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Semiotic Evidence and "Green" Victimology in Indonesian Environmental Criminal Law: Rebuilding Ecological Justice Through Law

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ABSTRACT

This article addresses a major gap in Indonesian environmental criminal law: ecological ***entities*** *such as rivers, forests, and ecosystems are* ***not clearly recognized as legal victims****. As a result,* ***translating ecological damage into legally comprehensible and admissible evidence remains difficult****. While green victimology has broadened the idea of "victim" beyond human beings, and ecosemiotics shows that nature can "communicate" harm through observable material signs, these perspectives have rarely been integrated into doctrinal legal practice, particularly in Indonesia. Using normative legal research, this study combines statutory, conceptual, and comparative* ***approaches with*** *semiotic theory. The materials examined include Indonesian environmental regulations, comparative jurisprudence on the rights of nature, ecocide scholarship, green victimology, and ecosemiotics. The article argues that ecological harm should not be treated merely as a technical failure to comply with administrative rules or as a human-centered loss. Instead, it should be understood as the victimization of ecological entities, including rivers, forests, wildlife, peatlands, and ecosystems as living systems. In this framework, semiotic analysis* ***bridges natural signs and legal proof by identifying ecological indicators, supporting them through scientific verification, connecting them to legally recognized categories of harm, and applying interpretive safeguards against subjective reasoning****. Ultimately, the study contributes to environmental criminal law by proposing a* ***comprehensive*** *reconstruction of ecological victimhood, clearer evidentiary standards for ecological signs, procedures for representing non-human victims, and restorative sanctions* ***supporting ecological repair****.*

Keywords*: Semiotics, Green Victimology, Ecological Justice, Environmental Criminal Law, Ecocide.*

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I. INTRODUCTION

In recent decades, environmental damage has become impossible to ignore. From large-scale deforestation to pollution of the oceans and air, and the destruction of wildlife habitats, these trends point to a deeper, structural imbalance in how humans relate to the environment (Barbier, 2019). According to the United Nations Environment Programme (UNEP, 2022), more than 75% of the Earth's land surface has been significantly altered by human activity. At the same time, over a million species are at risk of extinction (IPBES, 2019). The Amazon rainforest, for example, lost more than 13,000 km² of forest in 2021 (INPE, 2022). In Southeast Asia including Indonesia more than 24 million hectares of primary forest have been lost since 2001 (Global Forest Watch, 2023). These numbers show more than ecological decline. They also reflect the effects of extractive industries, gaps in regulation, and legal systems that still largely treat nature as something of value only to humans (Kotzé & French, 2018). Yet behind these statistics are rivers, forests, species, peatlands, and even the atmosphere non-human entities experiencing habitat collapse and ongoing ecological harm, Under many conventional legal frameworks, however, they are not recognized as victims (White, 2015). This is where green victimology becomes important: it offers a way to rethink who or what should be understood as the "real" victim of environmental wrongdoing (White, 2018).

The core problem, then, is not only that environmental destruction is increasing. It is also that legal systems often fail to treat ecological harm as victimization in its own right. Ecological systems may be directly damaged and measurable in scientific terms, but their "injuries" are frequently reduced to administrative breaches, economic losses, or risks to people. As a result, a serious gap appears environmental criminal law: nature can clearly show signs

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of suffering, but the law still lacks a strong framework to read those signs, verify them, and translate them into meaningful legal responsibility.

Victimology has traditionally focused on human suffering, shaped by an anthropocentric worldview that treats legal "victims" as only people or communities (Ali et al., 2025). But environmental harm often hits non-human life and landscapes directly rivers, forests, coral reefs, and endangered species sometimes in ways that are permanent or hard to undo (Nurse, 2017). Green victimology challenges this limitation. It argues that victimhood should not be limited to humans, because nature also has intrinsic value and interests that deserve legal protection (Angkasa, 2020a). This shift has major implications for criminal law systems that still tend to frame environmental wrongdoing as something like a technical breach of administrative rules or as a financial loss (Toine Spapens, Rob White, 2018). In practice, ecological destruction is rarely understood as ecological suffering in legal reasoning. What gets labeled as "pollution," "illegal logging," or "biodiversity loss" often reflects a deeper reality: nature leaves material signs of harm. Illegally cut stumps, toxic waterways, and vanishing species are not just physical events they are signals that need interpretation (Maran, 2020). That is where semiotics helps. Semiotics studies signs and meanings, offering tools to read ecological signals (Romero & Dryzek, 2021). In contemporary ecosemiotics, building on scholars like Sebeok, Kull, and Maran, ecosystems are seen as communicative systems: disturbances produce patterns that can be understood through scientific and legal analysis. Even so, criminal law often overlooks these "communicative" aspects (Longo & Lorubbio, 2023). Nature cannot file a lawsuit, but it can produce "testimony" in the form of observable indicators such a fish deaths that point to oxygen depletion, burned soils that reveal how intense a fire was, or unusual temperature spikes that suggest microclimatic disruption (Cano & Id, 2018).

