



## Introduction

The impact of human activities on nature has been increasing over the past years (e.g., overconsumption, food production, resources extraction, growing population...), endangering the preservation of species and the functioning of ecosystems. As stated in the global assessment report on biodiversity and ecosystem services written by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) (2019), only a transformative change may be able to address the current unsustainable pathway. Transformative change refers to “a fundamental system-wide change that takes into account technological, economic and social factors, including paradigms, goals and values” (Díaz et al. 2019; IPBES 2019) in a way that sustains the Earth’s biophysical systems, while meeting human development needs (IPBES 2019; Palomo et al. 2021). Transformative change involves individual changes (values, perceptions, behaviours) and changes at a more macro level (laws, regulations, institutions, market, innovations) (Kendal et al. 2018; Naito et al. 2022). Without transformative change, humanity is at risk of seriously degrading, even losing, nature’s crucial contributions to people (Chan et al. 2020), increasing the risk of future zoonosis outbreaks (UNEP 2016), triggering catastrophic climate change events (IPCC 2018, 2023), and generally going beyond planetary boundaries i.e., the safe operating space for human societies to develop and thrive (Steffen et al. 2015). In addition, according to the IPBES and the Intergovernmental Panel on Climate Change (IPCC), such transformative change is essential for achieving the Paris agreement, the post-2020 biodiversity targets, and several sustainable development goals (SDGs) (Chan et al. 2020; Palomo et al. 2021). This requires firstly identifying the direct and indirect drivers of biodiversity loss (Coffey et al. 2022), and secondly ensuring that the governance in place allows for the implementation of appropriate changes.

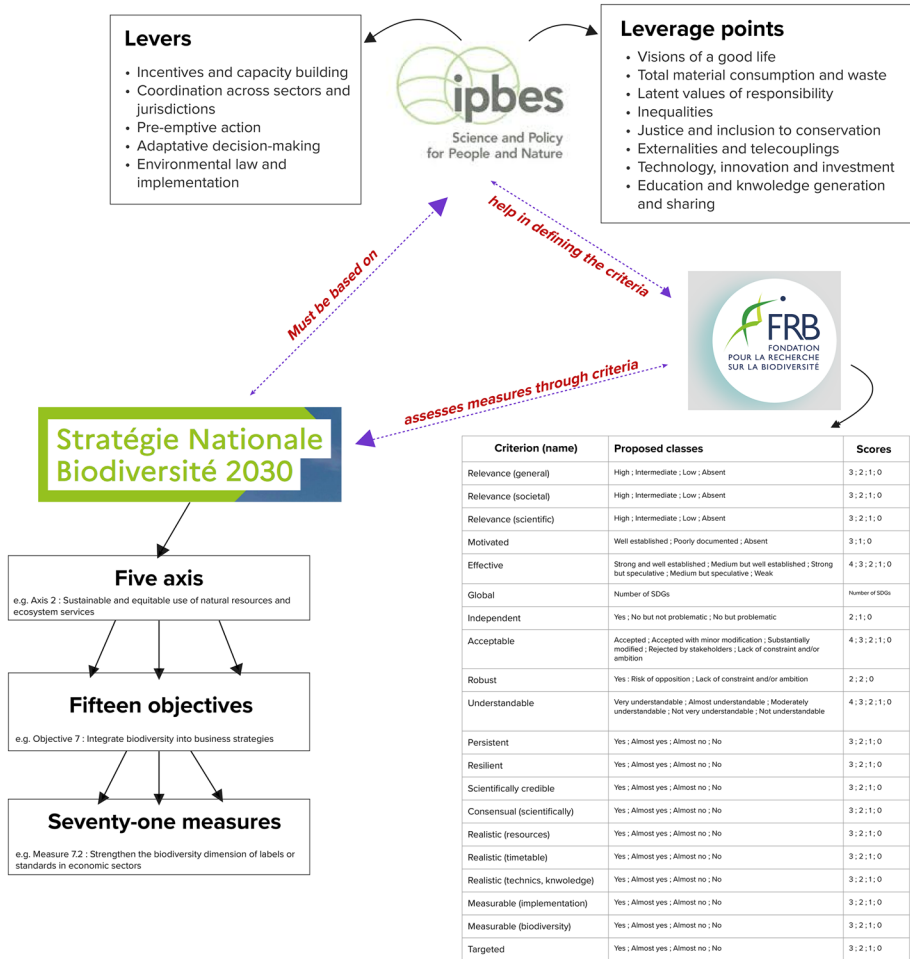
In its 2019 global assessment, the IPBES identified eight priority points (leverage points) and five main interventions (levers) to achieve societal transformation (Díaz et al. 2019; IPBES 2019) (see supplementary material 2). These levers include incentives and capacity building, coordination across sectors and jurisdictions, pre-emptive action, adaptive decision-making, environmental law and implementation. All of them can be applied across the eight leverage points, which are the following: visions of a good life, total consumption and waste, values and action, inequalities, justice and inclusion in conservation, externalities and telecouplings, technology, innovation and investment, and education and knowledge generation and sharing. All these leverage points can be applied by all types of actors—including the private sector, citizens, NGOs and governments—which can lead to reaching sustainable goals (IPBES 2019). They represent the key sectors and points on which to act in priority in order to yield the greatest impact. The IPBES recommendations are intended to be reflected within other schemes such as the United Nations Convention on Biological Diversity (CBD) as well as at the other levels of governance, especially states levels. The CBD is an international treaty, which has three main principles: the conservation of the biological diversity, the sustainable use of the biological diversity, and the fair and equitable sharing of resources and benefits (CBD 2022). It aims to promote measures in favour of a sustainable future for everyone. By ratifying the CBD in 1994, France is still committed to establishing biodiversity strategies or action plans in accordance with its international recommendations and frameworks. The third National Biodiversity Strategy [in French: *la Stratégie Nationale pour la Biodiversité* (SNB3)] is France’s response to the Global Biodiversity Framework (GBF) and to the

