The time factor in managing ecological damage

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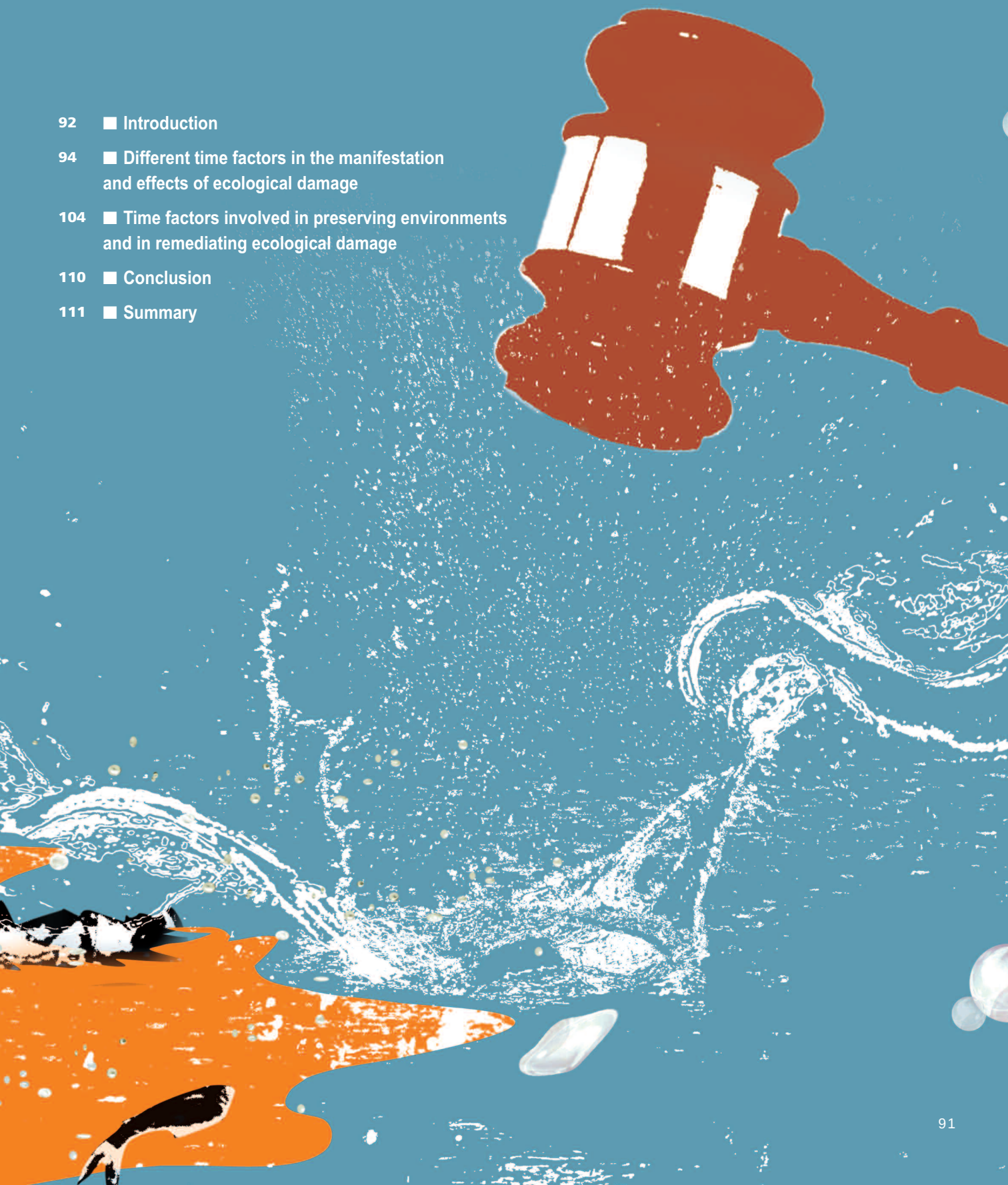


Introduction

As noted by Mr. Chemiller-Gendreau, “in a complex world, it is difficult to isolate a precise act from the causal sequence in which it is inserted, consisting of causes in the past and consequences in the future” (1995). Ecological damage is certainly one of the precise acts that raises the issue of time because **time spans in the legal system are a social phenomenon that do not necessarily coincide with the progression of nature**. Time in the legal sphere corresponds to human activities and not to nature and its processes.

In law, the notion of time is critically important. It intervenes in both the process of acquiring rights and in that of the extinction of those rights. By setting terms and limits, the legislator attempted, on the one hand, to protect the accused and ensure the equity of contradictory debates, and on the other, to avoid the disappearance of evidence. In law, time is necessarily short, as measured on the human scale, because the existence of laws implies decisions and sanctions. Beyond a certain time, legal action is no longer desirable because the evidence fades, causal links become less clear and the responsible person eventually dies. The law is governed by strict time criteria and legal procedures initiated beyond certain limits are forbidden by the statute of limitations (Remond-Gouilloud, 1992).

Environmental law is thus confronted with a true challenge. Ecological damage may occur instantly or over a period of years, i.e. it may become evident very suddenly or very gradually. For this reason, the time required by damage to become manifest does not necessarily coincide, on the one hand, with the legal requirements in terms of solid scientific and technical proof, and on the other, with the statute of limitations voted by the legislator. For example, a reference point in time is essential in order to characterise the ecosystem status prior to the disturbance, however, it is not always easy to know just how far back in time it is necessary to go. Similarly, gradual damage, i.e. damage that is slow and progressive, can take years and repeated events to manifest itself. In addition, the perception of gradual damage is often the result of new knowledge, for example concerning pollutants, and it is difficult, in the legal sense (i.e. assigning liabilities, etc.), to determine the consequences for aquatic environments at a given point in time.

The time span during which legal action may be taken corresponds to that between the manifestation of the damage and the limits set by the legal statute of limitations. On the one hand, factual reports of damage in the field are the trigger for legal action. On the other, the situation concerning knowledge and legislation at a given moment determines both the framework and the effective conditions of the legal action (non-retroactivity of the law, statute of limitations, etc.). Environmental law is therefore inevitably confronted with a conflict between times in human affairs and in the natural world, which explains why it attempts to adjust its procedures in an effort to reconcile the temporal discrepancies.

To that end, the legal system has developed a number of specific concepts and integrated others in order to adapt common law to the specificities of environmental law and the unique aspects of ecological damage. As discussed below, the notion of irreversibility is a perfect example (Makowiak, 2011) and it is not the only one. The concepts of remediation, restoration, common patrimony, future generations and sustainable development are other examples. The legal system has also succeeded in integrating time factors in its techniques designed to avoid and remediate ecological damage. This is because the concepts of conservation and remediation are effectively linked to the past, present and future.