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When these signs were interpreted carefully and methodologically, they can support evidentiary reasoning that gives legal recognition to ecological suffering (Segala et al., 2025). This can be seen in Indonesian environmental litigation. In Indonesian environmental litigation, the PT Kallista Alam case illustrates how courts may rely on ecological indicators such as hotspot data, aerial photographs, field inspection, and expert testimony to establish environmental harm. Although the case primarily arose in civil environmental liability, its evidentiary logic is relevant for developing semiotic reasoning in environmental criminal law. Similar patterns appear in ecological crises affecting the Musi River, Danau Toba, and recurring forest fires in Riau, where declining water quality, toxic algal blooms, and polluted air haze provide measurable signs of harm. These examples suggest that ecological semiotics can be used operationally in court not merely treated as theory.

The growing discussion about ecological justice supports a simple but important shift: protecting the environment cannot only be about human needs. It also needs to treat nature as something with its own standing and protections almost like a rights-bearing "subject" rather than just an asset people use (Wienhues, 2017). We can see this shift in countries like New Zealand, Colombia, and Ecuador, where courts have granted legal personhood to things such as rivers and forests (Finlayson, 2021). But turning this idea into legal practice is not straightforward. Rights-of-nature approaches still face problems, such as uncertainty about how to read ecological indicators in law, reforms that may be symbolic changing the wording of rights without improving ecological conditions, and possible tensions with Indigenous communities, especially when conservation policies disrupt or replace traditional ecological practices (Hall, 2017). In Indonesia, environmental criminal law has generally moved in that direction. It tends to prioritize state interests, economic considerations, and

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managing risk more than directly protecting long-term ecological sustainability (Zhou et al., 2024). Corporate involvement in environmental damage, uneven policy power, and weak enforcement can further weaken efforts to maintain ecological integrity (Flynn & Hall, 2017). One promising way forward is to bring semiotics into criminal law. Semiotics can help authorities and courts detect and interpret early signs of harm, so legal action can be preventive, not only reactive after the damage becomes irreversible (Faure, 2016). It can also help reveal that ecological destruction is not only a technical problem it often affects culture and identity. For many Indigenous groups, forests, rivers, and mountains are not just "resources." They have relational, spiritual and cultural meanings (Cosgrove, 2003). When they are destroyed, it can mean cultural erasure, not just environmental loss (Chunhabunyatip et al., 2018). Recognizing these cultural meanings strengthens the case that environmental crimes can create multiple layers of victimization, and therefore require a broader legal response than we currently see.

Rights-of-nature frameworks are a major step forward for environmental protection, but they also come with real-world trade-offs. If we treat them as a simple "ideal solution," we risk overlooking the harms they can unintentionally create. In some jurisdictions, conservation areas created under ecocentric ideas have actually pushed Indigenous communities out of ancestral lands. That can weaken the kind of relational worldview that according to many Indigenous traditions protects ecosystems more effectively than top-down, state-run management. Similar tensions have appeared in rewilding projects in parts of Latin America and Europe. For example, bringing back predator can disrupt landscapes that were previously "semi-managed," especially where keystone species still depend directly or indirectly on certain human interventions to survive. There have also been cases where granting rivers legal "personhood"

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remains largely symbolic. Even if the law recognizes nature as a subject, ecological recovery may not improve if enforcement is weak or if litigation becomes a substitute for actual restoration on the ground.

A key challenge, then, is moving away from purely human-centered thinking toward an ecocentric approach one that can treat ecological harm as real victimization, not just an environmental loss that humans happen to suffer from (López Porras, 2024). Doing that requires more than changing ideas. It also requires building workable legal tools especially methods that connect scientific findings to legal reasoning. That is where semiotics can help. Ecologically relevant "signs" (the visible indicators of damage) need to be handled in a careful way. In practical legal terms, they should satisfy standards such as staying consistent over time, being scientifically verifiable, and being supported by independent expert confirmation. These criteria reduce the risk of subjective or selective interpretation and strengthen doctrinal rigor (Agusalim, 2022). At the same time, the growing discourse on ecocide underscores how urgent it is to recognize large-scale ecological destruction as a serious wrongdoing (Winter, 2024). In that perspective, ecosystems can be seen as victims "suffering" that can be traced through patterns of signs showing severe, lasting (Arifin et al., 2024).

