sea-Turtle Conservation Program, including: (1) Management approach; (2) Participation and contributions of stakeholders; (3) Education, communication, and community awareness; (4) Scientific contributions; and (5) Sustainability [13, 14].

Through two rounds of the Delphi survey process [15], five experts in relevant fields assessed the importance and relevance of these criteria for evaluating the program's effectiveness by providing counterarguments during discussion meetings and scoring the indicators with a 5-point Likert scale. The final set of criteria and their respective indicators, after being agreed upon by the experts (Table 1), were designed into a questionnaire to evaluate the effectiveness of the turtle-conservation program. This evaluation was conducted with an evidence-based and multi-person scoring approach from individuals directly involved in the program, including: (1) one program supervisor; (2) three forest rangers from marine protected areas collaborating with the program; and (3) 50 program volunteers.

Each indicator was rated on a scale of 1 to 3 (1– Absent; 2– Present but not effective/no clear impact; 3– Present and very effective/has a clear impact).

Table 1. Framework of indicators for evaluating the effectiveness of the Sea Turtle Conservation Program in Vietnam

Indicator Group	Specific indicator
1. Management modalities	
1.1. Policy	The program incorporates legal regulations about the protection and conservation of sea turtles.
	The program has defined objectives and action plans for sea turtle conservation activities.
1.2. Finance	The program receives financial resources from the national budget.
	The program receives financial support from international organisations and projects.
	The program benefits from financial contributions from the private sector.
1.3. Management agency	The program is operationalised and implemented by functional agencies and local authorities.
	The program is operationalised and implemented through external projects and support.

pISSN 1859-1388
eISSN 2615-9678

Indicator Group	Specific indicator
2. Stakeholder engagement and contribution	
2.1. Stakeholders	The program involves participation from external projects and support (national and international non-governmental organisations).
	The program involves collaborative engagement from various sectoral agencies.
	The program involves collaborative engagement from local communities and other participants (volunteers).
2.2. Contribution	Stakeholders share and support financial resources.
	Stakeholders contribute technical expertise, human resources, and knowledge.
3. Education, communication, and community awareness	
3.1. Education	The program provides skills and policy knowledge training for implementing personnel.
	The program provides specialised knowledge training for program participants.
3.2. Communication	The program diversifies communication channels (social media, press, television, etc.).
	The program maintains consistent communication about its activities.
	The program includes post-participation communication and outreach activities by volunteers.
3.3. Community awareness	The community demonstrates a willingness to participate in sea turtle conservation efforts.
4. Scientific contribution	
4.1. Research activities	The program publishes scientific data on sea turtles (e.g., egg clutch size and survival rates) through various formats.
	The program produces formal annual reports for government management agencies and relevant stakeholders.
	The program actively engages in information exchange at expert meetings, thematic workshops, and conferences.
5. Sustainability	
5.1. Policy	Sea turtle conservation activities are integrated into national plans and programs.
	Sea turtle conservation activities are integrated into local action plans and programs.
5.2. Finance	Ensures adequate, continuous, and diversified financial resources.
5.3. Social	Demonstrates support and participation from the community and relevant stakeholders.

The effectiveness of conservation efforts were evaluated on the basis of the effectiveness level of each criterion within the program effectiveness assessment framework by using the following scale: poorly effective (0–33%); effective but not significant (34–67%); and effective (68–100%) [16]. The data collected from the questionnaires were checked to detect and eliminate erroneous or missing data and invalid responses before being analysed with SPSS 20.0 [17]. The Cronbach's alpha coefficient was used for reliability testing of the

data collected, and the standard deviation was used for calculating the average score of each indicator.

– Cronbach's alpha reliability testing was based on the following formula

$$\alpha = (\frac{k}{k-1})(\frac{s_y^2 - \sum s_i^2}{s_y^2})$$

where k represents the number of items (questions) in the survey instrument; s_y^2 is the sample variance of the composite scores obtained from each respondent across all items in the questionnaire; s_i^2 represents the summation of the variances of the scores for each item, calculated across all respondents to the questionnaire.