Different time factors in the manifestation and effects of ecological damage

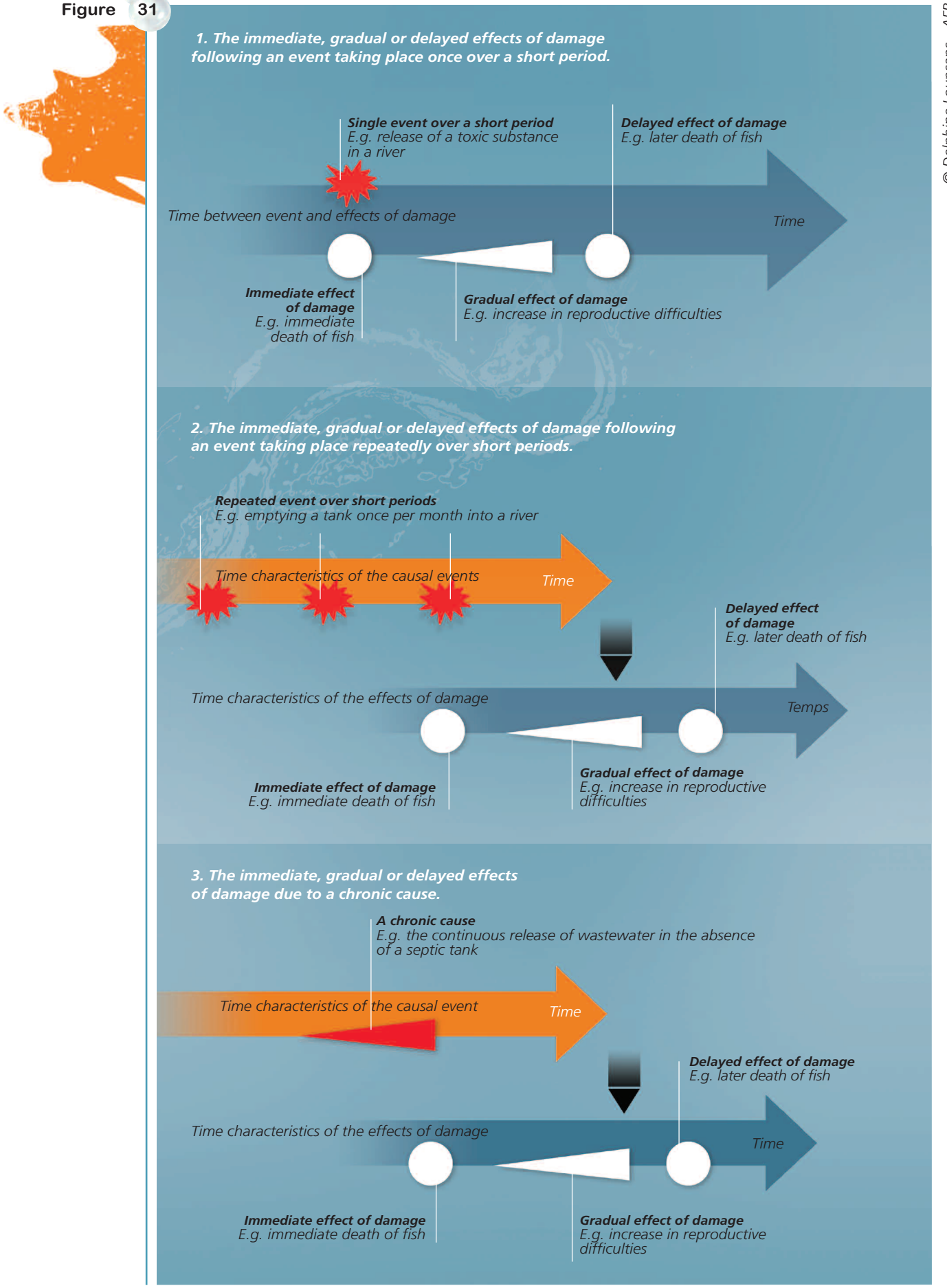
The issue of time perceived in terms of ecological damage lies at the heart of the distorted relationship between society and nature. In society, time is a human construct. That does not mean that it has no meaning, but that it is adjusted to human needs. In nature, time is made up of rhythms, cycles and breaks (Remond-Gouilloud, 1992). Practically speaking, that means that damages in common law are generally perceived on the basis of the causal link between the event giving rise to the damage and the damage itself. This is due to the fact that liability in law depends on damage that is current and certain. But similar to the fact that the event giving rise to ecological damage may take place once over a short period (e.g. a single release of a toxic substance in a river, see Figure 31-1) or repeatedly over short periods (e.g. emptying a tank once per month in a river, see Figure 31.2) or continually on a chronic basis (e.g. releasing wastewater continuously in the absence of a septic tank, see Figure 31-3), ecological damage may not manifest itself immediately (e.g. by the death of fish), except in cases of major accidents. The effects may be gradual (e.g. in the form of increased disturbances in reproduction) or delayed (e.g. death of fish at some later time).

What is immediate, gradual and delayed damage?

As noted above, ecological damage is defined as an impact on the environment and on the functioning of an ecosystem that can constitute a tort (legal consequence) for humans and nature (see Chapter 1). Caused by driving forces in the context of household (including services), industrial or agricultural activities (see Figure 31), this impact may be physical (affecting the hydromorphology of rivers, etc.), chemical (toxic substances) or biological (invasive species, microbiological contamination). The effects may be immediate, gradual or delayed.

Immediate damage produces an effect instantaneously. This is the case for accidents affecting the environment, resulting from a sudden and unforeseen event. The damage (e.g. fish mortalities) becomes clear virtually without delay following the sudden causal event (e.g. the release of a toxic substance in a river). The damage is visible and its cause can be easily identified. Examples are the sudden rupture of a tank or a pipe containing dangerous products that immediately reach the water table or flow into a nearby river. The effects are immediate, i.e. coincidental with the event, and consequently it is easier to observe and understand the situation and assign liability. The situation is very different in cases where the effects of the damage are gradual or delayed.

