



Protecting Blue Horizons – A role-play to make a marine protected area work

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Abstract. International biodiversity commitments will remain largely aspirational unless they are translated into socially legitimate forms of local action. This challenge is particularly evident in marine protected areas (MPAs), where conservation objectives intersect with fisheries, tourism, energy development, local livelihoods, and competing uses of marine space. Addressing these tensions requires ecological knowledge as well as stakeholder dialogue and an understanding of biodiversity governance as both a scientific and socio-political process. This paper presents *Protecting Blue Horizons*, a role-play exercise designed to help students and young adults explore how global biodiversity goals can be negotiated in local MPA contexts. The exercise combines top-down policy objectives with bottom-up stakeholder deliberation. Eleven stakeholder roles were developed through interviews, literature review, and professional experience. Particular attention is given to moderation and to the debriefing as components of reflection and learning. The role-play was tested in different educational settings. An initial implementation with young adults included debriefing and provided formative feedback on moderation and consensus building. Subsequent university implementations in Argentina and Mexico used shorter formats and constituted the analytical corpus of this study. As these sessions did not include formal debriefing, the analysis focused on recorded stakeholder deliberations. Directed thematic content analysis used the four overarching goals of the Kunming–Montreal Global Biodiversity Framework (GBF) as analytical categories. Goal B, concerning sustainable use and nature’s contributions to people, was most consistently represented, while Goals A and D were partially represented and Goal C, concerning fair benefit-sharing, was least represented. The findings suggest that *Protecting Blue Horizons* can support engagement with biodiversity governance while highlighting dimensions that require more explicit integration into scenario design, facilitation, and debriefing. The role-play is proposed as a flexible educational tool for strengthening deliberative skills and more grounded engagement with GBF implementation.

Keywords: Global Biodiversity Framework; marine protected area; implementation gap; role-play; guided learning process



35 1. Introduction

Human activities are the major cause for what has been recognized as the 6th Mass Species Extinction (IPBES 2019). It is thus important not only to spread knowledge and raise awareness about biodiversity issues. We depend on biodiversity in ways that are not always apparent or appreciated. Population collapses have been reported on land and in the sea. IUCN refers to species assessed for the Red List service as Critically Endangered (CR), Endangered (EN), or Vulnerable (VU) altogether as "threatened" species. Not only are almost 50,000 of the approximately 170,000 assessed species threatened, but these represent only a modest share of all species scientifically described so far. Many species are data deficient so that their status cannot be properly assessed (IUCN 2025). A species may start out as abundant, but gradually become rarer, until it may disappear either in parts of its original distribution range, that is, suffer local extirpation, or go extinct in the wild or even altogether.

45 Biomass reductions of wild species are not confined to vertebrates though these may be more eye-catching but affect other animals and plants too. A recent global assessment of living matter expressed in dry weight in comparison to human artifacts put the biomass of animal life, including humans, at 4 Gt compared to 8 Gt of human-made plastic. Plant matter was estimated at 900 Gt compared to 1,100 Gt of buildings and infrastructure (Elhacham, El-Uri, Grozovski et al. 2020). A detailed study in German protected areas showed a 75% decline of flying insect biomass over a 27-year time span (Hallmann, Sorg, Jongejans et al. 2017). Post WW II generations may have experienced the comparison of insects squashed on car wind shields in the 1970s or 1980s with almost clean wind shields today.

In the ocean, the extra-ordinary deployment of industrial fishing power in the same period has led to what has been termed 'fishing down marine food webs' (Pauly, Christensen, Dalsgaard et al. 1998). This in turn, triggered massive declines of fish biomass in all regional seas starting with the North Atlantic (Christensen, Guénette, Heymans et al. 2003). Latest available best estimates suggest that e.g. 37% (32-46%) of sharks, rays and chimeras are threatened (IUCN 2025). The extremely high levels of biomass extractions have profound effects on the functioning of marine ecosystems (Palomares, Froese, Derrick et al. 2020; González Ortiz, Walsworth, Hammill et al. 2025; Nauen, Adhuri & Fakoya 2025). These generate social, economic, and political ripple effects (e.g. Pauly, Nauen, Le Manach et al. 2025) that tend to be under-researched and require greater attention for more integrated solutions.