European Biodiversity strategy for 2030 (EBS). Published in March 2022, the strategy mostly aims to reduce direct and some indirect pressures on biodiversity, protect and restore ecosystems, and bring about far-reaching changes to reverse the biodiversity decline (Ministry of Ecological Transition 2022). The SNB3 being the principal French response to the global and European frameworks, it is thus essential to know whether this strategy acts on the most efficient levers and leverages points, and whether the strategy's measures are relevant and sufficient to lead to societal transformation and transformative change. It is also necessary to know whether the strategy identifies effective means of action and promotes a suitable regime of governance for such changes (Díaz et al. 2019; Razzaque et al. 2019). Indeed, the previous strategy—the second national strategy for biodiversity (SNB2)—failed to halt biodiversity loss for several reasons: insufficient reduction of pressures on biodiversity; insufficient identification and reform of the sectoral policies involved; poor coherence of public action due to the lack of clear objectives, quantified targets and action plans; weak political support and interministerial governance; unclear distribution of roles among all stakeholders; lack of a monitoring and assessment system. The SNB2 has led to the *status quo*. In this context, the French Foundation for Biodiversity Research (FRB), a science-society platform funded by research institutions, has developed a methodology for a public policy *ex-ante* assessment aiming to evaluate the capacity of a strategy to leverage and bring about transformative change. The methodology has been tested on the SNB3. Hence, our main aim was to classify the SNB3 measures according to their leverage power and to identify, for each measure, the elements that explain why they do or do not have leverage potential (Fig. 1). We need to ensure that this strategy does not follow a trajectory of business-as-usual and announcement effect, as can be the risk with the announcement of transformative change (Blythe et al. 2018). We present an original methodology for analysing strategy/public policies, which is easily replicable and directly usable by policymakers. This work is in direct response to the need to follow sustainable pathways in all spheres of our society, notably in politics, economy, education, and consumption.

## Towards transformative change: what do we want to reach?

Before presenting our assessment method, it is necessary to define more precisely what is meant by transformative change, and what is involved. The levers and intervention points developed by Díaz et al. (2019) include acting on the direct, but especially indirect, drivers of pressure on biodiversity, represented by current social structures: consumption, trade, demography, governance, institutions (Visseren-Hamakers et al. 2021). These indirect factors are the causes of the direct pressure factors identified by IPBES: land and sea use change, climate change, direct exploitation of nature, pollution, invasive alien species. Moreover, Naito et al. (2022) define three categories of action to achieve transformative change: (i) private actions (individual choices, no structural effect); (ii) social signalling actions (behavioural and norms changes); (iii) system changing actions (behavioural changes to alter institutions, laws, corporate actions, policies). Indeed, the SNB3 should fall into this third category, as it aims to instigate actions to change the socio-ecological system.

However, these actions are not enough alone. Many researchers have stressed that integrative, pluralistic, inclusive governance approaches must accompany the implementation of these actions (Díaz et al. 2019; Naito et al. 2022; Turnhout et al.



**Fig. 1** A schematic representation summarising the assessment process and the links between the levers, leverage points, assessment criteria and the national biodiversity strategy. The FRB assessed the SNB3 measures using twenty assessment criteria, which were defined on the basis of the IPBES levers and leverage points (cf. Supplementary materials 2 and 8)

2021). Current adaptation of practices and regulations is too slow; more radical solutions are needed that transform society as a whole (Hysing and Lidskog 2021). If the actions taken do not move away from current governance and socio-economic trajectories, they will not lead to profound changes (Díaz et al. 2019). We must, however, avoid the risk of simplifying the solutions proposed in the face of complex problems because they are based on complex ecosystems, which would not be sufficient to halt the decline in biodiversity (Hysing and Lidskog 2021). We must move from discourse to action (Fougères et al. 2022).

Finally, these approaches must be systemic, feeding each other, otherwise they risk leading to failure and maintaining the *status quo* (Folke et al. 2021; Jacobs et al. 2022; Patterson et al. 2017; Turnhout et al. 2021). Since the direct and indirect factors of biodiversity loss are linked and interdependent; without synergy, there is a risk of negative effects of the actions carried out (Chan et al. 2020). The proposed solutions, must therefore

be interdependent, addressing regulation, the economic sector, market functioning, institutions and individual behaviour.

## Materials and methods

*The list of all the variables used in this methodology is presented in Supplementary Material 1.*

### Presentation of the French National Biodiversity Strategy for 2030 (SNB3)

The SNB3 is the third national biodiversity strategy reflecting France's commitment under the Convention on Biological Diversity. It will be implemented over 8 years (2022–2030). The first part of the SNB3 was published in March 2022, and presents the measures of the strategy but without the associated targets and resources. The second part: the implementation (targets, financial resources, actors responsible for its implementation), is due to be published in 2023. It will integrate the recommendations of the 15th United Nations Biodiversity Conference of the Parties (COP15) and to evaluate the costs of the implementation of the measures. The FRB has evaluated the first part of the SNB3 to establish recommendations that will potentially be integrated into the second part of the strategy.

The first part of the SNB3 is composed of five thematic axes, within which are fifteen objectives (Fig. 1; Supplementary material 7). The five axes are the following: (1) the protection, restoration and resilience of ecosystems, (2) the sustainable and equitable use of natural resources and ecosystem services, (3) an aware, trained and mobilised society, (4) a cross-functional, results-oriented management, (5) financing serving biodiversity policies. In total, the strategy consists of 71 measures across these five axes and fifteen objectives. As axis 4 is the one organising the implementation of the strategy, and as the information on implementation is due to be published in the second part of the SNB3, we evaluated axes 1, 2, 3 and 5, equating to the analysis of 11 objectives including 55 measures out of 71.

### Definition of the assessment criteria

In October 2021, members of the FRB's scientific council worked on identifying leverage measures. The scientific council defined 20 assessment criteria aimed to answer the following question: "What are the characteristics of a leverage measure?" (cf. supplementary material 3). They relied on the transformative change literature and on the first phase report of the French assessment of ecosystems and ecosystem services (Kervinio 2020). These criteria should make it possible to identify whether the measures proposed in a strategy or action plan meet the challenges of transformative change. The assessment criteria need to identify whether the measure is relevant in its proposal and responds to an identified major issue of biodiversity loss ("relevance" criterion from a general, societal and scientific point of view), whether it identifies the activities and causes of this biodiversity loss ("motivated" criterion), whether it proposes solutions adapted to the problems ("effective" criterion), whether it is systemic and addresses more than one societal issues and sustainable development objectives ("global" criterion), whether it is based on plural and credible scientific work ("scientifically credible" and "scientifically

consensual” criteria). The criteria must also address the long-term nature of the measures: whether the measure can have a long-term effect, thanks to resources and actions that last over time (“persistent” and “resilient” criteria), whether its implementation is possible (“realistic” criterion, in terms of resources, timetable and available techniques and knowledge), and whether its effects can be evaluated (“measurable” criterion, in terms of implementation and effects on biodiversity).