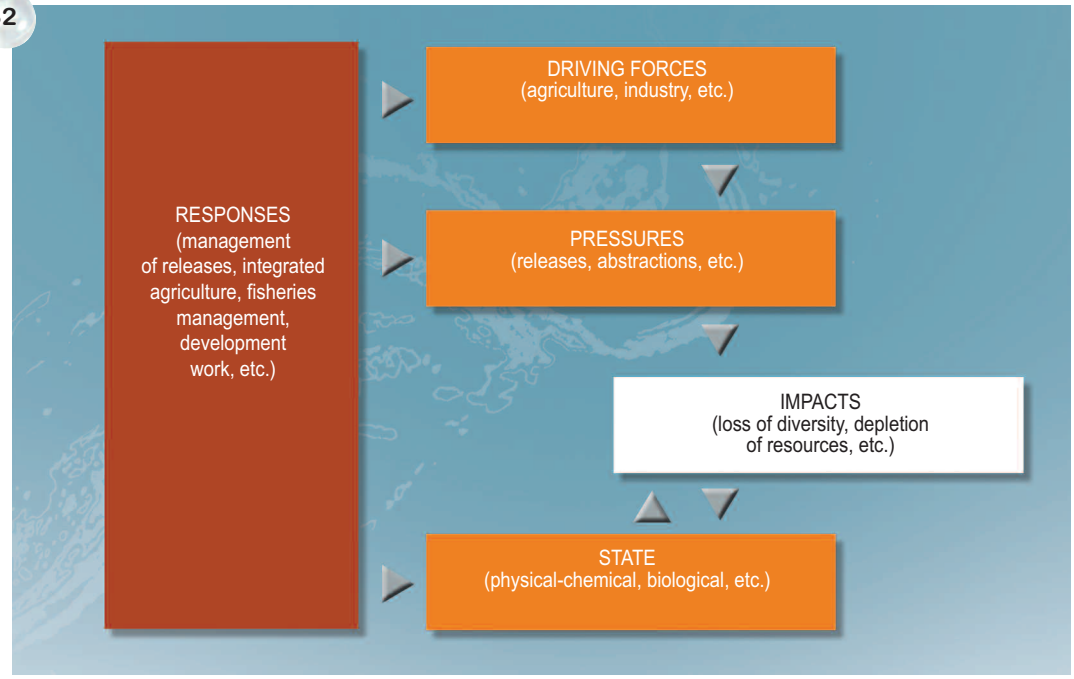
Figure 31



Damage is said to be gradual when the persistence of the causal event progressively produces environmental damage (e.g. increased reproductive difficulties in fish). In some cases, gradual damage may require many years and repeated events to manifest itself. That is the case for chronic pollution that is the consequence of the repeated or continuous release of pollutants. Chronic pollution may also be caused by highly persistent substances that continue to pollute even when the source has been discontinued. In this case, the environment is polluted progressively and the corresponding criteria are decisive in characterising the damage. The same is true when stone banking is installed progressively in several spots to stabilise the banks of a river or meanders are progressively cut to rectify a river bed. In the final analysis, it is the repetition of acts that, over time, significantly impact the morphology of rivers (Wasson *et al.*,1995). The detection of gradual damage is also made possible due to new knowledge on pollutants. In the past, releases that were not considered toxic were not monitored or filtered. Consequently, they accumulated over the years until their danger could be proven scientifically.

Damage is said to be delayed if there is a significant time step between the causal event, which may take place once, repeatedly or be chronic, and the effect produced by the damage. In this case, the effects of the damage occur at some later time. This may occur when, for example, a toxic substance spills, but is not immediately released to the environment either because it is contained and cannot disperse (e.g. packets of substances from a hospital, released to a river, whose contents enter into contact with the water once the packets have dissolved) or because the substance immediately lodges in the sediment. It is only when the sediment releases the substance that the effects will be felt.

Figure 32



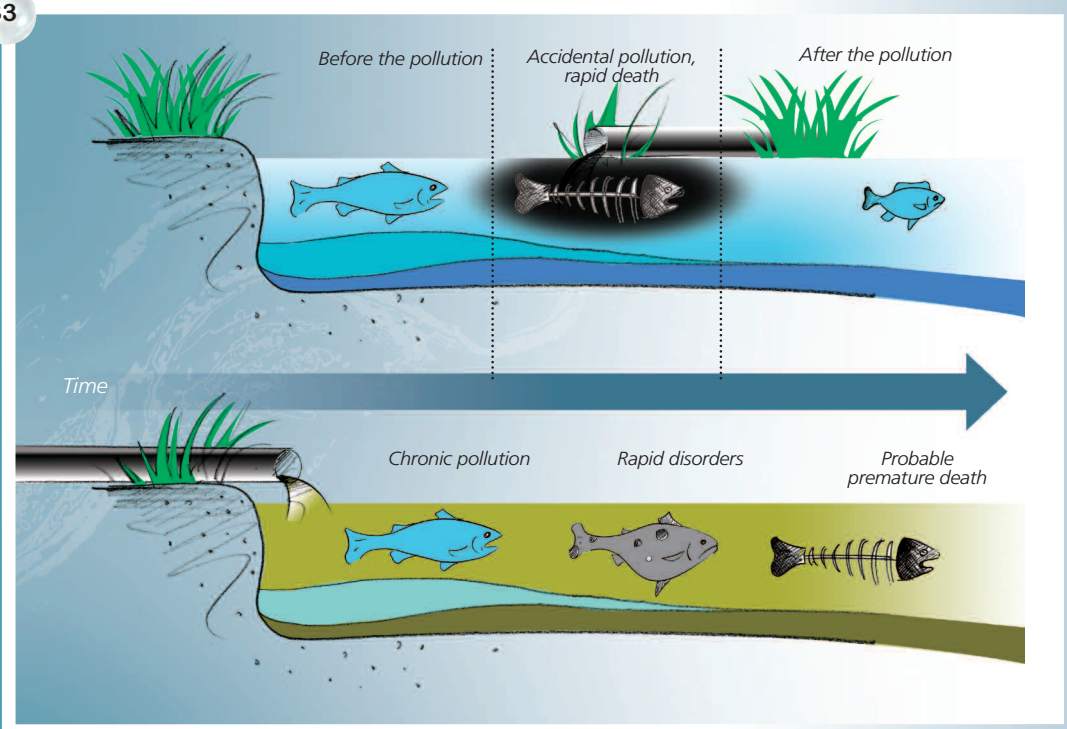
The Driving forces, Pressures, State, Impact, Responses (DPSIR) model. (See EAA, 2000).

Impact times for micropollutants in a river

Micropollutants can provoke disturbances and alterations in the functions of living organisms, leading to adverse effects and in some cases death.
There are two main types of toxicity:

- **immediate toxicity** when the pollutant causes the death or major physiological disorders immediately or shortly after the exposure to the substance;
- **chronic toxicity** when the pollutant causes either irreversible, long-term effects due to the continuous absorption of small doses or cumulative effects.

Figure 33



See Seine-Normandie Water agency, 2014.

How are these different types of damage handled by the legal system?

As noted above, the effects of damage may be immediate, gradual or delayed (see Box 22). But however long the effects take to become evident, the damage can be more or less long-lasting. This duration of damage implies that the law must take into account whether the damage is reversible or not. This led to adopting or developing concepts and principles such as sustainable development, the precautionary principle and the concept of patrimonialisation, in order either to slow or stop the effects of the damage or to reduce their impact. These concepts and principles have in common that they make it possible to go beyond the scientific uncertainties by taking into account economic, social and political aspects that enable the legal system to address the problem (Kast, 2003).

■ The concept of the irreversibility of ecological damage lies at the crossroads between the past, present and future

Irreversible damage may produce effects over the short, mid or long term, but damage in itself, whatever the term, is not necessarily irreversible. The concept of irreversibility lies at the crossroads between the past, present and future. It implies the idea of a before and an after. It describes a process leading to the disappearance of an element or of a state that once existed but will not return to the damaged site. Environmental irreversibility corresponds to a specific type of damage that results in the impossibility of a return to the baseline condition of the impacted element or situation. This is the case, for example, of the destruction of a rare spawning ground for sturgeon by a gravel miner. To speak of taking into account the irreversibility of ecological damage means that the legal system sees irreversibility as an adverse ecological process (Guilbert, 2013).

To arrive at that conclusion, the legal system had to and continues to adapt because it is difficult for it to determine that irreversibility exists in that the concept involves temporal features with which the law is not accustomed. That means the law must succeed in aligning two concepts, namely "**factual irreversibility**" (based on the scientific observation of, for example, the elimination of a species) and "**legal irreversibility**" (i.e. the legal integration of the ecological situation which establishes the legal decision in time) (Guilbert, 2013). The challenge confronting environmental law is therefore to slow, avoid, reduce and if possible stop acts and behaviour likely to produce an irreversible situation while limiting the scientific uncertainties (concerning the existence of the damage or the proof of its extent) in order to consolidate the legal standing of the decisions taken. The scientific, economic, social and cultural aspects of the irreversibility condition the legal processing of the concept.