– Standard deviation was calculated according to the following formula

$$SD = \sqrt{\frac{\sum_i^n (x_i - \bar{X})^2}{n-1}}$$

where SD denotes the standard deviation; x_i represents the i-th observation in the sample; $\bar{X}$ is the arithmetic mean of the observations; n is the sample size (number of observations).

3 Results

3.1 Reliability assessment of the evaluation framework for the Sea Turtle Conservation Program in Vietnam

Statistical analysis reveals that the reliability of the indicator framework achieved a Cronbach's alpha coefficient of approximately 0.94, demonstrating strong internal consistency and stable assessment capability. This suggests that the indicators are likely to reflect conservation effectiveness and exhibit a robust intercorrelation. These findings indicate that the framework is appropriate for the research objectives and possesses broad applicability in related studies, supported by a high degree of agreement among experts from diverse fields, underscoring the interdisciplinary nature of the indicator framework.

3.2 Effectiveness of the Sea Turtle Conservation Program in Vietnam

Management modalities of sea turtle conservation activities

As presented in Fig. 1, the management modalities were evaluated as effective, with all indicators scoring above 76%. However, the management approach still exhibits areas requiring improvement to enhance efficiency and ensure long-term sustainability.

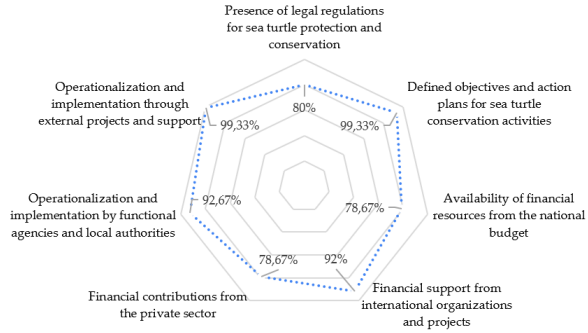

Fig. 1. Radar chart illustrating the effectiveness of indicators within the management modalities

The Sea Turtle Conservation Program demonstrated high effectiveness in two primary indicators: the establishment and adherence to relevant legal regulations (80 ± 0.55%) and the clear definition of objectives and action plans (99.33 ± 0.45%). From its inception, the program established specific goals and detailed plans for each phase and project, while ensuring transparent information dissemination through channels such as the program's website, marine protected area information centres, and the IUCN platform.

In terms of management, the program implemented a multi-stakeholder governance model characterised with close coordination among various entities: MPA staff, the IUCN, and local government agencies. This collaborative framework not only prevented conflicts among participating parties but also ensured synchronised operations, achieving high effectiveness with consensus rates of 92.67 ± 0.43% for the involvement of government agencies and 99.33 ± 0.04% for the support from external projects and organisations. This synergy optimised resource allocation, enhanced capabilities, and facilitated the

pISSN 1859-1388
eISSN 2615-9678

continuous implementation of the program over 10 years.

Regarding financial resources, the program benefited from a diversified funding portfolio encompassing the state budget, international organisations, and the private sector. However, the primary funding source remained international organisations such as the IUCN and the U.S. Fish and Wildlife Service (FWS), with an effectiveness rating of 92 ± 0.43%. Conversely, while domestic and private sector funding was positively evaluated, it exhibited a lower consensus rate (78.67 ± 0.5%), indicating an imbalance in the financial structure. This significant reliance on international funding poses potential risks to the long-term sustainability and effectiveness of the program. When financial support from NGOs is no longer available, the continuation of ongoing projects and the implementation of new ones will be stalled, with the worst-case scenario being a complete cessation of all projects. Additionally, the costs related to personnel, equipment, and the maintenance of the program's management structure will also be significantly affected.

Stakeholder engagement and contributions in sea turtle conservation activities

Beyond the collaboration with governmental bodies and organisations, the program also benefited from the active participation and enthusiastic support of the community, encompassing diverse sectors ranging from local volunteers and sea turtle rescue teams to artists.