60 In December 2022, delegates from 196 governments at the Conference to the Parties (COP15) adopted the Kunming-Montreal Global Biodiversity Framework (GBF) under the UN Convention on Biological Diversity (CBD). The GBF supports the achievement of the Sustainable Development Goals and sets out an ambitious pathway towards living in harmony with nature by 2050 through four goals: (1) halt species loss and restore nature; (2) use land and seas sustainably; (3) share benefits and services; and (4) mobilise the necessary resources. The Framework comprises four long-term goals for 2050 and 23 action-oriented targets for 2030, including the restoration of 30% of degraded ecosystems and the effective conservation and management of at least 30% of terrestrial, inland water, coastal and marine areas. This should be achieved, among others, through a stop of harmful subsidies and finance supporting positive change. The challenges are stark, however, as shown by the assessment of finance for nature by UNEP (2026). The analysis suggests that for every dollar supporting positive change, e.g. through investing in renewables and regeneration, 30 are spent on harmful practices.

70 Stephens (2023), in International Legal Materials, contextualizes the adoption of the GBF at COP15 (December 2022) and its evolution from the 2011–2020 Strategic Plan for Biodiversity to the non-legally binding political plan aimed at operationalising the legally binding CBD.

Similarly, after years of complex negotiations, a new legally binding Treaty was agreed in June 2023 to protect biodiversity in areas beyond national jurisdiction, or BBNJ for short, under the Law of the Sea, equally foreseeing protecting 30% of the ocean by 2030. This legally binding provision thus strengthens the political consensus on the need



for action to address the biodiversity crisis. The expected ratification milestone was achieved in time for the September 2025 UN General Assembly: the BBNJ Treaty reached the required 60 ratifications on 19 September 2025. This triggered its entry into force 120 days later, with the Agreement becoming legally effective on 17 January 2026.

80 Both negotiation processes have been concluded thanks to a range of measures intended to operationalise fair benefit sharing and capacity building in countries lacking them (Santos, Devereaux, Gjerde et al. 2022).

The urgent need to protect vast areas of land and sea from massive extraction is widely recognised and essential for achieving recovery targets. Implementation remains difficult, however, especially in areas with multiple and often overlapping uses. Tensions are particularly acute where long-term nature restoration objectives conflict with shorter-term
85 extractive interests, as in the case of deep-sea mining. Governments have declared marine protected areas, yet most are considered ‘paper parks’ (Relano, Mak, Ortiz et al. 2022). From a literature review Di Cintio, Niccolini, Scippioni et al. (2023) distilled stakeholder participation as the single most effective socio-economic factor for real protection. This is another way of underlining that trust-building among stakeholders through respectful dialogue and a fair sharing of costs and benefits is crucial for addressing the implementation gap between internationally or nationally negotiated treaties or
90 laws and their actual enforcement (Nauen 2023). It also resonates with Jasanoff (2004) who points out that approaches to managing social affairs usually do not scale. They work best by paying attention to and considering the different types of knowledge, experience, cultural and other characteristics of people, organisations, and institutions not only at local, but also ‘higher’ scales. Embracing different perspectives enables more robust outcomes. That forms of respectful dialogue in a safe space, where participants are accepted without prior judgement can generate improvements of living conditions
95 even under adverse circumstances, has been documented (Nauen & Arraes Treffner, 2021, 2022).

We developed a role-play for young adults to create a space for stakeholder dialogue. Our objectives are to (a) connect global treaties and their objectives to local implementation, and (b) introduce the players to practising their listening and deliberation skills as they impersonate different stakeholders or rights holders. Several of these will have at least partially contrasting interests. In the process, it is hoped that players become more curious about how biodiversity can be restored
100 and protected for healthy ecosystems, equity and benefit sharing. Practising the dialogue format, they gain a better first-hand appreciation about the challenges and opportunities of stakeholder participation. Practice will also hone their ability to marshal arguments that clarify and put forward the objectives and needs of the role they impersonate.

1.1 Active and constructivist approach in real contexts

Role-playing has established itself as an active and student-centred pedagogical tool, particularly valuable in
105 environmental education. It consists of the simulated representation of real or hypothetical situations, where each student assumes a specific role within a scenario related to the subject of study. Unlike the traditional lecture, this strategy aligns with the principles of constructivism, which hold that learning occurs most effectively when the learner constructs his or her own understanding from authentic and relevant experiences (Crow & Nelson 2015). The same authors point out that in a role-play, participants “create their own meaning” by confronting real-world problems and connecting theory
110 with practice. This immersion in plausible scenarios reflects the experiential learning described by Kolb: students learn by doing, reflecting on their decisions, and drawing lessons applicable to later real-life situations (Kolb & Kolb 2005). In addition, the social component of role-playing – the interaction between participants – responds to the constructivist postulate that social interaction enhances learning, allowing the exchange of ideas and the co-construction of knowledge. In short, role-playing creates an active learning environment, centred on the student, where the student becomes the
115 protagonist of his or her own learning process instead of a passive receiver of information (Crow & Nelson 2015).