This observation explains and leads to three main conclusions.

■ **The irreversibility of ecological damage is analysed by the law in terms of "disappearance" and "destruction".** This makes it possible to take into account the dynamic nature of ecological processes while upholding the need to protect them. The concept raises the question of how to maintain the equilibrium and cycles of ecosystems (the reproduction of species and renewal of resources), taking into account their natural capacity to regenerate and to continuously evolve (absorption of pollutants, loss of species according to the laws of nature). This is what is called the resilience of ecosystems. It corresponds to the capacity of an ecosystem, a habitat, a population or a species to recover a normal degree of functioning and development after having suffered a significant disturbance (Holling, 1973). It is only once the resilience of the ecological system has been exhausted that it initiates a reorganisation of its processes and that the situation may be considered irreversible. In cases of accidental pollution such as oil spills and other catastrophes, the resilience of the environment is generally insufficient. For gradual or delayed pollutions resulting from normal operations, it is essential to define the resilience threshold of the environment.

■ **The law favours a rather broad definition of environmental** even if a degree of uncertainty persists concerning possible reversibility in the future. Environmental irreversibility may be absolute, which is the case for the disappearance of a species. The irreversible process of the disappearance results in a situation that cannot be modified. However, it is important to acknowledge that not all irreversibilities are absolute. The law freed itself of this temporal constraint by deciding not to prolong cases on the basis that the situation may be reversible over the long term. In this manner, it avoided the risk of inaction on the basis of arguments that the environment could possibly, over the very long term, restore itself. This decision is also grounded on the fact that there is no means to determine objectively if and when the restoration could take place.

■ **Irreversibility is seen as a serious consequence** (Remond-Gouilloud, 1992). Scientific uncertainty should not encourage inaction, but it cannot justify all action. A long time span during which it is impossible to return to the prior situation is not necessarily a serious or negative consequence, however in some cases irreversibility is a decidedly adverse consequence. In the latter scenario, the ecological damage may possibly be remediated, but it will not be undone and the consequences may be long lasting. Consequently, though the impossibility of restoration is not certain, irreversible damage is necessarily serious because it constitutes, in any and all cases, a loss of potential.

What is more, the 1995 Barnier law (Law 95-1001 on reinforcing environmental protection) stipulates that "the absence of certainty must not delay effective and proportionate measures to prevent serious and irreversible damage". In its 2005 report titled "Responsibility and socialisation of risk", the *Conseil d'État* discussed a growing suspicion concerning technical progress. Questioning the ambivalent effects of progress has now become systematic. Scientific uncertainty is now associated with the risk of serious and irreversible damage.

Currently, the law distinguishes three levels of more or less long-lasting effects of ecological damage:

- irreversible damage to the environment, i.e. manifest degradation that cannot be remediated;
- damage that is reversible only after a long period that varies depending on the regenerative cycles of the environment and of nature;
- damage that can be remediated over a reasonable time span.

In this manner, the law takes into account the time likely required for the damage to be resorbed, ranging from a few days to decades and even centuries. **Legal proceedings are favoured when the damage to the environment is irreversible or when it cannot be remediated within a reasonable period** (2015 ministerial circular). The 2015 circular stipulates that "the length of time likely required for the damage to be resorbed must be taken into account" and that on this basis, prosecutors should launch legal proceedings if the damage is irreversible or if the damage cannot be remediated within a reasonable period".

Consequently and as noted by M.-J. Littmann-Martin and C. Lambrechts (1992), it becomes apparent that "the notion of irreversibility cannot be separated from that of damage" and that "irreversible ecological damage may be defined as damage that cannot be remediated rapidly, due to scientific or technical reasons, or also economic reasons if the cost of remediation is deemed prohibitive to the point that it is simply not possible".

In spite of all efforts, "the concept retains its multi-faceted mystery even while slowly gaining an emergent form of autonomy" (Littmann-Martin *et al.*, 1992). That is why the concept of irreversibility necessarily evokes other notions that are also confronted with the dilemmas arising from the temporal dimensions linked to the manifestation of ecological damage. All in all, the best solution is to avoid the damage.

■ The precautionary principle as a means to overcome the scientific and legal uncertainties concerning future risks

"Protect ourselves from the unknown in the absence of any known or acknowledged reason. Act or not act according to the questions, mysteries, silences put forward by the current progress of science and technology. That is the curious attitude to which the precautionary principle invites." It was with those words in 2001 that A. Rouyère opened his presentation during the symposium "New legal standards for public liability" held at the *Palais du Luxembourg* in Paris.

It was the Declaration of Rio in 1992 that for the first time referred to the precautionary principle for environmental protection. In French law, the expression "precautionary principle" was used for the first time in the Barnier law (2 February 1995) on reinforcing environmental protection. The precautionary principle, which is a principle assigning responsibility, is an incentive to adopt preventive measures intended to avoid potentially serious damage that would be difficult to remediate and where the causal links have not to date been scientifically proven (Flückiger, 2003). A further purpose is to sanction negligent behaviour (Baghestani-Perrey, 1999). It follows that, where the term irreversibility designates the incapacity of stakeholders to change a situation or a process, the precautionary principle, a fundamental component of sustainable development, encourages us to decide and/or act (either by doing or by refraining from action), when uncertainty prevails, on the basis of assumptions while waiting for further scientific knowledge to be come available (Guilbert, 2013).

The main contribution of the legal precautionary principle and of the philosophical, scientific and social discussions that surrounded its emergence is that it spread the idea that uncertainty and even ignorance may be a source of rights and not only a legal consideration (Rouyère, 2001).

Even though it is by definition confronted with uncertainty, the concept of precaution attempts to dissipate the uncertainty by developing knowledge and to reverse prior decisions where necessary. If there is doubt concerning the causes or effects of events, the worst case is assumed.

That being said, the purpose is not to totally eliminate all risk because there often exists an irreducible margin of risk that is considered socially acceptable in light of the expected advantages. The precautionary principle can therefore be considered an approach to action and decision-making in a context of great uncertainty, requiring measures proportionate to the seriousness of the risk, even if the latter is only potential (Bouzon, 2001). Given the uncertainty surrounding certain technical aspects, the law manages the risk inherent in the system ("I know that I do not know") by setting behavioural standards, imposing both action and non-action, based on our awareness of the deficiencies of our knowledge (Coulon, 2001).

Consequently, **the objective of the precautionary principle is both to protect the environment and to prevent its degradation.** It avoids damage where the consequences are unknown due to scientific uncertainties or to scientific controversy concerning the effective consequences (e.g. the long-term effects of pesticides in water). It is not the same as the preventive principle which aims to avoid damage for which the consequences are known (e.g. releases of toxic substances in water).

■ The "polluter pays" principle as a means to avoid damage or limit its future effects

The "polluter-pays" principle was originally designed specifically to protect the environment from gradual damages by spreading the costs of chronic pollution among the various polluters (Smets, 1993). Given the uncertainties raised by chronic pollution, it could not be managed using the standard liability regimes. This is because chronic pollution progresses insidiously and is often initially absorbed by the environment. It is only when the environment has become saturated that the pollution becomes apparent, often causing irreversible damage. This time lapse between the release of the pollutants and the manifestation of their presence hinders efforts to pinpoint the moment in time when the pollution occurred. As a result, there is uncertainty concerning both the moment when the damage may be ascertained with certainty and the implementation of remedial action.