According to Fig. 2, the Sea Turtle Conservation Program obtained a high degree of consensus regarding stakeholder engagement, with 93.33 ± 0.45% for the participation of governmental agencies and both national and international non-governmental organisations, and 99.33 ± 0.04% for the involvement of local communities, indicating notable effectiveness and success. This diverse participation enabled the program to receive technical assistance, human resources, knowledge transfer, and financial support. However, financial contributions from stakeholders exhibited lower effectiveness (84.67 ± 0.51%). In fact, the Vietnam turtle-conservation program started with international funding sources. Local financial resources are relatively limited. This may lead to an issue with sustainable conservation efforts.

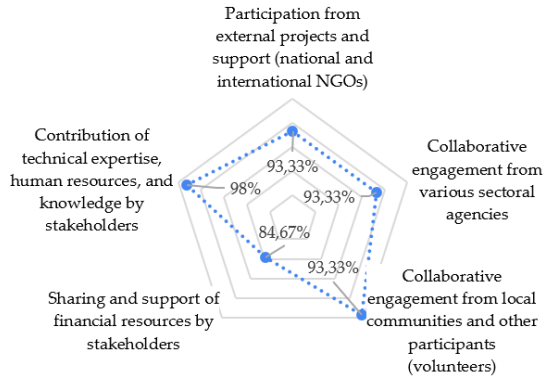

Fig. 2. Radar chart illustrating the effectiveness of indicators within stakeholder engagement and contributions

Conversely, the provision of technical expertise, specialised knowledge, and human resources demonstrated significant effectiveness, with a consensus level of 98 ± 0.13%. During the nesting season, volunteers played an essential role in supporting forestry officers with patrolling, monitoring, rescuing nesting turtles, collecting eggs, as well as participating in beach clean-up initiatives and promoting the protection of the turtles' habitat. Marine Protected Areas also supported the provision of specialised training for volunteers, ensuring safe living conditions, thereby enhancing the human resources available for *in situ* conservation efforts.

In addition to the support from the community and volunteers, the program also received assistance from state agencies and international organisations in providing legal support, facilitating the transfer of modern technology, and sharing specialised expertise. This robust network among protected areas, volunteers, and both domestic and international organisations has established a solid foundation, enabling the program to not only maintain effectiveness but also achieve significant accomplishments in the protection of sea turtles, a species playing a crucial role in the marine ecosystem of Vietnam.

Education, communication, and community awareness through Sea Turtle Conservation Program

The program placed a particular emphasis on providing skills and specialised knowledge training for both staff members and volunteers participating in the initiative.

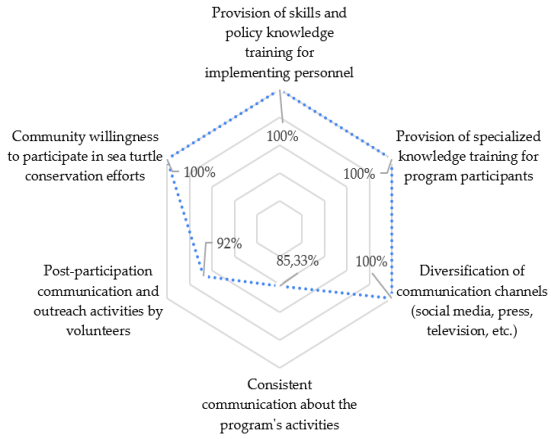

Fig. 3. Radar chart illustrating the effectiveness of indicators within education, communication, and community awareness

According to the program facilitator, volunteers, before their involvement in the Sea Turtle Conservation Program, receive comprehensive training on legal knowledge and practical skills at Marine Protected Areas and are provided with clear guidance regarding their responsibilities. During their engagement, volunteers continue to receive mentorship and professional support from forestry officers to enhance their expertise and ensure that tasks are performed according to established protocols. Simultaneously, the program staff undergo regular annual training to update their specialised knowledge and skills in addressing emerging challenges. As a result of this comprehensive investment in training, the program achieved absolute effectiveness (100%) in both indicators: training of implementing personnel and training of volunteers (Fig. 3).