This methodological approach also shares features with Problem-Based Learning (PBL). By placing students in front of a specific environmental problem that they must analyse and solve, role-playing requires inquiry, critical thinking and



application of knowledge in a similar way to PBL. In fact, Chen and Martin (2015) suggest that effective educational methodologies in environmental education must include "a problem-solving approach that demands a solution." The same authors point out that role-playing meets this criterion by confronting students with real challenges – such as negotiating the creation of a protected area balancing conservation and economic uses – forcing them to look for viable solutions. Thus, learning is aimed not only at acquiring knowledge, but also at using it to generate changes and solve specific environmental situations. This is fully in line with the practical and transformative nature that contemporary environmental education seeks.

1.2 Meaningful Learning and Motivation

One of the great pedagogical advantages of role-playing is that it promotes meaningful learning by linking academic content with real contexts and problems that are relevant to the student (Ausubel 2000). By designing environmental role scenarios based on real situations (marine pollution, resource management, conflicts between sectors, etc.), students see the importance and practical application of the concepts they are learning. Brown, Collins & Duguid (1989) argue that authentic tasks situated in real contexts promote deeper learning. In role-playing, the authenticity of the setting – for example, simulating a debate between fishermen, scientists and authorities about a marine reserve – makes it easier for students to "bridge the gap" between theory and reality, making it easier for them to integrate new content in an understandable and lasting way (Figure 1).



Figure 1: Conceptual framework

Likewise, the playful and participatory nature of this technique usually increases the motivation of the students. In contrast to passive methodologies, role-playing acts as a "motivational trigger" that turns the student into a true active participant, involving him or her emotionally and intellectually in the activity. Studies in university contexts have proposed the use of role-playing precisely to improve significant learning in subjects traditionally disconnected from practice, given its ability to arouse the student's interest and make them participate actively in their learning (Rodríguez 2016). Participants often report that they value being able to "learn from their peers, test their ideas in a safe environment, and receive feedback" during the role-playing process, in contrast to the conventional expository class (Crow & Nelson 2015). In the case of environmental education, this additional motivation is key, since environmental issues (climate change, conservation, regeneration, etc.) can sometimes be perceived in an abstract or distant way. Role-playing brings them to life, allowing students to experience first-hand the associated challenges and dilemmas, which increases their interest and commitment to learning.



2. Method

Role-plays are being used in a range of contexts, one being in education or training (Prager 2019; Ada4go n.d.). A role-play constitutes a social activity, typically aiming at cooperation and character development. Used in education, role-play can involve participants in several overlapping levels of reality: as characters within the simulated situation, as players interacting according to the rules and dynamics of the exercise, as persons bringing their own experiences and values into the activity, and as human beings engaged in cooperation, conflict, empathy and reflection. The transformative potential is discussed by Daniau (2016) in relation to the four dimensions of learning: knowing, doing, being, and relating. It can also be a research tool where stakeholders explore drivers and decision-making processes e.g. in spatial planning (Vieira Pak and Castillo Briera 2010). Simulations or role-plays are current educational approaches in many fields, from medicine (de Wijse-van Heeswijk, van Laere, Trautwein et al. 2025), learning in technical maritime professions (Sellberg 2018), and gamification (Crookall, Oxford and Sanders 1987). Crookall (2010, 2023) underlines the particular importance of allocating sufficient attention and time for a player-focused debriefing to underpin learning effects.

Here we sketch a link between the global agreements to step up biodiversity protection through expansion of marine protected areas and the challenges to build consensus in a fictitious local context where different stakeholders are potentially in conflict with one another. This constitutes the background of a template for a narrative of the role-play ‘Protecting Blue Horizons’. A rough outline is offered for a potential situation where an MPA is intended for biodiversity protection and regeneration but meets with opposing interests. It is highlighted that this is but a possibility, which may be usefully replaced by a local example.

2.1 Role-play design and development

The stakeholder profiles were developed from interviews with people involved in different aspects of marine protected areas. Their backgrounds included research, MPA establishment and management, business, policy, civil society, and adult education. Most direct contacts were with stakeholders in European countries, but also a few in Asia, Africa and Latin America. The EU Ocean Days in 2024 offered opportunities for numerous informal interviews with experts on MPAs. Twelve more structured interviews were conducted in person and through online conference calls. An equal number of persons were contacted through email in different regions. Conference and meeting presentations of persons with a wide range of institutional profiles, who explained the process of building consensus around an MPA and how to deal with a range of challenges, were additional valuable sources. Further literature research together with the professional experience of the authors provided the set of information inputs to help shape the character profiles for the role-play.