This principle was included in 1987 in the Single European Act and subsequently in the Maastricht Treaty. In France, it was inserted in the Barnier law (2 February 1995) on the reinforcement of environmental protection. It is defined as a principle "according to which any costs arising from measures to prevent and reduce environmental pollution and from work undertaken against pollution must be assumed by the polluter". Though it is not truly a principle of liability in that it does not designate the responsible entity causing the pollution, it does ensure compensation and contributes to the need of determining the liabilities (de Terssac and Gaillard, 2008). The polluter-pays principle thus engages the environmental liability of an operator, due to his professional activity, in the event of serious damage or the threat of imminent, serious damage to the environment. A threat of imminent damage corresponds to the delicate situation where the damage has not yet occurred, but requires action to avoid its occurrence or to limit its effects.

The 2004 European directive on environmental liability, transposed into French law by the Law on environmental liability (2008), is the first piece of EU legislation to include among its main objectives the implementation of the polluter-pays principle (COM (2010) 581 final, 12 October 2010). It establishes

a common framework for liability in order to prevent and remediate damage caused to animals, plants, natural habitats and water resources, as well as damage affecting soil. It distinguishes two complementary situations, each corresponding to a different liability regime. The first applies to dangerous or potentially dangerous professional activities listed in Annex III of the directive (agricultural and industrial activities requiring a permit, etc.). The second applies to all professional activities not listed in Annex III, but only when damage (or the threat of imminent damage) is inflicted on species and natural habitats protected by EU legislation. In this case, the operator is liable only if he committed a fault or was negligent.

When there is a threat of imminent damage, the cognizant authorities in each Member State may:
- force the operator (the potential polluter) to take all appropriate, preventive measures;
- or take themselves all appropriate, preventive measures and later recover the costs.

When damage has occurred, the cognizant authorities may:
- force the operator to take all appropriate, remedial measures (set by the rules and principles laid out in Annex II of the directive);
- or take themselves all appropriate, remedial measures and later recover the costs.

If several damages have occurred, the cognizant authorities may decide on the order in which they are remediated.

The type of remediation of environmental damage differs depending on the type of damage. For damage affecting water, the objective of the directive is to restore the environment to its conditions prior to the damage. To that end, the damaged natural resources or the degraded ecological services (benefits) must be restored or replaced by identical, similar or equivalent resources/services, either on the damaged site or, if necessary, on a different site.

■ Patrimonialisation of the environment as a means to create responsibility for a shared future

Conservation is the basic component in all patrimonial efforts. The debates on sustainable development, climate change and environmental degradation have continued, under a new guise, a movement launched in the 1800s in the form of policies to preserve/conserve nature by establishing it as part of our patrimony.

Patrimonialisation of the environment contributes to efforts to create responsibility for a shared future. This shared patrimonial responsibility manifests itself as a legal link between the past and the future. **It is part of the effort to create a collective, no-fault liability regime as an alternative to identifying and assigning to an individual a cause or fault likely to initiate damage, that is generally gradual or delayed.** By patrimonialising the environment, there is a shift from individual assignment of liability for damage to the assignment of socialised or collectivised liability. This notion centres on the idea of "saving", in the sense of maintaining something that is threatened, i.e. "safeguarding" it. That implies not only "taking care", but also "guaranteeing", "vouching for" and being "responsible for". The assignment of the adjective "patrimonial" to an environmental object automatically implies the appointment of a responsible entity and the creation of a link between that entity and the object (Crenn, 2003).

That being said, in France, the approach via the resource remains the dominant procedure. Contrary to other types of natural areas (landscapes, mountains, coasts), the patrimonial approach to rivers is less well established even though in the 1992 Water law, water is acknowledged as the shared patrimony of the nation and the European water framework directive (WFD, 2000) noted that "water is not a commercial product like any other but, rather, a heritage that must be protected, defended and treated as such". Rivers are the link between patrimonialised water and river basins designated as the territory for the local management of the resource. Water policy is confronted with a major difficulty concerning two of its main objects (Marc, 2007),

namely rivers fall under the category of possessed goods (state-owned and non-state-owned rivers), but running waters are common goods (Ghiotti, 2009). Hesitating between these two legal categories, the use and management of rivers in France oscillates in its legal standing between two purposes, the first economic, the second social and patrimonial. This raises a number of problems notably because it brings to the fore the question of managing a collective good when confronted with personal interests (agriculture, hydroelectricity, etc.) and consequently the issue of coordinating the preservation of a natural patrimony and the exploitation of the cultural heritage (Germaine and Barraud, 2013).

However, a few decisions by the courts have begun to consolidate the patrimonial value of rivers. In the legal decision rendered by the Tours District Court in 2008 (see Chapter 3), the judge decided to take into account both objective (fish mortality, cleaning of the river, restocking with fish, efforts to inform the public) and more subjective aspects (nostalgia for the landscape and prior fishing conditions, original beauty of the site, the spirit of the area and the history of the people). In this precise case, the factors used to assess the damage and the remediation of the tort were the irreversibility of the situation, the impact on the biomass, the patrimonial value and the "work to remediate the accident", i.e. the creation of aprons to oxygenate the water and the creation of habitats in deep waters.

Consequently, though the environment belongs to those alive today, it becomes patrimony for those who come later (Honneger *et al.*, 2014). It becomes common patrimony only in as much as it is acknowledged as that of future generations (Hartog, 1998). The nature of patrimony resides in the fact it is an inheritance (Cottet, 2013). Environmental features deemed patrimonial are ipso facto seen as inherited, indivisible and irreplaceable (see Box 23). Inherent in patrimony is therefore its projection into the future. It contains a potential future that increases its value, notably social, cultural, economic, symbolic and, of course, territorial, as a strategic issue.

The three stages in the patrimonialisation of the Loire valley

Following the failure of a first attempt, a 260-kilometre section of the Loire valley between Chalonnes and Sully-sur-Loire was placed on the UNESCO list of world heritage as a cultural landscape in the year 2000. As noted by S.Ghiotti (2009), the emergence of the environmentally-based patrimonial dimension in the Loire valley corresponds to a new step in the perceptions and relationships between the local populations and their river environment. In terms of the reference systems brought into play and the time factors in the implemented public policies, this new step follows that of the dikes and that of the dams (Huyghues-Despointes, 2008).

Patrimonialisation took place in three steps.

1. The first step occurred when the river ceased to be seen as "developable" with the cancellation of the declaration of work in the public interest for the Serre-de-la-Fare dam in 1991. This was due in part to two factors:

- the emergence and strengthening of positions and alternatives that were not only credible, but received strong social support along the entire length of the river as indicated by the creation of the *Loire vivante* committee in 1986 and the non-profit *SOS Loire vivante* in 1988, which federated numerous other groups from throughout the valley (Bonin, 2008);
- the new context introduced by political decentralisation, whereby the costs and funding of infrastructure projects provoked changes in the positions of the various stakeholders. The new distribution of costs, benefits and decision-making processes took some time to take root, as evidenced by the discontinuities and duplicate procedures in the system of government for the Loire, that finally stabilised with the creation of the EPALA (public development agency for the Loire and its tributaries in 1984.