In addition, although the assessment method does not aim to evaluate the first steps of the SNB3 writing process (online public consultation and stakeholders’ virtual meetings), it is important to ensure that the SNB3 will allow for a more transformative governance in its implementation: does it appear to be inclusive in the proposed measures? Does it identify the *winners* and *losers* of its implementation? Does it consider the plurality of visions and values in society? Fundamental changes can generate resistance, contestation, conflict and power struggles by actors who do not see fit the changes (Díaz et al. 2019; Grin et al. 2010; Patterson et al. 2017). Certain interest groups may push for *status quo* (asking for more research, more evidence) or technocratic and limited solutions rather than systemic ones (Fougères et al. 2022; Lamb et al. 2020). Further, the actors responsible for implementing transformative actions may not be sufficiently trained and may have difficulty understanding the issues at stake (Fougères et al. 2022; Martin et al. 2020). It is necessary to identify these risks and ensure that they are taken into account in a strategy or action plan. The assessment criteria of “targeted”, “robust”, “acceptable”, “understandable” and “independent” allow for verifying this.

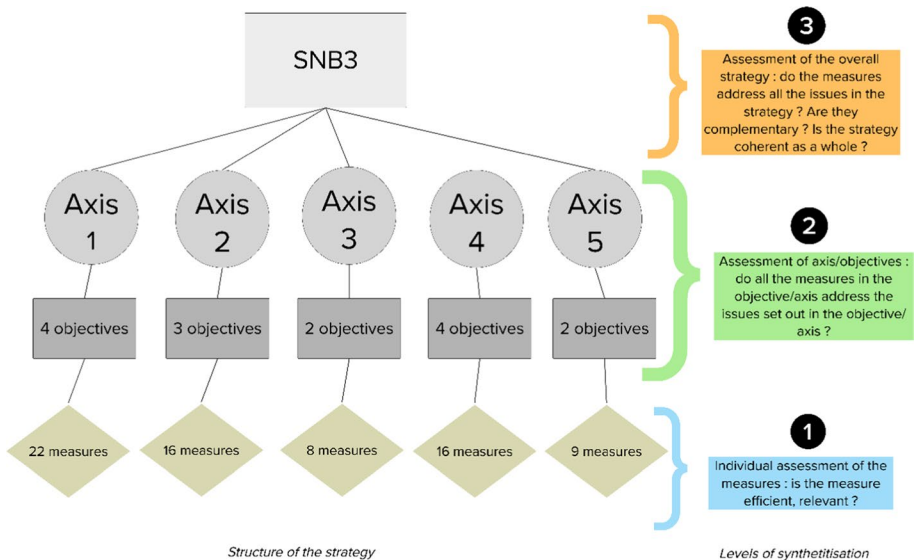
It is important to emphasise that the chosen criteria are, individually, classic components of public policy assessments. The interest of this method lies in the fact that they have been considered as a whole. The aim of our methodology is to be able to assess whether the measures proposed by a strategy, in this case the SNB3, can accelerate change. Once identified on a theoretical level, we tested these criteria on the SNB3, to verify their practical application on a real policy case and as the content of the SNB3 is very heterogeneous. Tests were preliminarily carried out with some of the strategy’s measures: this allowed us to adjust and pinpoint criteria description in order to make, on the one hand, the assessment feasible and, on the other hand, the method replicable and applicable to any type of strategy or policy. As a result of these preliminary tests, the criteria and their descriptions were refined and listed in a table with additional information: name of the criterion, description of the criterion, precision on the elements evaluated through criterion, rating classes for each criterion (cf. Supplementary material 3).

## Assessment and analysis process

The methodology proposes to undertake an assessment following four main steps: (i) the individual assessment of each measure of one strategy/public policy with ratings and comments; (ii) the ratings and assessments harmonisation; (iii) the synthesis of the assessments; (iv) a multi-criteria analysis of the measures.

- i. *Individual assessment of each measure of one strategy/public policy* Each measure was individually evaluated by academic experts with relevant expertise. To reduce/limit any potential assessment bias, each measure was evaluated by at least two experts working in different institutions. For each criterion, experts provided ratings and comments.

- ii. *Ratings and assessments harmonisation* Once every individual assessment is completed, all the experts who took part in the assessment for the same group of measures met to discuss in order to reach a consensus for each criterion of each measure. These meetings helped to reduce assessment bias, as the final ratings are validated after discussions between all the experts. This step resulted in a single assessment for each measure, reflecting the consensus of all experts. It ensures the robustness of the results that will be obtained during the multi-criteria analysis of the measures (cf. (iv)) with an equivalent rating scale for all the measures even if they have not all been evaluated by the entire panel of experts (cf. Supplementary material 5).
- iii. *Synthesis of the assessments* Assessments were synthesised at three different levels (cf. Fig. 2), (i) assessment synthesis of the measure itself against all criteria, (ii) assessment synthesis of each measure through the objective and/or the axis to which it belongs, and (iii) assessment synthesis of each measure within the whole strategy/public policy. This allowed to highlight the strengths and weaknesses of the measure i.e., is the measure itself relevant? Is there a consistency between each part of the strategy/public policy? Does the whole strategy/public policy address the initial issue? These three levels allow for a general reflection on the strategy, visualizing a measure for itself, but also its level of involvement and interdependence with other measures: a transformative change, as previously stated, can only be possible if all direct and indirect factors are targeted, if the strategy concerns all spaces, ecosystems, actors and scales.
- iv. *Multi-criteria analysis of the measures* A ranking of the measures in relation to each other, independently of their individual leverage capacity, is performed. This analysis highlights the criteria that can be improved, allowing the measure examined



**Fig. 2** Schematic diagram showing the three different levels of assessment. (1) First phase: the assessment of the individual measures; (2) Second phase: the assessment of the 15 objectives across the five axes; (3) Third phase: the assessment of the overall strategy. The SNB3 is made up of five axes, within which fifteen objectives are divided. In total, the SNB3 contains seventy-one measures (cf. Supplementary material 7)



to increase its leverage capacity. By comparing all the measures, the multi-criteria analysis allows us to see if all the characteristics are met to bring about a global, systemic change, by mobilizing all the sectors responsible for the loss of biodiversity in society. The multi-criteria analysis methodology is presented in the next section (cf. section “[Multi-criteria analysis](#)”).