The program has also been highly successful in its communication efforts through the diversification of information dissemination channels, including the official IUCN website, state-owned press, social media platforms, and television programs. Announcements regarding activities, volunteer recruitment, and events are consistently updated, enabling the program to reach a broad public audience. Notably, many volunteers, after their participation, have initiated creative projects such as "Mid-Autumn Festival for Baby Turtles" and "Phiêu" that significantly contributed to the dissemination of the conservation message. While communication activities achieved high results, with the indicator for diversification of communication channels reaching 100% and outreach by volunteers at 92 ± 0.43%, the indicator for consistent information updates only reached 85.33 ± 0.52%, indicating a need for improvement to enhance continuity in communication (Fig. 3).

After 10 years of implementation, the IUCN Sea Turtle Conservation Volunteer Program achieved remarkable results. Around 1,000 volunteers were selected out of 12,000 applications from 2014 to 2024. The consensus rate regarding the effectiveness of this activity was 100%, affirming the program's significant appeal and the community's willingness to contribute. Over the years, most of the volunteers showed high satisfaction with the program (Fig. 4). Most volunteers, after their participation, became "communication ambassadors", contributing to the widespread dissemination of the conservation message to the community. These accomplishments not only demonstrate outstanding effectiveness in sea turtle conservation efforts but also create a sustainable social network, contributing to increased awareness regarding the protection of endangered wildlife in Vietnam.

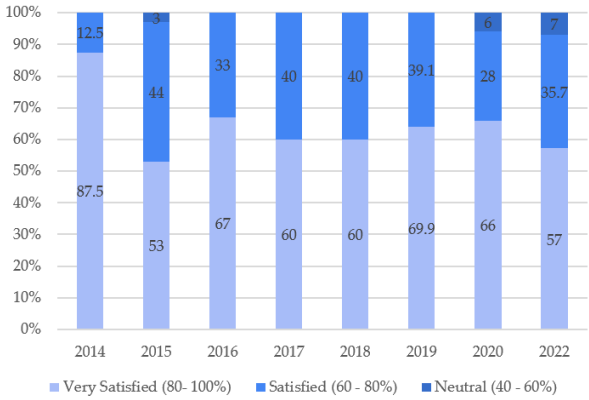

Fig. 4. Evaluation of volunteer satisfaction levels (2014 – 2022) (10-Year Journey – IUCN Sea Turtle Conservation Program-Summary Report)

Contribution of scientific information from sea turtle conservation activities

Over the 10-year implementation period since 2014, the Sea Turtle Conservation Program in Vietnam has achieved numerous significant scientific milestones. Specifically, the program has published over 40 peer-reviewed scientific articles, organised more than 15 events of varying scales to facilitate professional

pISSN 1859-1388
eISSN 2615-9678

exchange and enhance public awareness, produced and broadcast nearly 15 reports on national television channels, and uploaded over 60 videos to YouTube and various journalistic platforms. Furthermore, five projects initiated by volunteers have been and are currently implemented, alongside thousands of posts, images, and video clips disseminating the conservation message across social media. These contributions have generated a substantial body of data, providing crucial support to scientists in monitoring and assessing the extinction risk of sea turtles in Vietnam. Nevertheless, the program still faces limitations regarding the effectiveness and usability of the collected information, which require improvement in the future.