2. The second step started with the signature in 1994 of the first *Loire Grandeur Nature* plan (PLGN) between the State, the Loire-Bretagne Water agency and EPALA. Similar to the shift in policy by *Voies navigables de France* (VNF - French waterways authority) for the management of the *Canal du Midi*, the modified position of EPALA concerning hydraulics, the environment and local development signalled a tactical, institutional change where the objective was to conserve its legitimacy and a certain impact in the management and decision-making processes that the change in the perceived nature of the river might have cost the agency. Participation of EPALA in the ecological and environmental management plan for the river is a sign that the opposing opinions between stakeholders are not insurmountable and that the debates also exist within the institutions taking part in the governance of the Loire River.

3. The third step consisted of the creation of the Loire-Anjou-Touraine regional nature park in 1996. This new entity was a further step in the environmental dynamics in the Loire valley, but it can also be interpreted as a parallel initiative (in the fields of patrimony, development and the environment) by one of the stakeholders, the Centre regional council, an important player with whom it will be necessary to coordinate policies.

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The Loire River.

Time factors involved in preserving environments and in remediating ecological damage

Time factors involved in detecting the effects of ecological damage create problems for environmental law, but those involved in preventing ecological damage or remediating the resulting ecological torts are just as troublesome. The procedures selected to protect and remediate the environment take place within a time frame that, once again, raises the issue of the relationship, specific to the human perception of time, with the past, present and future. Whether the measures target protection or remediation, the stakeholders (judges, project owners, etc.) must always juggle with the past, present and future..

Taking action now to avoid future damage

As noted by J. Makowiak (2011), the present may be seen as the existing environment that should be studied and monitored in order to gain knowledge and to preserve it. The monitoring is part of **a continuous, permanent process that can be revealed only in the present**. This existence in the present is manifested by the periodicity of the reports and the creation of monitoring networks aiming, for example, to describe the current status of environments (an example being the WFD monitoring networks). In light of the controlled future, the means of prevention can be based in a present receptive to environmental law. This is because the multiple means of prevention used in the present will serve as "warning systems" and lead to greater awareness of the fragility of environments and species or, in some cases, of their disappearance. It is on this basis and starting from this present toward the future that several means of prevention provided for by the legislator can be implemented.

First of all, environmental preservation in order to avoid ecological damage can be in the form of **zoning** (natural zones with high ecological value (ZNIEFF), Natura 2000 zones, biotope-protection decisions, national nature reserves, zones with environmental restrictions (ZER), etc.). Decisions to protect the biotope, for example, are taken using a procedure that enables a Prefect to establish measures targeting the conservation of biotopes such as ponds, swamps, marshes, hedgerows, copses, heathlands, dunes, swards and all other types of natural environments only slightly impacted by humans, in as much as these biotopes are required for the feeding, reproduction, rest and/or the survival of species. Another example are the zones with environmental restrictions (ZER) that can be used to protect priority water abstractions. Article 21 in the Law on water and aquatic environments (LEMA, 2006) provided for the possibility of creating ZERs in which an action plan is set up to limit erosion, protect wetlands and/or protect abstraction supply zones.

Finally, another example is the placing of a river (or reach) in List 1, which means that no authorisations or contracts for new structures may be granted if they constitute an obstacle to ecological continuity (Art. R214-109 in the Environmental code).

These zoning procedures are conservation measures that sanctuarise certain natural environments (Meur-Ferrec, 2007) in order to limit the anthropogenic pressures likely to damage them. That is why some speak of "isolating" or "caging" environments (Therville, 2013; Arnould, 2005). By using environmental zoning to preserve certain environments from external pressures, the legislator decided to make the present permanent. These measures to safeguard the environment are therefore a purely legal concept of the present because in the real world, natural environments continuously evolve.

The prevention of damage may also be a feature in a project. The design and execution of projects qualified as "lesser environmental impact" require that the "avoid - mitigate - compensate" procedure be implemented (MEDDE, 2013; Onema, 2015). A project qualified as "lesser environmental impact" is one which enables France to meet the European requirements in terms of damage to or the conservation of a certain "status" in the environment, examples being the good status of water bodies as per the WFD, the conservation of protected species or of high-value habitats as per the Habitats directive, etc. These "status objectives" for environments or protected species are subject to mandatory results, otherwise fines may eventually be imposed by the EU. The "avoid - mitigate - compensate" procedure is now the basis for all environmental procedures in preparing projects (impact studies, land clearing, Water law, Natura 2000, protected species, etc.).

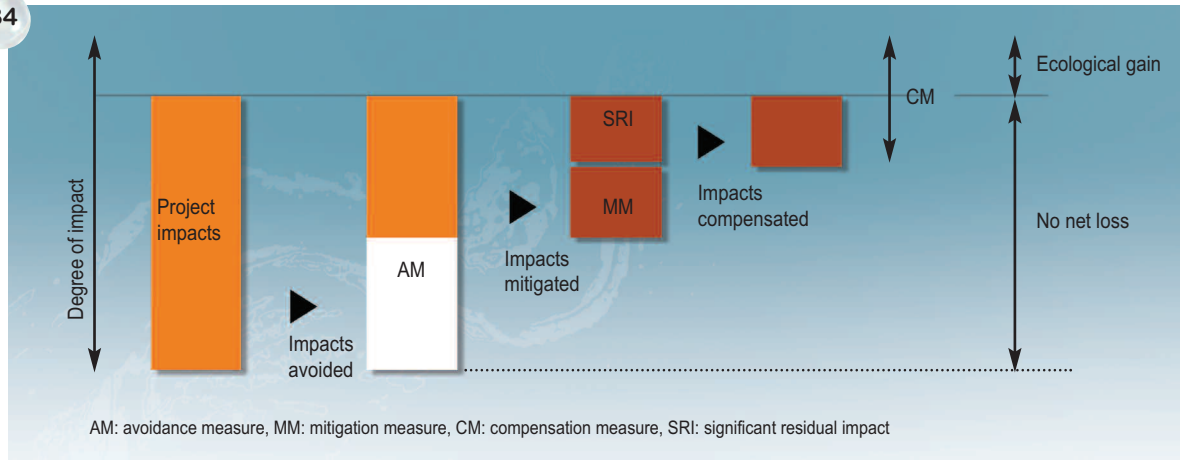
The purpose of the "avoid" in the procedure is precisely not to cause ecological damage, or as little as possible, because it will be necessary to remediate it if the damage is permitted to occur (see Figure 34). The less damage done, the less need for the project owners to correct it or to compensate it. There are three main types of avoidance measures (Onema, 2015):

- avoidance of the project itself. The objective is to determine if the project is worthwhile. For large, linear-infrastructure projects, the value of the project is assessed very early, prior to the design stage, during the public debate;
- geographic avoidance. The tactic here is to modify the site of a project or the itinerary of a linear infrastructure in order to eliminate any impact on environments and/or species requiring protection;
- technical avoidance. Technical solutions are adopted that eliminate any impact.