## Multi-criteria analysis

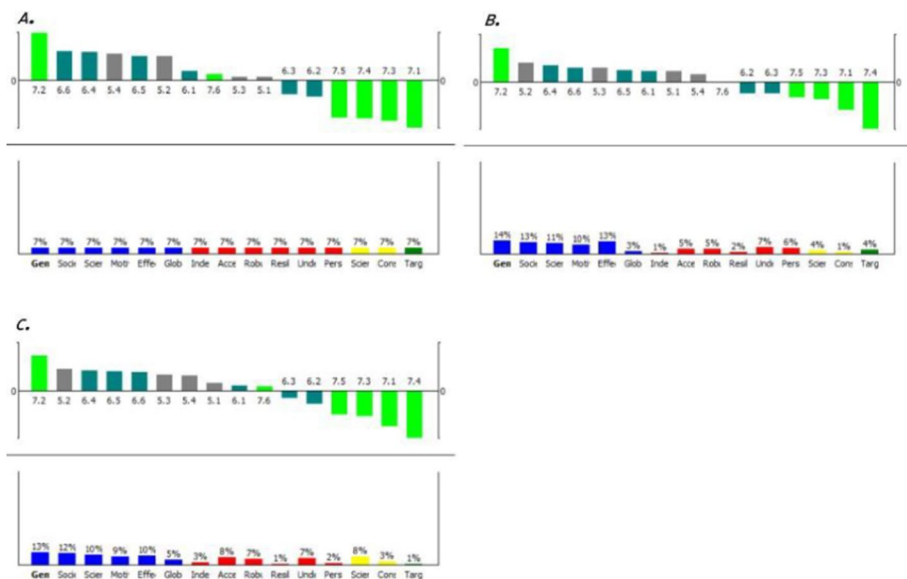
The multi-criteria analysis consists in grouping the measures together to identify the strengths and weaknesses of each measure, and thus identify what could be improved for each measure. It also consists of weighting the assessment criteria. Indeed, this method provides an overview of the strengths and weaknesses of a strategy. Because limiting reflection to individual assessments of measures can mask the overall trajectory of a strategy, a series of questions were put to experts. These were: are all sectors of activity with an impact on biodiversity mentioned? Are all ecosystems targeted by measures? Does the strategy use all possible levers (regulations, laws, incentives, economics, public awareness)? Similarly, the multi-criteria analysis makes it possible to identify areas where there are gaps: e.g., relevance of the measures as a whole, identification of the actors, whether or not the long-term issue is taken into account. While the measurement of the leverage effect of a given measure is characterized by its individual assessment, the multi-criteria analysis allows to assess whether the strategy or the action plan will succeed in engaging the stakeholders and the policy makers in a positive trajectory, to lead to a real transformative change in society. It can also be used as a real decision support.

To carry out this multi-criteria analysis, first, we assigned a score to each rating class (cf. Supplementary material 4) and secondly, we weighted the scoring in terms of the leverage potential of a measure). The multi-criteria analysis was carried out using the *Promethee* software (<http://en.promethee-gaia.net/>). The use of this software allows the scores to be varied, and the ranking of the measures according to the different weightings to be compared. For each individual measure, it also makes it possible to define the criteria that downgraded the leverage potential, thus making it possible to identify the measures and the criteria that need to be improved. The software allows to define the distribution function of the ratings for each criterion. In fact, the scores attributed to the rating classes are not necessarily linear nor instinctive. For example, concerning the ‘robustness’ criterion, opposition to the measure by stakeholders’ interest may mean that the measure is ambitious and going in the right direction (thus, score=2) (e.g., banning pesticides will necessarily lead to opposition from conventional farmers). However, if a measure does not lead to any opposition, it may also be because it is not particularly ambitious (then, score=0), and therefore does not lead to real transformative change after its implementation. Therefore, during the assessment process it is important to rely on the arguments associated with a rating, in order to define the appropriate score. It is possible to complete the grid for the minimum or maximum ratings that could be obtained (cf. Supplementary material 6). Also, the setting of the multi-criteria analysis allows to define a value from which the difference in rating between the measures is significant. This option is particularly useful for the “global” criterion for which it was considered that a difference of four Sustainable Development Goals (SDGs) was significant to compare two measures. To weight the criteria, we questioned two groups of stakeholders (e.g., citizens, firms, NGOs and scientists) asking them to rank criteria in relation to each other. The ranking of these criteria was based on the importance given by each stakeholder to the criterion



defining whether a measure has a leverage effect or not. Each person had to rank the criteria individually (from 0 to 20; 20 equating to highest ranking possible thus most relevant and efficient). Then, for each group of stakeholders, the average score for each criterion was calculated. Finally, each criterion was ranked according to its average score. This allows to run three weighting scenarios: the reference scenario (no weighting), and other scenarios for each group of stakeholders (one weighting for each type of stakeholders). More precisely, several types of results can be obtained from the multi-criteria analysis:

1. *The inter-ranking of measures by scenario* This ranking allows to visualize, among the measures of the same group, those which have the most potential by taking into account all the criteria, and conversely those which have the least potential compared to the others (cf. Fig. 3). Thus, the highest ranked measure in a group will be the one that has the most potential in comparison to the other measures in the group. However, this does not mean that such a measure is *perfect*, since a measure can be rated poorly in the individual assessment but be the highest ranked within a group of measures if the others were less well rated.
2. *A graph identifying the criteria that improve or lower the ranking of measures* This graph shows (cf. Fig. 5), for each measure, the criteria that enabled a measure to be ranked well, and the criteria responsible for the lowering of the ranking. This graph



**Fig. 3** Ranking of the measures of SNB3 axis 2. **A** reference scenario, **B** societal scenario and **C** scientific scenario. The order shows the evaluation criteria and their weighting for each scenario. Different colors were used to graphically represent the different objectives of the strategy. The grey bars represent objective 5—Promote biodiversity-friendly economic activity, the dark green bars represent objective 6—Promote the agro-ecological transition of agricultural production methods and food system and the light green bars represent objective 7—Integrate biodiversity into business strategies. The numbers above and below the bars represent the number attributed to each measure, i.e., “7.2” represents measure 7.2—Integrate biodiversity into reporting and investment choices of the strategy (cf. supplementary material 7 for names of all measures). The percentages at the bottom of each graph represent the criteria weighting for each scenario

therefore makes it possible to quickly identify, for each measure, any criterion that needs to be improved. It also provides an overall view of the criteria that were less well documented in the policy and for which an effort must be made.