Existing research helps, but there is still a gap. Green victimology has broadened the notion of "victim" beyond humans, yet it often does not provide a clear legal method for proving ecological suffering in criminal court. Rights-of-nature discussions sometimes recognize rivers or ecosystems as legal subjects, but they tend to focus more on constitutional or civil law rather than the strict evidentiary demands of criminal law. And while ecosemiotics explains how nature communicates harm through signs, it has rarely been translated into concrete categories of environmental criminal law. This article

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aims to fill that gap by combining green victimology and semiotic analysis to reconstruct ecological victimhood, evidentiary reasoning, and restorative sanctions especially within the Indonesian legal context.

II. RESEARCH METHODS

This research uses a normative legal method to examine how ecological justice can be reconstructed within the environmental criminal law. It applies several complementary approaches: the statutory approach analyzes legal norms related to environmental protection, criminal responsibility, evidentiary standards, and ecological restoration. The conceptual approach focuses on the doctrines of green victimology, ecological justice, ecocentrism, and the idea of nature as a legal subject. The comparative approach reviews legal developments in jurisdictions that have recognized rights of nature, ecological personhood, or legal reasoning grounded on ecocide (Kontesa & Fernando, 2024). Meanwhile, the semiotic approach is used to understand how ecological harm can be treated as a system of signs and translated into legal reasoning. The semiotic analysis is carried out through four stages. First, ecological harm is identified through classifies material indicators such as fire scars, toxic blooms, sedimentation, biodiversity loss, water discoloration, air pollution, and species mortality. Second, the harm is scientifically validated using ecological baselines, laboratory confirmation, remote sensing data, expert assessment, and temporal-spatial consistency to distinguish natural variation from human-caused damage. Third, the validated signs are translated into legal categories, including environmental damage, pollution, unlawful conduct, causation, corporate responsibility, and obligations for restoration. Fourth, the study evaluates normatively whether existing environmental criminal law is

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sufficient to recognize ecological victims and to support restorative sanctions aimed at repairing ecological ecosystem (Sinaga et al., 2024).

The research relies on legal materials in the form of legislation, court decisions, comparative jurisprudence, and scholarly literature concerning environmental criminal law, green victimology, ecosemiotics, rights of nature, and ecocide. These materials are analyzed using qualitative content analysis to identify doctrinal gaps and to develop a prescriptive model for reconstructing ecological criminal law (Endriana et al., 2023).

III. RESEARCH RESULTS AND ANALYSIS

This analysis is organized into three connected parts. First, it explains how green victimology reshapes the meaning of "victim" by moving legal attention away from human victims alone and toward ecological entities. Second, it shows how semiotic reasoning can turn ecological damage seen in the real world into evidence that courts can recognize. Third, it draws out what these two ideas mean approaches for Indonesian environmental criminal law, especially regarding how ecological victims are represented, how evidence should be assessed, and what kinds of restorative sanctions should follow.

A. The Transformation of Victimological Paradigms from Anthropocentrism to Green Victimology

Victimology an academic field that studies victims' position in the criminal justice system grew within an anthropocentric worldview shaped by mid-20th-century humanism (Vanfraechem & Bolívar, 2015). in early victimological thinking, harm, trauma, or loss were understood as experiences that only human beings can suffer. Because of this, the label "victim" was generally limited to human individuals or communities (Sollund, 2021). This

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limitation is closely tied to older Enlightenment legal ideas that place human rationality and moral responsibility at the center, while treating non-human beings as something less than subject more like objects that can be owned, managed, or regulated (Nicolaisen et al., 2020). As a result, environmental damage such as ecosystem decline, habitat destruction, and species extinction has often treated only as an indirect harm to human well-being, not as suffering that nature itself endures (Chacon, 2023).

This anthropocentric view is now being increasingly questioned. As global ecological crises worsen, it becomes clear that human-centered frameworks are often too limited to capture what is really happening. Climate instability, declining biodiversity, and pollution that crosses national borders show a key point: environmental harm does not only threaten human interests it directly damages ecological systems that do not have legal standing, and whose "suffering" goes largely unrecognized nor unrepresented in criminal law (Kotzé, 2021). In response, scholars from environmental ethics, ecology, and socio-legal studies argue that legal "subjectivity" should not be reserved for humans alone.

It is from this broader shift that green victimology emerges. Green victimology reframes the idea of a victim: it is not only a human individual or community. Instead, it includes animals, plants, ecosystems, and even atmospheric systems that are affected by environmental wrongdoing. Rather than treating the environment as a passive backdrop to human activity, green victimology emphasizes that nature hash intrinsic value and that ecological harm can amount to a real, independent form of suffering requiring that should be legally acknowledged and protected (Shamloo Bagher et al., 2017). In doing so, it challenges the long-standing philosophical divide between humans and nature that liberal legal traditions have often maintained.