In addition to the preference placed on avoidance in the "avoid - mitigate - compensate" procedure, it should be noted that for *ex ante* compensation, the case here, compensatory measures are imposed for a future damage. This damage is foreseen given the residual, negative impacts on the environment that the project will have following the failure of the avoidance and mitigation measures, i.e. it is foreseeable, but has not yet occurred (Martin, 2016). Once again, the unavoidable link between the present and future becomes fully visible and enables the legal system to insert the protective measures in a temporal chain of events aiming to preserve the environment in the present by anticipating the damage. This approach is also recommended by the precautionary principle, a principle with applications ranging well beyond environmental law. G.Martin (2016) notes correctly that an operator prospecting a new market can, for example, avoid the risk of not achieving a satisfactory return on the investment.

The most effective means of remediating damage, whether in social, economic or ecological terms, is simply to avoid it or to anticipate it. However, that is not always possible and in such situations, the objective is to remediate the damage and to deal with the time factors inherent in the remedial operation. On the one hand, remedial operations may be organised over more or less long periods. On the other, for each type of remedial action, not only will the evolution of environments follow a different trajectory, but the remedial action itself makes it necessary to constantly juggle between the past, present and future.

Figure 34



Measures in the "avoid - mitigate - compensate" procedure to avoid project impacts on the environment. See Onema, 2015 (Tome 2, GIL guide).

Compensation in kind, a type of remediation that acknowledges the past, takes the present into account and anticipates the future

Compensation in kind consists of contributing to remediating environments that have been degraded, damaged or destroyed. It takes the form of an intentional human intervention (ASTEE, 2013) that initiates or accelerates the process by which a damaged environment returns to its status prior to the disturbance and recovers some of its characteristics (proportion of sensitive species, diversity of habitats, etc.).

■ How is remedial action launched?

Remedial operations can be launched in different manners that each set the action in a different time frame.

As noted above (see Chapter 3), compensation in kind may be initiated by a **procedure of the judicial police**. In this case, the citation for ecological damage drawn up by the environmental inspector trips the procedure intended to address the damage. Once the damage has been confirmed and pronounced as an ecological tort by the judge (see Chapter 3), the judge may sentence the defendant to compensation in kind, among other options. In this case, the remedial action is placed in a time frame that depends on the judicial procedure. In spite of the fact that the courts may take a long time (due to the congestion of the legal system), the value of a judicial procedure is that it normally accelerates the start of the remedial action. **The court decision to remediate the damage means that the time limit for the work may be determined and set by the judge.**

The remediation may also be initiated by a project. In this case, it is the malfunction observed on site that leads to the decision to remediate the damage. That being said, if it is not the triggering factor, the remedial operation will most often be an element in a procedure of the administrative police. All installations, structures, work and developments covered by the nomenclature in the Water law (Annex to article R. 214-1 in the Environmental code) must have been declared or their authorisation requested prior to the launch of the operation.

Articles R. 214-6 to R. 214-56 present the procedure for processing the declaration and authorisation files (Onema, 2012). **In this case, the time frame for the remedial action is long**. The preparation of the project (environmental studies, joint definition of the objectives of remediation, selection of the remediation technique) requires a certain amount of time and the regulatory procedures preceding the decision to authorise the project impose a further delay that can exceed six months.

Finally, compensation in kind may be triggered by an **urgent situation** and be part of a risk-management process. Procedures seeking urgent remediation are possible due to the specific nature of environmental law,

which deals essentially with policing activities. In their capacity to exercise special administrative-police powers, the cognizant authorities have both the power to sanction damage and the power to **issue injunctions** when confronted with urgent situations or accidents. This power to issue injunctions also means that the authorities are relieved of the need to provide prior formal notice. The urgency of the situation justifies immediate action. In the water field, for example, the administrative authorities may order any and all persons to put an end to a cause of danger or to damage to the aquatic environment (Art. L. 211-5 in the Environmental code). Injunctions are frequent in the environmental field. In addition to injunctions, another means to respond to urgent situations is the formulation of emergency action plans when a major hazard has become evident (e.g. pollution following an industrial accident). These plans set up the strategy for action, inform and protect the population and list the measures that the operator must implement. Finally, in addition to these means available to the administrative authorities in exercising their special administrative-police powers, the urgent situation may require the intervention of a judge. Two jurisdictional means are available for urgent situations, jurisdictional injunctions and summary procedures. These two means existed well before the advent of environmental law, but have undergone significant development in the environmental field to enable the legal system to adapt to the specific aspects of ecological damage. One example is the possibility included in the 1992 Water law of launching a procedure to halt a disturbance, in the form of an injunction issued by a Correctional Court following an urgent hearing of the operator or a summons to appear within 48 hours (Art. L. 216-13 in the Environmental code). This procedure may also be triggered by the State prosecutor acting at the request of the administrative authorities or of a non-profit that has been certified or been in existence for over five years. A judge for summary procedures may also halt the execution of administrative decisions. The decision to launch this type of operation takes place over a very short period of time, almost immediately after the urgent situation becomes apparent.

■ What are the different types of remediation? What do they have in common?

There are many types of compensation in kind and they apply to specific types of environmental evolution (see Figure 35).

Restoration of damaged environments may be compared to the restoration of a Renaissance painting that has faded over the years, but where the image and original colours are still sufficiently visible to enable the work of the restoration experts. Through restoration, a damaged environment is turned back in the direction of its **prior trajectory**, i.e. toward the evolution that it would have experienced if the disturbance had not occurred. One of the difficulties in restoration is to characterise the prior trajectory, to select a reference ecosystem that may be seen as "an approximation of the desirable status, a standard selected from several possible alternatives and that may be reached through a succession of steps called a trajectory" (Le Floche *et al.*, 1995). That being said, an actual restoration of the environment to the exact condition that existed prior to the disturbance is simply not possible. In fact, **a restored ecosystem can never be an exact (and static) replica of the past**, as if it were a painting or a dioramic exhibition in a museum (Aronson, 1995).

When the pressure weighing on an environment is too strong or lasts for too long, the environment may no longer have sufficient vitality to restore itself simply through the removal of anthropogenic pressures, i.e. it may be incapable of recovering a level of dynamic activity similar to the activity that would have existed if the disturbance had not occurred. Internal processes are severely modified and the trajectory is modified. In this case, major human intervention is required to change the situation, either by putting the ecosystem back on a favourable trajectory (rehabilitation) or by recreating the ecosystem (replacement). For the most ambitious remediation projects, these three types of intervention may be required and care must be taken to coordinate them over both time and space.