3. *The scenario comparison graph* Allows to identify whether the ranking of the measures is similar—or, conversely, very different, regardless of the chosen weighting of the criteria (cf. Fig. 4). As each scenario is representing one vision of the society, it is then important to see whether the ranking of the measures changes according to the different visions of society. If the lowest ranked measures are the same in all scenarios, this would mean the weighting is not responsible of the ranking of these measures: the cause of the weakness of the measures relies on the design of the measure itself. It is then possible to clearly identify the measures that need to be improved as a priority within the policy, so they can be leveraged to bring about real structural changes in society.
4. *The simulation with the implementation of the measure* We used the simulation within the SNB3 assessment to go further with the analysis (cf. Fig. 6). The simulation is based on the integration of implementation criteria into multi-criteria analysis. The process is the following: the maximum scores are associated to the implementation criteria for the lowest ranked measure in each scenario, in order to over-score this measure. More explicitly, a score of “three” (maximum) is assigned for each of the implementation criteria to the lower ranked measure; a score of “zero” (minimum) is assigned for each of the implementation criteria to all other measures. We interpret that if the lowest ranked measure before the simulation remains low ranked after the simulation, then the implementation component of the strategy will not—if perfectly fulfilled—improve the ranking of this measure, and therefore indicates that this measure will never be a lever. This tends to prove that the “leverage” character of a measure and its success depend on all the criteria, not only on one part.

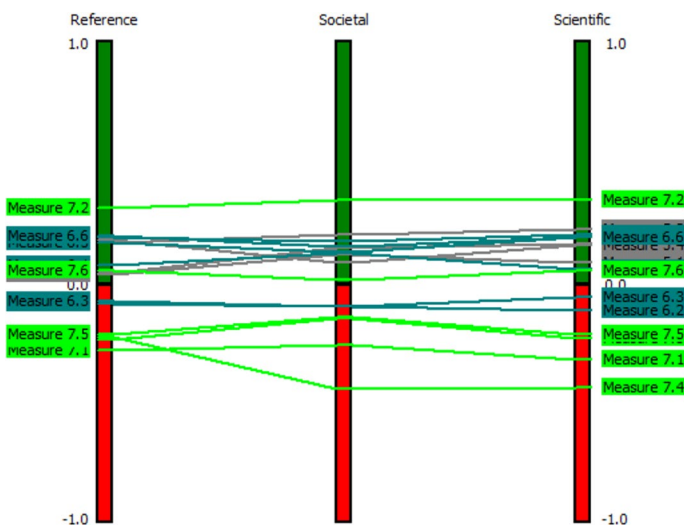


Fig. 4 Comparing the ranking of the three scenarios

An illustration of the results obtained for the multi-criteria analysis of axis n°2, entitled *Sustainable and equitable use of natural resources and ecosystem services*, is presented in the section “[The multi-criteria analysis of Axis 2](#)”.

## Results: the case of the third French National Biodiversity Strategy

### The multi-criteria analysis of Axis 2

Here we choose to present the results of the multi-criteria analysis of Axis 2 entitled ‘*Sustainable and equitable use of natural resources and ecosystem services* of the strategy’ as the use of natural resources is a major concern in terms of biodiversity erosion. Indeed, Axis 2 comprised 16 measures used to assess Axis 2’s three objectives: objective no. 5—Promote biodiversity-friendly economic activity; objective no. 6—Promote the agro-ecological transition of agricultural production methods and food systems; and objective no. 7—Integrate biodiversity into business strategies.

The results of the assessment are quite heterogeneous, which allows us to illustrate all the potential results that can be obtained through our methodology.

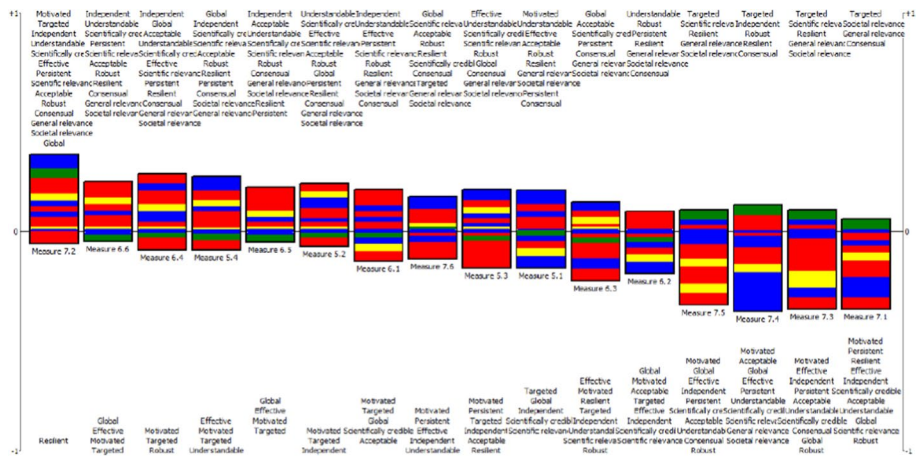
For this evaluation, we used the three scenarios: the reference scenario where no weighting of the criteria is performed, the societal scenario, and the scientific scenario (Fig. 3).

For graphs 3A–C, the top histogram represents the inter-ranking of the measures from the multi-criteria analysis and the bottom histogram represents the weighting of the evaluation criteria. There is no direct link between these two graphs in terms of scale.

This figure makes it possible to visualize the inter-ranking of the measures and to identify those that have a greater leverage power compared to the others. It also allows to distribute these measures in relation to the average score obtained (corresponding to the 0 line). For example, in our case study, we observe that the inter-ranking is similar between the three scenarios cf. Fig. 3A–C. The measures of objective 7 “Integrate biodiversity into business strategies” are mostly ranked lower whatever the weighting of the criteria, except for measure 7.2 *Integrate biodiversity into reporting and investment choice*, which is the highest ranked overall. In all three scenarios, measures of objective 6 “Promote the agro-ecological transition of agricultural production methods and food systems” are on average the highest ranked. A measure is favored by the weights chosen. The measure 5.2 *Supporting the transition of fishing and aquaculture towards practices compatible with the preservation of biodiversity, particularly multi-trophic aquaculture* gains five places in the ranking between the reference scenario (3A) and the weighted scenarios (3B, C).