We developed 11 characters, namely the designated manager of the MPA, the mayor (public official), an industrial fisher, an artisanal fisher, a woman in artisanal fisheries, a natural scientist, a social scientist, a manager of a tourist company, a manager of an offshore windfarm, a manager of the local sewage plant, and a representative of a nature conservation civil society organisation (Figure 2). Each character has a one-page information sheet offering a sketch of the background and likely arguments to characterise the position to be impersonated. The objective of developing consensus for a functioning marine protected area is clearly stated. All players are therefore invited to listen carefully to the views and opinions of the others in search for common ground though consensus should not be obtained at all costs. It is not necessary to use all characters. Especially if time is a constraining factor, the role-play can be enacted with fewer stakeholder roles.

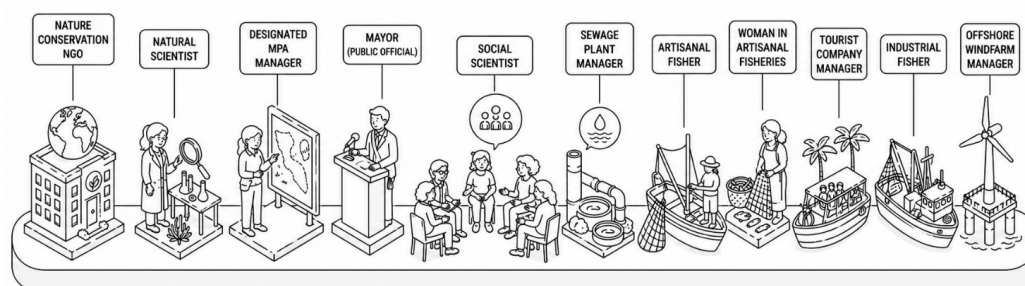


Figure 2: The stakeholder ecosystem: Each player receives a detailed briefing sheet outlining their character's constraints, economic drivers, and negotiation leverage.

In addition, a general introduction to the role-play is offered together with a more detailed advice for a moderator. The role of the moderator is to make sure that the conversation remains focused on the goal of developing a consensus for a functioning MPA and that all voices are being heard. In other words, although not directing the conversation, the moderator should prevent a particularly forceful person dominating the exchange and stopping a perhaps more reserved participant in their expression. By the end of the allotted time, the moderator should seek recognition by all parties of the need for protection. Destructive activities, such as bottom trawling, should be prohibited within the MPA core zone. It is clarified that consensus is sought, but not at the expense of sacrificing the core protection concern e.g. of protecting key habitats, spawning areas. It must be avoided being so permissive that a paper park would result that will not generate any of the benefits sought and in turn risk that all parties are dissatisfied and even disenchanted. It is clearly stated that “agreeing to disagree” and to continue the conversation on another occasion is a legitimate result.

The moderator's role extends also to the debriefing, when players end the simulation and return being themselves again. Stepping back from the game's potentially emotional atmosphere, participants can now reflect on their experience during the game. They can examine whether they felt treated fairly in their role and as a person, and how they related to the other characters. They can analyse what had happened during deliberations, and what they thought needed further information gathering and follow-up. Crookall (2010, 2023) emphasizes the importance of this debriefing, including the need to give space to very personal reactions or mental associations as these can be – and often are - key triggers of learning and appropriation of new insights. These can help better understanding of the complexities of social negotiation processes, thus counter the temptation of simplistic solutions at the expense of nature or economically weaker actors. The reflections during the debriefing may also open new vistas towards socially and environmentally fair pathways and cast light on one's personal sensitivities and well-being.

Expecting to trigger some more interest, an information sheet with further reading and sources of experiences and practice is available.

2.2 Educational implementations and analytical corpus

We conducted an initial test involving a set of two parallel sessions with all or almost all 11 actor profiles in English played by university students at a marine youth conference in 2024. The participants had mostly chosen their character the first day of the conference when the principle of the role-play was presented in plenary and had had time to read and digest the description well ahead of the enactment of play. The two groups met the following day, sitting in open circles with their individual briefing sheets available. Only a bit more than one hour was available for the role-play proper, too little to go deeper into the dynamics with all characters, but enough to hear all voices and get an initial ‘feel’ for the dynamics of a multi-actor deliberation process.



As part of the World Oceans Day celebrations in 2024, third-year undergraduate students in the Biology program at the Universidad de Belgrano conducted a role-playing exercise with the participation of second- and first-year students. In February 2025, a similar role-playing exercise was conducted at the Zitácuaro campus of the Universidad Centro Panamericano de Estudios Superiores (UNICEPES) in México, with undergraduate students of different careers, including environmental sciences, psychology and business administration, amongst others. At the Latin American institutions, the role-play exercises were moderated by professors and/or authorities. In both cases, participants were divided into six groups, each representing a distinct type of actor in a simplified negotiation setting: a public official, a scientist, an artisanal fisher, an industrial fisher, a wind farm owner, and a nature conservation NGO representative. Each group received an introductory explanatory video and printed materials in Spanish to prepare for their respective roles. Following this preparatory stage, each group of actors had 20 minutes to formulate their arguments before entering a moderated exchange. The debate was facilitated by an instructor and supported by advanced students in the program.