Figure 35

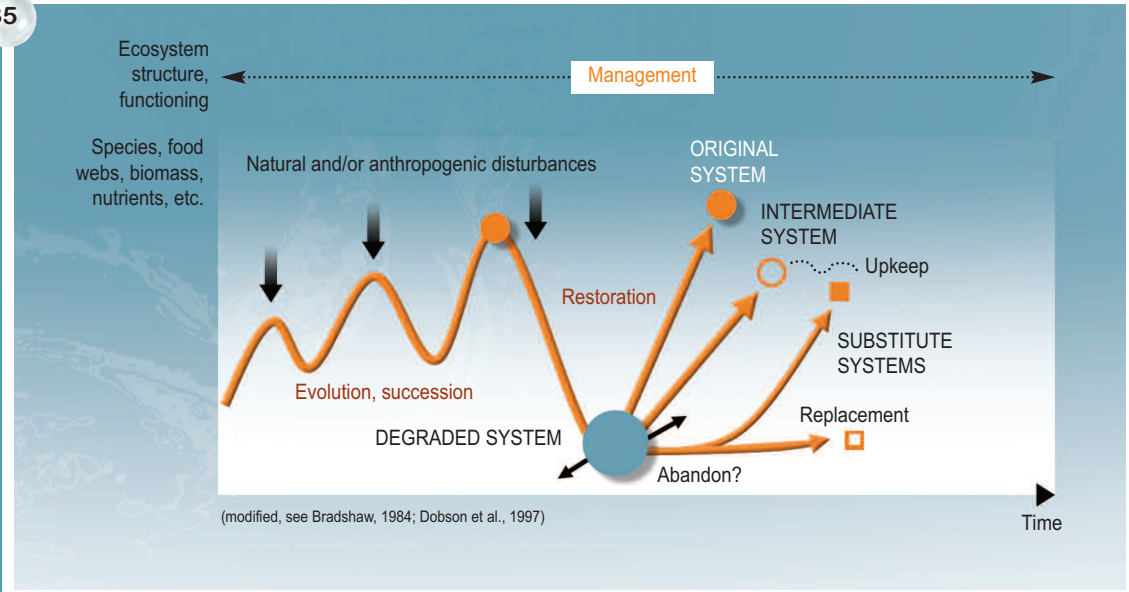


Diagram showing the evolution of ecological systems and the available options depending on the objectives (Barnaud and Fustec, 2007).

It is clear that, though these operations are based on the status prior to the disturbance, **they all take place in the present**. The trajectory, i.e. the path, the itinerary of the environment evolving over time, serves as the basis for the intervention objectives and for the development of a reference model that all are conditioned by the present. Ecological remediation attempts to adhere to the current cultural and environmental realities and trends, in a contemporary ecological and socio-economic approach, i.e. not exclusively technical or development oriented. That is why it is necessary, for this type of project, to take into account scientific knowledge, technical know-how and the perceptions of social groups (Bioret *et al.*, 2011).

These operations also and above all consist of **anticipating the future**. A remedial project always begins with an idea of the future status of the damaged ecosystem or landscape once restored. Similarly, the rights of future generations are mentioned in article L.110-1 of the Environmental code and in the Constitutional charter of the environment. This article, comparable to a social contract, structures the responsibilities and the promise made over the long term. It is a component in the concept of sustainable development which targets not only the responsible use of living resources so that they can be renewed for future generations, but also their conservation and remediation.

Remediation of nature is a means to care for the future generations. Restoration and rehabilitation (but not replacement) of degraded environments are a means to maintain or even to increase the ecological goods and services (populations, ecosystems and landscapes) available to humans in both the current and future generations. These operations are consequently part of a trans-generational process. Avoiding and remediating damage is also a means of acknowledging the long term that is manifested primarily by the legal recognition of a moral right, that of the future generations.

Water is the “shared patrimony of the nation” (1992 Water law) and the WFD states that "water is not a commercial product like any other but, rather, a heritage which must be protected, defended and treated as such". In addition to the issue of the general interest which is inherent in the implementation of this right, there is also the issue of the responsibility of the current generation for the well-being of future generations. Aquatic environments are remediated for both today and tomorrow.

However, remediation of ecosystems is nonetheless a bet on the future. This uncertainty is manifested in the limited control over the results of the work done and the expectations in terms of the future development of innovative techniques.

Remediation of nature means planning ahead. Today, it is particularly difficult to ensure the success and permanence of restoration operations. For example, in spite of a growing number of operations to rehabilitate wetlands in France, very few monitoring programmes have been set up following the work. For this reason, it is difficult to assess the effectiveness of the work done and the value of the work for the future. The reaction of environments following restoration or rehabilitation work is not yet well understood. Each function of an ecosystem (self-cleansing, degrading of organic matter, etc.) may react very differently over time following the work and evolve independently of the other functions (Dausse, 2016). Similarly, work to restore a service (e.g. the supply of drinking water, etc.) is a bet that the service will still be of value in the future. Ecosystem services reflect the interaction between a society and its environment, via the benefits that the society draws from the ecosystems. They reflect the interaction between ecological dynamics, land use and the priorities set among different ecosystem services by local stakeholders and political decision-makers at a given moment in managing a territory (Bierry, 2015; Onema, 2011).

Remediation of nature means innovating. That means, first of all, modifying thought processes. For example, river restoration projects aim to recreate a degree of autonomy for the river. This idea may seem evident today for stakeholders involved in river management. But it represents a historic breakthrough in the technical rationales guiding public policies for work in rivers until recently (Morandi, 2015). The earlier objective of controlling the river was obviously linked to the desire to improve the capacity to foresee river functioning. Efforts to increase the autonomy of a river will necessarily lead to greater uncertainty. Though the overall functioning may remain foreseeable, it may be necessary to accept that it is less foreseeable on the local level (Loire-Bretagne Water agency, 2011). It also means developing new techniques that will make it possible in the future to remediate damage that today cannot be remediated simply because we do not know how.

Conclusion

It is clear that ecological damage raises specific temporal issues. Whether the objective is to observe, avoid or remediate, ecological damage takes place outside of human time frames. It is to coordinate time in nature and time in human society that the law evolved by developing and enhancing a number of concepts and principles that now make it possible, though progress is still required, to better understand ecological damage, as well as to avoid and to remediate it. However, it is also clear that this situation continues to evolve because society evolves in parallel.

Knowledge and technical know-how progress, leading society as a whole to question how it thinks and acts by looking to the past to find the means to take action in the present while planning for the future. Avoiding and remediating ecological damage is a means for society to put sustainable development into effective practice. It is also a means to reconcile time in nature and time in human society. And it signals that we have understood Antoine de Rivarol when he said that “time is like a river, it does not flow back to its source”, meaning that the remediation of ecological damage is similar to time, i.e. we can never turn it back, we can undo certain things, but never completely.

SUMMARY of chapter 5 The time factor in managing ecological damage

Key concept

The time horizons in the legal and social spheres are not necessarily those observed in nature
In law, time is necessarily short, as measured on the human scale. But ecological damage can take a short time or years to occur. The time span during which legal action may be taken corresponds to that between the manifestation of the damage and the limits set by the legal statute of limitations.

Key points in understanding the subject

It is to reconcile these time frames and attempt to coordinate them that the law developed new concepts and succeeded in integrating the various time factors in its system to avoid and remediate ecological damage.

Key points to remember

Time factors concerning the cause of the damage lie in close conjunction with those involved in the manifestation of the damage.

It is generally when the damage becomes clear, precisely because it can be observed, that legal procedures can be launched. But beyond a certain time, legal action is no longer desirable because the evidence fades, causal links become less clear and the responsible person eventually dies. This is a consequence of the time lapse between the cause and the manifestation of the damage.
Three scenarios may be distinguished.

1 The immediate, gradual or delayed effects of damage following an event taking place once over a short period.

2 The immediate, gradual or delayed effects of damage following an event taking place repeatedly over short periods.

3 The immediate, gradual or delayed effects of damage due to a chronic cause.

The procedures selected to protect and remediate the environment take place within a time frame that, once again, raises the issue of the relationship with the past, present and future.

Avoidance of damage today remains the best means to avoid damage tomorrow.
When that is not possible, compensation in kind remains the best solution. Remedial operations can be launched in different manners that each set the action in a different time frame.