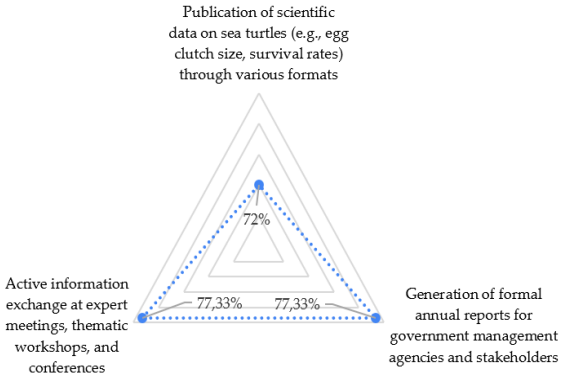

Fig. 5. Radar chart illustrating the effectiveness of indicators within scientific contribution

According to the survey results (Fig. 5), the widespread publication of sea turtle data achieved an effectiveness of only 72 ± 0.79%, while specialised workshops, information exchange seminars, and the production of annual reports for government agencies and stakeholders demonstrated higher effectiveness at 77.33 ± 0.46%. However, this figure remains a concern. These limitations are readily apparent: the sea turtle data published by the program often tend to be general, lacking regular updates and innovation. Furthermore, information regarding the program's projects, specialised workshops, or expert seminars is often difficult to locate or is only published on a limited number of minor news outlets with incomplete information. These shortcomings create certain difficulties for researchers and interested individuals seeking to synthesise or reference data and cross-reference information.

3.3 Solutions for enhancing the effectiveness of the Sea Turtle Conservation Program in Vietnam

The survey results of the evaluation indicators indicate that the Sea Turtle Conservation Program has been implemented very effectively and comprehensively, achieving a score of 89.09 ± 0.05% (Fig. 6). However, certain limitations persist in the areas of management, finance, and social aspects that require addressing. To ensure the program's sustainable and long-term operation, the implementation of specific solutions is necessary to improve identified weaknesses. The evaluation groups demonstrated a very high degree of consensus regarding the proposed solutions, focusing on enhancing effectiveness in the key areas of policy, finance, and social engagement.

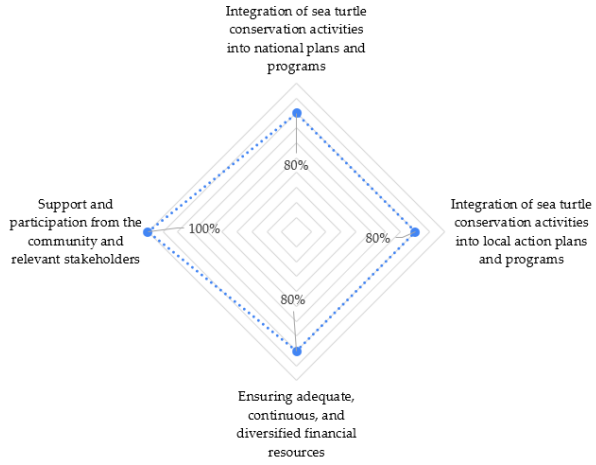

Fig. 6. Radar chart illustrating the effectiveness of solutions for enhancing program effectiveness

The Sea Turtle Conservation Program in Vietnam needs to be integrated into national and local conservation policies and plans to enhance its effectiveness and sustainability. This integration will facilitate legal and financial support from the government, improve management and staff training, and promote monitoring and guidance of conservation activities.

Establishing a periodic reporting system is essential for the program to update progress and outcomes, enhance communication through information agencies, and collaborate with other conservation projects to optimise resources and share knowledge. However, the program's current reliance on

international funding necessitates its integration into national development strategies to ensure financial stability.

The program's success also hinges on consensus and support from the community. Survey results indicate a long-term commitment to collaboration from volunteers and protected areas, and the support from the broader community, including education, tourism, and research sectors, plays a crucial role in expanding and sustaining program effectiveness. Leveraging this support will contribute to the protection of sea turtles and biodiversity in Vietnam.

4 Conclusion

The Sea Turtle Conservation Program in Vietnam, led by IUCN, protected areas, national parks, and volunteers, has made notable progress over the past decade, especially in management and stakeholder participation. All management indicators exceeded 76%, while the involvement of governmental agencies, non-governmental organisations, and local communities reached very high consensus levels (up to 99.33 ± 0.04%), demonstrating the program's effectiveness and positive impact in education, communication, and raising public awareness. Despite these achievements, the program remains heavily reliant on international funding, with limited domestic and private sector support, and its scientific output is still insufficient, with outdated and inaccessible data. To ensure long-term sustainability, the program should strengthen domestic resource mobilisation and enhance the quality, transparency, and accessibility of scientific data, thereby improving both management effectiveness and scientific value.