2.3 Directed Thematic Content Analysis

To analyse the transcripts of the role-playing games conducted at both Latin American universities, a directed thematic content analysis was applied, guided by the four global goals of the GBF. Affinito, Butchart, Nicholson *et al.* (2025) evaluate its monitoring framework, noting both its ambition as a multilateral agreement and the challenges of implementation. Methodologically, this corresponds to what Hsieh and Shannon (2005) define as a directed approach to qualitative content analysis, in which existing theory or relevant research findings guide the initial coding categories.

Accordingly, each GBF goal provided a thematic axis from which indicators or categories of analysis were derived, such as biodiversity awareness, international cooperation, and environmental justice. The transcripts were then examined to identify how, and to what extent, these themes appeared in the role-playing exercises. They were read repeatedly and coded manually by the second author. Relevant statements were compared with the predefined GBF-based indicators, and the coding was subsequently reviewed against the original transcripts. No AI tools were used to generate or interpret the thematic results.

The indicators used are qualitative and thematic, meaning that they are not numerical metrics but conceptual categories grouping fragments of discourse by theme. For instance, “international cooperation” is linked to Goal D, while “biodiversity awareness” relates to Goals A and B. Anchoring the analysis in the GBF, supports the content relevance and interpretive validity of the analytical framework, since the categories are derived from an internationally recognized biodiversity policy framework. Moreover, the Framework itself emphasizes the need to “integrate transformative education on biodiversity” into formal and non-formal programmes, which makes its use as a reference for educational activities consistent.

Nevertheless, the use of a recognized framework does not by itself guarantee validity. Transparency in category definition, coding criteria, and the selection of illustrative excerpts remains necessary to strengthen the trustworthiness of the analysis. In this sense, Elo, Kääriäinen, Kanste *et al.* (2014) highlight the importance of ensuring reliability, validity, and transparency throughout the qualitative content analysis process.

In this case, codes were defined following Hughes (2023) who details its structure—four global goals and 23 targets—and its relevance for conservation, restoration, sustainable use, and financing. Unlike conventional content analysis, this approach enables the extension or refinement of existing theory through textual evidence (Hsieh and Shannon 2005). It assumes that the dynamics of the role-playing exercises can be analytically decomposed into these global themes, making them pertinent for describing pedagogical content. Although the Framework still presents gaps in coverage and implementation (Affinito, Butchart, Nicholson *et al.* 2025), using its objectives as a thematic guide reinforces the coherence and scope of the evaluation.



255 Although qualitative content analysis can combine qualitative and quantitative elements, here a non-frequential approach was chosen. The focus is on recording the presence or absence of each thematic axis in the transcripts, rather than quantifying their frequency. This dichotomous indicator approach is appropriate for a diagnosis of thematic coverage, rather than a detailed statistical analysis.

260 Finally, to provide a synthetic descriptive summary of thematic coverage, each indicator was assigned a score of 2 when it was identified in both university transcripts, 1 when it was identified in only one transcript, and 0 when it was not identified in either transcript. For each GBF goal, a thematic coverage index was then calculated by averaging the indicator scores and normalising them by the maximum possible score. This yielded a descriptive index ranging from 0 to 1, where higher values indicate broader cross-case thematic representation.

3. Results

3.1 Formative insights from the initial test

265 Here we report but the first monitored implementation experiences with the role-play in the two types of configurations outlined above. Feedback from a larger sample may provide more nuanced and additional insights about the most useful setting in a given context. In this context, we are exploring the possibility to complement the written description of each character in the role-play with a short explanatory video to attune to learning and viewing habits of Generation Z.