Figure 4 provides a visualization of the change in inter-ranking as a function of the scenarios and the weightings. For example, the comparison of the scenarios shows that there are small differences between the rankings. We can therefore look at the different criteria involved in the ranking of the measures.

Figure 5 allows to visualize the inter-ranking of the measures with a greater level of precision. In the upper part of the figure are listed the criteria that explain why the measure is better ranked than the following ones. In the lower part of the figure are listed the criteria that explain why the measure is less well ranked than the previous ones. The graphs for the three scenarios show similar results (Fig. 4 only represents the reference scenario). What these three graphs tell us is that regardless of the scenarios, some criteria need to be better filled in to allow the lowest ranked measures (relative to the other Axis 2 measures) to be



**Fig. 5** Criteria involved in the ranking of Axis 2's measures of the Reference scenario. The colors used represent the four different categories of criteria. Blue: societal and scientific challenges; red: societal integration; yellow: scientific support; green: implementation

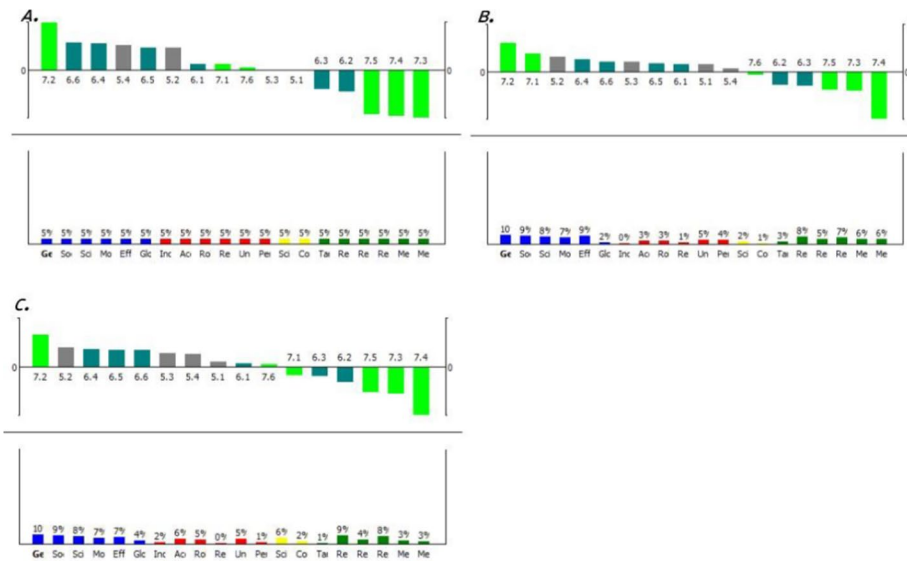
better ranked. Thus, the criteria of “motivation” (what transition dynamics will be induced) and “effectiveness” are responsible for the downgrading of measures for, respectively, 14/16 measures and 10/16 measures. What these graphs also show—and this is the case in all three scenarios—is that three quarters of the criteria for Objective 7 measures (except for measure 7.2) contribute to the poor ranking of these measures and are therefore poorly informed.

The simulation exercise (cf. Fig. 6) of the inter-rankings with the implementation criteria was undertaken for measure 7.1 *Strengthen the biodiversity dimension of labels or standards in economic sectors*, the lowest ranked measure in the reference and scientific scenarios. The variation we are interested in is that of the reference scenario, since it was the lowest ranked measure. The simulation allows measure 7.1 *Strengthen the biodiversity dimension of labels or standards in economic sectors* to move up eight places in the ranking of measures. However, it remains in the bottom half of the measure ranking. The over-scoring of certain criteria does not allow this measure to be among the top-ranked, showing its weaknesses stem from the criteria already assessed.

## General results

We considered the complementarity between the measures of the SNB3 and the state levers identified by the IPBES (2019) i.e., levers that could be activated by governments and policymakers at the national level. This comparison makes it possible to complete the results obtained according to the assessment based on criteria and the multi-criteria analysis. The recommended state levers are broken down into the following categories:

- Direct biodiversity preservation instruments
- Protection instruments
- Restoration instruments
- Instruments for indirect preservation of biodiversity and instruments for transforming economic activity trajectories into sustainable trajectories



**Fig. 6** Integration of the implementation criteria for measure 7.1—Strengthen the biodiversity dimension of labels or standards in economic sectors. **A** Reference scenario, **B** societal scenario and **C** scientific scenario. The order shows the evaluation criteria and their weighting for each scenario. Different colors were used to graphically represent the different objectives of the strategy. The grey bars represent objective 5—Promote biodiversity-friendly economic activity, the dark green bars represent objective 6—Promote the agro-ecological transition of agricultural production methods and food system and the light green bars represent objective 7—Integrate biodiversity into business strategies. The numbers above and below the bars represent the number attributed to each measure, i.e., “7.2” represents measure 7.2—Integrate biodiversity into reporting and investment choices of the strategy (cf. supplementary material 7 for names of all measures). The percentages at the bottom of each graph represent the criteria weighting for each scenario

- Instruments for organizing sustainable cities that respect biodiversity
- Instruments to take the path of a sustainable economy that respects biodiversity

These levers encourage the transformation of the current economic model towards sustainable and biodiversity-friendly models. Several state levers are reflected in 23 of the 71 measures of the SNB3. These measures are likely to have leverage potential, as the actions they propose have been identified by IPBES—on the basis of 15,000 scientific publications and 150 researchers mobilised globally—as elements to be put in place by governments leading to transformative change (IPBES 2019). This result should be contrasted with the scientific analyses. A large number of measures partially respond to a state lever either because they focus on a type of species or ecosystem, a particular territory, or an existing system. This raises questions about the systemic nature of the strategy. While it is necessary to take into account regional and local specificities, it is also necessary to generalise to all biodiversity at the national scale. Other measures respond to a state levers in a restricted part of their description, at the level of actions or sub-measures. The risk is then that a measure with leverage potential is diluted within other actions with potentially less leverage and, therefore, little implementation. It could be useful to start from these measures (or sub-measures) to concentrate the action, the steering and the financing. Several state levers do not seem to be reflected in the SNB3

because the directions to be taken, the instruments to be mobilised, and the actions to be implemented are not explicitly mentioned (cf. supplementary material 8). Conversely, several measures of the strategy (19 out of 71) do not appear to rely on a state levers.