Conflict of interest

The authors declare that there are no conflicts of interest regarding the publication of this article.

References

1. Mazaris A, Schofield G, Gkazinou C, Almpanidou V, Hays G. Global sea turtle conservation successes. Science Advances. 2017;3(9):e1600730.
2. Early-Capistrán MM, Sáenz-Arroyo A, Cardoso-Mohedano JG, Garibay-Melo G, Peckham SH, Koch V. Reconstructing 290 years of a data-poor fishery through ethnographic and archival research: The East Pacific green turtle (Chelonia mydas) in Baja California, Mexico. Fish and Fisheries. 2018;19(1):57-77.
3. Lopez GG, Saliés EC, Lara PH, Tognin F, Marcovaldi MA, Serafini TZ, Coastal development at sea turtles nesting ground: Efforts to establish a tool for supporting conservation and coastal management in northeastern Brazil. Ocean & Coastal Management. 2015;116:270-276.
4. Rizkalla CE, Savage A. Impact of Seawalls on Loggerhead Sea Turtle (Caretta caretta) Nesting and Hatching Success. Coastal Research. 2011; 27(1):166–73.
5. Kamrowski RL, Limpus C, Moloney J, Hamann M. Coastal light pollution and marine turtles: assessing the magnitude of the problem. Endanger Species Research. 2012;19(1):85-98.
6. Drobes E, Ware M, Beckwith V, Fuentes M. Beach Crabbing as a Possible Hindrance to Loggerhead Marine Turtle Nesting Success. Marine Turtle Newsletter. 2019;159:1-4.
7. Merwe JP, Hodge M, Whittier JM, Ibrahim K, Lee SY. Persistent organic pollutants in the green sea turtle Chelonia mydas: nesting population variation, maternal transfer, and effects on development. Marine Ecology Progress Series. 2010;403:269-278.
8. Andrés E, Gómara B, González-Paredes D, Ruiz-Martín J, Marco A. Persistent organic pollutant levels in eggs of leatherback turtles (Dermochelys coriacea) point to a decrease in hatching success. Chemosphere. 2016;146:354-361.
9. Martins S, Ferreira-Veiga N, Rodrigues Z, Querido A, de Santos Loureiro N, Freire K, et al. Hatchery efficiency as a conservation tool in threatened sea turtle rookeries with high embryonic mortality. Ocean & Coastal Management. 2021;212:105807.
10. Erb V, Wyneken J. Nest-to-Surf Mortality of Loggerhead Sea Turtle (Caretta caretta) Hatchlings on Florida's East Coast. Frontiers in Marine Science. 2019;6:1-10.
11. Patrício AR, Hawkes LA, Monsinjon JR, Godley BJ, MMPB F. Climate change and marine turtles: recent advances and future directions Endangered Species Research. 2021;44:363-395.

pISSN 1859-1388
eISSN 2615-9678

12. Bui TTH, Nguyen ST. Report on IUCN Sea Turtles Conservation Volunteer Programme (2014–2020). Hanoi: IUCN Vietnam Country Office; 2020. 88pp.

13. Washington H, Baillie J, Waterman C, Milner-Gulland EJ. A framework for evaluating the effectiveness of conservation attention at the species level. Oryx. 2015;49(3):481-91.

14. Hockings M, Stolton S, Leverington F, Dudley N, Courrau J. Evaluating Effectiveness A framework for assessing management effectiveness of protected areas. 2nd Edition. 2006. 2nd ed ed. Gland: IUCN; 2006.

15. Mukherjee N, Hugé J, Sutherland WJ, McNeill J, Van Opstal M, Dahdouh-Guebas F, et al. The Delphi technique in ecology and biological conservation: applications and guidelines. Methods in Ecology and Evolution. 2015;6(9):1097-1109.