270 The debriefings at the marine youth conference showed several reactions. In the first test group, they were mostly related to the role of the moderator for not ensuring that the encouragement of cooperation did not happen at the expense of the biodiversity protection goal. In this group players ended with the feeling that they were heading towards a 'paper park' as the moderator was probably not reminding the group strongly enough of the overall biodiversity protection objective. One particularly stubborn and articulate stakeholder had – to his own surprise – swayed the entire conversation in his favour. That left a number of players unsatisfied with themselves and with the moderation. In hindsight they thought they

275 could have made better use of the opportunity to put forward the arguments in favour of their interests in relation to the overarching objective. In the second test group, the risk of one player domineering the debate, albeit with the best intentions for the public good, was gently stopped by the moderator to allow all voices to be heard. Because some technical options were not clear to all participants, room was given to additional explanations. Despite the time restrictions everybody had the opportunity to

280 speak out, though that was not sufficient to come up with a generally acceptable solution. The moderator thus used the last few minutes to explore whether the principle of establishing an MPA could be accepted, with the details of the Where and How referred to another round of deliberations. After a short exchange that was accepted by all and appreciated as a realistic pathway in the debriefing. The participants also expressed the wish for a less constrained setting where they could forget that they were playing and get deeper into the clearly complicated balancing act between different

285 perspectives, constraints and needs.

The feedback of these two groups was used for some adjustments particularly in the advice for the moderator. Two points were strengthened: ensuring consensus was desirable, but not at any cost; and making sure that all participants could express themselves. In addition, the instructions now recommend to either draw up a map or use a map of a nearby coastal area to help visualising the spatial overlaps of interests to facilitate seeking to minimise trade-offs.

290 We expect that repeated playing enhances learning processes significantly as players expand their understanding of both the technical and politico-institutional settings of the change process they are grappling with. They acquire greater confidence in speaking out and explain their points clearly to others. Reiss, Gilligan and Bradham (2025) showed this



being the case in a large-scale deployment of a board role-play about the energy transition towards climate neutrality of a Mega-City, which has so far involved large numbers of schools, universities and businesses in several countries.

295 3.2 Thematic coverage of the GBF in the Latin American university role-plays

The analysis revealed an uneven representation of the four GBF goals. Goal B, related to sustainable use, ecosystem services, nature's contributions to people, and sustainable development, was the most consistently represented in the students' discourse. Goals A and D were only partially represented: some references were made to ecosystem integrity, restoration, biodiversity protection, funding, capacity-building, and collaboration, but these dimensions did not appear
 300 with the same breadth or consistency. Goal C, concerning fair and equitable benefit-sharing, traditional knowledge, and access and benefit-sharing arrangements, was the least represented (Table 1).

Table 1: Thematic coding framework used to analyse the role-play transcripts from Universidad de Belgrano and UNICEPES, based on the four overarching goals of the Kunming–Montreal Global Biodiversity Framework.

GA-Protect and Restore		Both	One	None
T1: Ecosystem integrity, connectivity and/or resilience	I1: Mentions of ecosystem processes or functions			X
	I2: Reference to ecosystem integrity or resilience	X		
T2: Restoration of natural areas	I1: Discussion of restoration activities		X	
T3: Prevention of species extinction and recovery of wild species	I1: Comments on species protection or extinction risk	X		
	I2: References to the abundance or population recovery of native species	X		
T4: Genetic diversity	I1: Recognition of genetic diversity		X	
GB-Prosper with Nature				
T1: Sustainable use and management of nature resources	I1: Mentions of sustainable resource use	X		
T2: Nature's contributions to people, including ecosystem services	I1: Discussions on ecosystem services		X	
	I2: References to biodiversity or nature's contributions to people	X		
	I3: References to links between biodiversity and human well-being	X		
T3: Rehabilitation of declining functions or services	I1: References to the rehabilitation of declining ecosystem functions or services		X	
T4: Sustainable development	I1: References to sustainable development or sustainability	X		
GOAL C – Share Benefits Fairly				
T1: Benefit-sharing related to genetic resources	I1: Mentions of monetary or non-monetary benefit-sharing arrangements related to genetic resources			X
T2: Benefit-sharing related to traditional knowledge	I1: Mentions of monetary or non-monetary benefit-sharing arrangements related to traditional knowledge			X
T3: Protection of traditional knowledge	I1: Recognition or protection of traditional knowledge	X		
T4: Access and benefit-sharing arrangements	I1: Inclusion of indigenous people and/or local communities in decision-making		X	
	I2: References to equity or fairness in the distribution of benefits	X		
	I3: References to relevant international agreements		X	
GOAL D – Invest and Collaborate				
T1: Means of implementation: scientific,	I1: Mentions of funding, investment, or financial flows for biodiversity protection	X		



technical, capacity-building and financial resources	I2: References to capacity-building initiatives	X
	I3: Proposals for collaboration or partnerships	X
	I4: References to technology transfer	X
T2: Equitable access of scientific, technical, capacity-building and financial resources	I1: Discussion of equitable access for developing countries and economies in transition	X

Note. GA = Goal A; GB = Goal B; GC = Goal C; GD = Goal D. T1, T2, T3, T4. refer to Theme 1, Theme 2, Theme 3, Them 4, respectively. I1, I2, I3, I4 refer to Indicator 1, Indicator 2, Indicator 3, Indicator 4, respectively.