The individual assessments of the measures, as well as the multi-criteria analysis, make it possible to refine the results of the comparison with the IPBES state levers. The individual assessments of the measures show that the proposed actions are not very ambitious, risk causing a lot of conflicts between stakeholders, and for some are not very relevant because they do not target the major direct and indirect pressures on biodiversity. The proposed third French National Biodiversity Strategy do not seem to be in line with the current challenges in terms of biodiversity loss, and only partially address the problems.

Using the categorization of actions to be mobilized simultaneously by Naito et al. (2022), namely private actions, social signalling actions and actions to change the system, we see that the SNB3 does not fully mobilize each of these categories. The SNB3 favours the first two types (private actions and social signalling actions), whose effects are insufficient, since they are mostly aimed to modify individual behaviours, or social norms. It fails to target the third category that aimed to change laws, corporate actions, policies and institutions, and therefore having the most global and major effect.

When the strategy as a whole is analysed using multi-criteria analysis, the results give an overview of the criteria that fail. Many of the criteria are insufficiently informed, and do not accurately present the mechanisms of the actions to be implemented, as well as the problems targeted and the solutions to be provided (i.e., “motivated” and “effective” criteria). Many measures do not appear to be “robust”, because the search for consensus was such that the measure was emptied of its ambition, the associated transformative effect disappearing. Similarly, many measures are not “acceptable” because no counterpart has been thought of to compensate for the effects on the *losers*. Comparing the different analysis scenarios, there is little difference between the rankings of the measures. This means, for the SNB3, that it is not the differences in vision of groups of stakeholders that change the ranking of a measure, but rather the content of the measure itself.

The simulation of the criteria for implementing the measure clearly shows that for a measure to be a lever, all the conditions must be met: all the criteria must be well informed and validated. In fact, for a strategy to launch a new dynamic of change, it must be perfectly thought out and constructed as a whole. Some of the strategy’s measures are well evaluated, and individually they seem to be able to produce a leverage effect. However, when looking at the strategy as a whole, these positive effects may be counterbalanced by the lack of effect or even the perverse effects of other measures. The entire strategy must be on the level to be able to produce a significant transformative effect, otherwise the absence or limited effect of certain measures will limit the transformative character of the strategy, and the hoped-for consequences in the long term will not be present.

## Discussion

Applied to the third French National Biodiversity Strategy, this assessment method allowed us to establish several conclusions based on the individual assessments of the measures (level by measure) and the multi-criteria analysis (global level). Eight main findings were identified.

- (1) The measures show an incomplete network of pressures, territories, ecosystems, targets and actors: certain anthropogenic pressures with major impacts on biodiversity are not identified (i.e., urban and industrial pollution), the ultra-marine territories are not really mentioned despite their specificities (biodiversity hotspots), the marine environment is not targeted, and the actors are little or poorly identified, which raises questions about the strategy's ability to engage the whole society in a paradigm shift.
- (2) The strategy does not propose a systemic dimension of the issues, causes, possible solutions and interactions between humans and nature, and does not distinguish the essential from the anecdotal, which is however necessary (Holling 2001). While the areas on which to focus are well identified, there is a lack of articulation between these different issues: some aspects are treated independently even if they are interdependent. Moreover, the strategy is very heterogeneous in terms of its level of precision and in its ambition: some measures target major issues, while others target more anecdotal subjects, which risk diluting efforts without actually contributing to the desired leverage effect.
- (3) The strategy fails to emphasize the need to avoid impacts at an early stage and in conjunction with territorial planning. It relies instead on the aspect of limiting or compensating for impacts. It risks missing a real lever for reducing pressures on biodiversity.
- (4) The strategy is based on a top-down and non-transparent approach, without capitalizing on scientific expertise and local knowledge. The process of developing the strategy, although based on a citizen consultation involving associations, territories, citizens and experts, is unclear: it is difficult to know what has been kept from these consultations. Similarly, there is little mention of local stakeholders in the strategy, with the exception of a few specific questionable groups (i.e., hunting federations), which is problematic because they are the ones who will be responsible for implementing the strategy. Finally, it is necessary that this strategy draw on local networks and academic and non-academic knowledge (Beck and Forsyth 2020; Grumbine and Xu 2021).
- (5) The strategy is highly uncertain as to its capacity to reform, transform and engage certain tools to make them truly effective, due to the lack of details on the conditions of implementation (quantified objectives, details on the proposed tools, methods, indicators, timetable and implementation stages). In addition, certain levers are not very well mobilized: the reduction of pressures, the sustainable use of resources, synergies between different policies (i.e., health and biodiversity), and the restoration of ecosystems. The strategy calls for the elaboration of numerous reports, even though some of them already exist, or for the reinforcement of existing mechanisms: this raises questions about the concrete actions that could result from them, since some of these same actions were proposed in the SNB2 and did not lead to sufficient effects to halt the biodiversity decline.
- (6) The strategy relies heavily on voluntary approaches, labels and certifications. While this may seem to signify the commitment of a wide range of actors, it seems to delay or even restrict the spectrum of its transformative power, due to the lack of signalling of changes in paradigms and practices. It does not sufficiently mobilize regulatory and legal reform. Given the direct pressures on biodiversity, the interdependence of business and biodiversity (Sandbrook et al. 2022), and the current economic context, "goodwill" measures do not seem to be sufficient to induce significant changes, since there is no guarantee that a sufficient number of actors will take them up.
- (7) The strategy would benefit from taking into account the dependence of humans on nature. The leverage potential of the measures could be improved if the text explicitly



pointed out the plurality of visions, values and practices in the human-biodiversity links, as well as those to be promoted in order to bring about the changes necessary for a sustainable cohabitation. The SNB3 still seems to be part of a utilitarian vision of nature, and does not shed light on the direction to take to limit the impacts of maximizing supply services and the use of material resources. More emphasis needs to be placed on regulatory contributions, relational, intrinsic values, to have a more systemic vision (Hysing and Lidskog 2021).

- (8) The SNB3 seems to have favoured lowering ambitions rather than identifying *winners* and *losers* who need to be supported. Indeed, this endangers the success of the strategy; it risks stumbling into the *status quo*. The vague content of certain measures seems to favour the search for compromise to the detriment of concrete action with a potential leverage effect, a transformative power, including impacts on private and public actors.