From a methodological standpoint, applying directed content analysis (Hsieh & Shannon 2005) provided a robust strategy to assess whether students' discourse reflected themes prioritized by international biodiversity policy. In this approach, coding categories are predefined based on theoretical or policy frameworks, ensuring strong content validity. The GBF, as the most recent and ambitious multilateral agreement on biodiversity (Stephens 2023; Hughes 2023; Affinito, Butchart, Nicholson *et al.* 2025), offered a coherent structure for identifying whether educational activities integrate globally recognized priorities such as ecosystem restoration, benefit-sharing, and international collaboration. The use of presence/absence coding, rather than frequency counts, aligned with the exploratory aim of this study and avoided over-interpretation of repeated mentions that might stem from conversational dynamics rather than conceptual salience (Elo, Kääriäinen, Kanste *et al.* 2014).

The results show that Goal B (Prosper with Nature) was well represented. Students in both universities referred to ecosystem services and sustainable development, demonstrating that ecological and sustainability issues are readily accessible in their discourse. By contrast, Goal C (Share Benefits Fairly), which emphasizes equitable access to genetic resources and protection of traditional knowledge, was the least represented. Goal A (Protect and Restore), which focuses on ecosystem integrity, restoration of natural areas, conservation of species and genetic diversity, and Goal D (Invest and Collaborate), focusing on financial resources, capacity building, and technology transfer, were partially represented. These gaps highlight that although ecological knowledge and sustainable use of resources may be spontaneously mobilized in educational simulations, issues of justice, equity, and global governance may not emerge without explicit facilitation.

The descriptive thematic coverage index supported the qualitative interpretation of the coding matrix. Goal B showed the highest level of thematic coverage (0.83), followed by Goal D (0.70) and Goal A (0.67), both of which were only partially represented. Goal C showed the lowest level of coverage (0.50), confirming that issues related to benefit-sharing, traditional knowledge, and equity were only weakly addressed across the university role-plays (Figure 3).

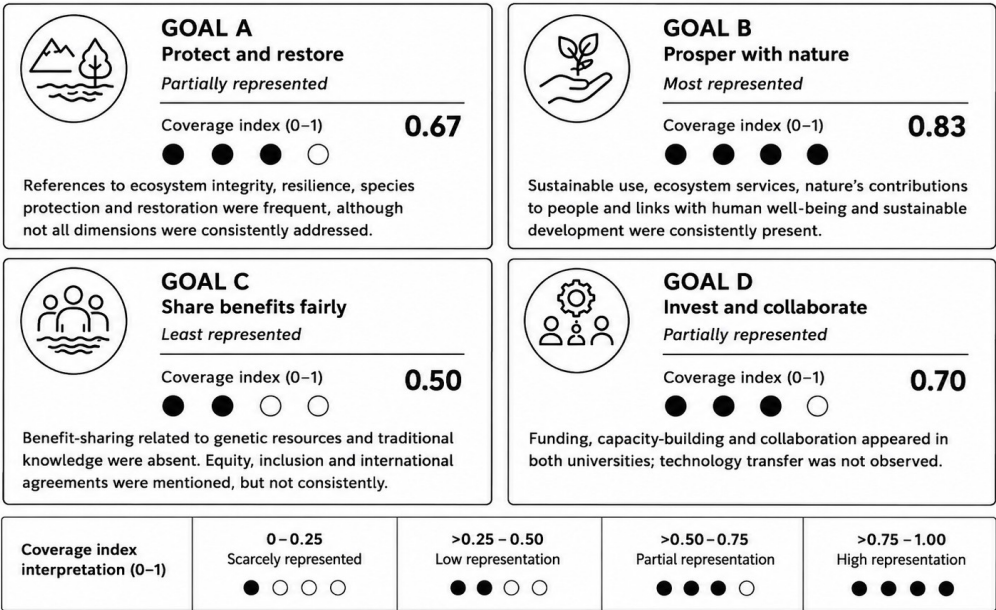


Figure 3: Directed thematic content analysis of university role-plays transcripts based on the Kunming-Montreal Biodiversity Framework (GBF).

Note: Index calculations: 2= present in both university transcripts; 1= present in one transcript; 0= absent in both. For each goal, index= (sum of indicator scores)/ (2 x number of indicators in the goal), yielding values from 0 (absolute absence) to 1 (absolute presence).

325 Pedagogically, these findings suggest that the role-play, in the educational settings examined here, can foster awareness of ecological and sustainability issues. Socio-political dimensions of biodiversity governance were less prominent. This may be particularly relevant in natural science programmes, where greater emphasis is understandably placed on ecological and biological dimensions than on the social sciences and humanities. Given that the GBF explicitly calls for transformative education to address both ecological and social aspects of biodiversity (Hughes 2023), the findings point to a need for redesigning role-play scenarios to explicitly incorporate dilemmas around benefit-sharing, inclusion of Indigenous peoples and local communities, and international cooperation and encourage participation by a broader mix of students from the natural and social sciences as well as from the humanities. Doing so would align classroom practices more closely with the multidimensional nature of the GBF's aim of regenerating and protecting biodiversity in typically contested contexts. This way, the role-play alerts students towards a fuller understanding of biodiversity governance as a human, socio-economic, scientific, cultural and a political challenge.

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In sum, this initial study confirms that role-play can be a powerful pedagogical tool for engaging students with biodiversity issues but also underscores the importance of deliberately and explicitly integrating equity and governance topics if the full spectrum of the GBF goals is to be represented in educational practice.

4. Outlook and Conclusion

340 The first tests of the role-play Protecting Blue Horizons explored two different configurations for learning about the establishment and functioning of a marine protected area. In the initial test, students, mostly with backgrounds in marine



science, sat in an open circle, with each participant representing one of the stakeholder characters. The debriefing highlighted the importance of the moderator in keeping the conversation focused on the biodiversity protection objective and ensuring that all voices were heard. It also showed that some participants felt more comfortable with their chosen characters than others and would have appreciated more time to explore the issues at stake and interact more intentionally with the other roles.

The university implementations in Argentina and Mexico placed greater emphasis on clarifying stakeholder positions through group work focused on a reduced set of core characters, followed by moderated exchanges among the role groups. The recordings of these sessions allowed for a finer-grained qualitative analysis of the extent to which the four goals of the Kunming–Montreal Global Biodiversity Framework were addressed in the deliberations. The analysis showed that Goal B, related to sustainable use, ecosystem services, nature’s contributions to people, and sustainable development, was the most consistently represented. Goals A and D were only partially represented. Goal C, concerning fair and equitable benefit-sharing, traditional knowledge, and access and benefit-sharing arrangements, was the least represented.

Taken together, these findings reinforce the pedagogical importance of debriefing. The initial test showed that debriefing helps participants process negotiation dynamics, reflect on the role of moderation, and recognise when consensus-building risks weakening the conservation objective. The thematic analysis of the Argentina and Mexico sessions adds a further insight: without an explicit reflective phase, some key socio-political dimensions of biodiversity governance may remain underdeveloped in students’ discourse. Debriefing should therefore not be treated as a merely optional closing activity, but as a central learning moment in which facilitators can help participants revisit neglected dimensions of the GBF, including equity, benefit-sharing, financing, capacity-building, international cooperation, and the protection of traditional knowledge.

These results suggest that future versions of the role-play should more explicitly integrate justice, equity, and implementation challenges into the role descriptions, introductory materials, moderation guidance, and debriefing prompts. This would help participants move beyond the more readily accessible language of sustainability and ecosystem services towards a fuller understanding of biodiversity governance as both an ecological and socio-political process. In this sense, the role-play should be used primarily as a formative learning tool rather than as an instrument for comparing student performance across contexts.

The diversity of perspectives generated by the activity should be welcomed and encouraged, with emphasis on respectful exchange, situated learning, and adaptation to local contexts. From these early experiences, we also conclude that teaching aids for high school and university educators would be valuable to support the use of Protecting Blue Horizons as an enrichment of the curriculum. Such materials could include guidance for adapting the scenario, facilitating deliberation, conducting debriefing, and connecting participants’ reflections with the principles of the GBF. In doing so, the role-play may help illuminate the combination of ecological protection, social legitimacy, stakeholder dialogue, and transformative learning needed to protect blue horizons more effectively.

Code and data availability

Not applicable, however, the complete set of instructions of the role play ‘Protecting Blue Horizons’ in English, Spanish, French, Italian, and German are freely available on the *Mundus maris* website in the section Resources at <https://www.mundusmaris.org/educational-resources/protecting-blue-horizons/>



Author contributions

Both authors contributed equally to the conceptualisation, analysis, writing, editing and review. Generative artificial intelligence tools were used as assistive tools during the preparation of this manuscript. ChatGPT (OpenAI) was used to improve the clarity, readability, and fluency of the text. Both NotebookLM (Google) and ChatGPT were used interactively to support the development of figures based on textual material provided by the authors. The figure-development process involved iterative prompting, review, and refinement by the authors. All AI-assisted outputs were critically reviewed, edited, and validated by the authors, who take full responsibility for the final content of the manuscript.

Competing interests

The authors declare not competing interest.

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