Based on the assessment and conclusions presented, it does not appear that the SNB3 will bring about transformative change in the society. In addition to the systemic vision, which is essential to take into account the dependencies within socio-ecosystems (Visseren-Hamakers et al. 2021), and to a structuralist approach to the analysis of problems, it is also necessary to take into account the multiple values associated with nature (Chilvers and Kearnes 2015; Colloff et al. 2017; Markusson et al. 2020), particularly those that integrate the systemic dependence of humans on nature by stakeholders. The biodiversity crisis and the opportunities to address it are closely linked to the spectrum of values prioritized in political and economic decisions at all levels (Novalia and Malekpour 2020). Institutions, conventions, social norms, legal rules are underpinned by certain values and in turn support them, thus influencing the values that matter in decisions. There is a need to take into account the diverse values of nature, recognizing the asymmetries of economic and social power among actors, which would reduce socio-environmental conflicts and make transformative change towards sustainability more likely to be achieved.

The assessment criteria make it possible to review all issues of transformative change. The criteria are complementary, and address both what motivates the measure, what supports and justifies its content, and how the measure may or may not have a real positive impact on biodiversity, and thus lead to transformative changes in all spheres of society. The results of scientific assessments carried out by experts constitute a genuine tool for discussion between stakeholders, enabling subjective arguments to be backed up by an independent scientific approach based on a set of explicit criteria. This methodology thus aims to provide decision-makers with food for thought and suggested improvement of public policies.

## Opportunities

The application of the methodology to assess the third SNB3 has highlighted several opportunities for its use. First, this application validated the robustness and rigor of the methodology in its ability to assess the measures that have the highest leverage potential within a strategy/public policy, to evaluate which one has the potential to lead to transformative change. It also demonstrates its easy replicability for other types of policy, strategies, action plans and programs. It can be used at various scales: international, national, local, with possible adjustments in the criteria used depending on the scale. The fact that this method is replicable and adaptable to a range of contexts can encourage different stakeholders to evaluate their strategies and action plans using an existing method,

which does not require additional resources to be allocated to the development of an assessment method specific to each stakeholder. This assessment method can also be used during the design stage of a policy, in order to make projections and identify gaps to be adjusted within the measures before official publication, or in *ex-post* assessment—once again with adjustments and additions to the criteria. It also allows very precise comments or recommendations by academic experts during the scientific assessment of each measure. Eventually, it allows to rely on relative scientific consensus thanks to the ratings harmonization.

## Limitations and solutions

A certain number of limitations were identified. First, the assessment time is long: mobilisation of experts, realisation of individual assessments, harmonisation, synthesis of the harmonisation of the assessment, and analysis of results. In our case study, it took up to 5 months if all the measures are simultaneously evaluated by experts. Secondly, the step to enlist academic experts is slow and uncertain (*N.B.* this phase lasted a total of 4 months). Indeed, for very specific topics at least two experts must be identified in order to evaluate each of the measures correctly. In our study, a total of 62 experts agreed to evaluate the measures (from 292 experts initially contacted). Six measures (out of the fifty-five measures evaluated) were assessed by only one expert, due to the lack of experts' availability. Thirdly, the assessment criteria was not always relevant for certain measures as the methodology had been defined in a global way, without specificity for one type of strategy, policy or another. Therefore, some criteria may not be applicable in all cases. Fourthly, this assessment is based on academic expert opinion. Therefore, they may be some bias, due to a certain level of subjectivity during assessments. Incidentally, this can be reduced by increasing the number of experts evaluating the same measure. The same biases are found in the multi-criteria analysis (quantitative approach), since it is based on the results of individual assessments (qualitative approach). Finally, although this method is theoretically applicable at all scales, it can be difficult to implement the strategy to local scales for various reasons: less time to devote to an assessment, and fewer financial and human resources available.

Several solutions can be put forward to overcome these limitations. One solution could be to reduce the number of measures to be evaluated e.g., by prioritizing and selecting the “major” or most “political” measures of a strategy or plan. Although, it is important to keep in mind that the assessment would not be complete and may even reduce the strategy's capacity to bring about transformative change. A second solution could be to reduce the number of assessment criteria, by using criteria selected after consultation with a group of stakeholders. In this way, the scoring bias due to the absence of data for certain criteria could be assessed using a sensitivity test of the multi-criteria analysis (e.g. leave-one-out method) in order to validate the robustness of the final ranking if these criteria were not taken into account. We do not recommend limiting the number of experts, as this would lead to excessive bias that would be impossible to compensate for. A final solution would be to integrate the assessment into the strategy/plan development phase (*ex-ante* evaluation), which would allow more time to be devoted to the assessment, to integrate the financing of the assessment into the project as a whole (and no longer as an additional cost), and to integrate into a strategy only those measures that have the greatest leverage effect. In addition to this assessment process, we also emphasize that this method does not consider the governance regime in place, and its potential reforming character. Our method

is not the most appropriate to be applied to the study of a strategy elaboration process. It could be improved in this way.

## Conclusion

The methodology developed by the Foundation for Research on Biodiversity (FRB) allows for an independent and multi-criteria analysis of a strategy or public policy in order to determine which of the proposed measures or actions are the most likely to provide leverage, and therefore to be supported as a priority in financial and human terms. It is complementary to other types of *ex-ante/ex-post* assessment methods. In addition to this analysis, we recommend taking into account governance processes. Our method allows us to assess whether a strategy will be able to institute a trajectory of change, towards a dynamic of sustainability, and whether its measures will have a leverage effect. However, it does not assess the governance regime in place. Indeed, a strategy can be both relevant and unsuccessful if it is not implemented with an adequate governance regime (Beck and Forsyth 2020; Huntjens and Kemp 2022; de Koning et al. 2023). The study of the processes of elaboration, consultation, and implementation of strategies could therefore shed more light on the compatibility of governance systems with proposed transformative actions.

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**Data availability** The data used all come from the National Biodiversity Strategy published on the website of the Ministry of Ecological Transition, available here: <https://www.ecologie.gouv.fr/strategie-nationale-biodiversite>. The individual assessments of the Strategy's measures are available (free access) on the FRB website: <https://www.fondationbiodiversite.fr/analyse-des-strategies-en-faveur-de-la-biodiversite-developer-une-methode-et-lappliquer-au-processus-en-cours-de-la-snb3/>.

## Declarations

**Competing interests** The authors declare having no competing interests.

**Ethical approval** The project has been approved by the Scientific Council of the FRB.

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