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This change is supported by philosophical approaches that stress ecological interconnectedness. For example, Arne Naess's deep ecology rejects the idea that nature is valuable only for its usefulness to humans, and argues that nature has intrinsic ethical value (Allegri et al., 2025). Aldo Leopold's land ethic widens the moral community beyond humans to include soils, waters, plants, and animals, suggesting that humans should act as responsible members of a wider living community (Taylor, 1993; Skinner, 1976). Likewise, James Lovelock's Gaia hypothesis portrays Earth as a self-regulating system where parts are interconnected so when one element is damaged, the effects ripple through the whole system (Boston, 2008). Taken together, these ideas undermine the basic assumptions behind anthropocentric law, and they provide a stronger basis for extending "victimhood" to ecological entities because their suffering is not isolated. It is built into the broader, systemic patterns of environmental degradation.

A major implication of this shift is that the legal system has to rethink what counts as a "victim" in criminal law. Under green victimology, harmed rivers, destroyed forests, endangered species, and damaged air and atmosphere can be understood as victims in their own right. Their injury does not have to be proven only through harm to humans. Instead, ecological suffering becomes something the law can cognize on its own terms.

This approach is reflected in Colombia's 2016 Constitutional Court decision about the Atrato River (González-Serrano, 2024). In that case, the Court recognized the river as a subject with rights and appointed the State, together with Afro-Colombian and Indigenous communities, as co-guardians. The ruling also went beyond symbolism by setting real, enforceable duties including ecological monitoring, coordinated restoration programs, and ways for communities to participate in the decision-making. The Court recognized

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the Atrato River, its basin, and tributaries as subjects of rights and linked ecological degradation to violations of biocultural and fundamental rights.

Overall, this jurisprudence shows how victimhood can be expanded to include ecological systems and that recognizing rights for nature is not just a matter of changing legal language. It requires institutional changes, shared stewardship, and state obligations that can actually be enforced. The Atrato ruling also highlights how Indigenous and Afro-descendant cosmologies many of which see rivers and forests as living beings can shape constitutional reasoning and broaden the knowledge base behind environmental law. For criminal law specifically, this means adjusting how we define harm, culpability, and reparation, so that ecological degradation is not treated merely as a minor administrative violation, but as a direct wrongdoing against an ecological subject.

A closer look at cases around the world suggests that courts often do something very close to semiotics-even when they never call it that. Judges routinely read ecological indicators as meaningful proof of environmental harm and link them to wrongdoing. For instance, in Ecuador's 2011 case involving the Vilcabamba River, the court treated things like sediment build-up, changes in the river shape, and hydrological blockage as signs that the ecosystem was being harmed by road construction. Similarly, in Colombia's T-622/2016, evidence such as mercury bioaccumulation, biodiversity loss, and altered flow patterns helped the court recognize the Atrato River as a rights-bearing entity and a victim of structural violence. In New Zealand's settlement concerning the Whanganui River, trends in river-health indicators over time, shifts in species composition, and disruption to Māori's cultural and spiritual understandings of the river were treated as a kind of narrative evidence that supported legal personhood.

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At the same time, wider global discussions on ecocide are pushing this direction further. Proposals related to ecocide at the International Criminal Court show growing acceptance of the idea behind green victimology within international criminal law namely, that protecting the planet's systems is not only a policy goal, but an ethical necessity for both present and future generations (Bandopadhay, 2024). In this framing, large-scale environmental destruction is not only a danger to humanity; it becomes a serious wrong against ecosystems that have their own intrinsic worth.

Green victimology also builds on a clear theoretical foundation: it rejects the idea that nature exists only as a tool for human use. When legal systems take intrinsic value seriously, they can move beyond treating environmental harm as just a failure to follow regulations. Instead, ecological harm can be understood as an offense against the dignity and integrity of ecological life. In that sense, ecological suffering is not merely a policy problem it becomes a real legal injury that calls for a substantive response from criminal law (Wei et al., 2025).

However, moving toward green victimology is not without difficulties. Most legal doctrines, court procedures, and rules are still built around the assumption that victims and harm are fundamentally human. Once victimhood is expanded to include ecosystems, new questions immediately arise: Who represents the ecological victim? Do ecosystems have "agency" in the legal sense? And what level of proof is required to show that real ecological harm has occurred? Critics also caution that rights-of-nature approaches can create unintended side effects such as conservation measures that push Indigenous communities aside, rewilding efforts that disrupt species that depend on human-managed environments, or laws that are mostly symbolic and do not actually change ecological outcomes.

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For green victimology to work in practice, it therefore needs concrete methodological tools ways to detect and interpret ecological suffering in a legally credible manner. This is where semiotics and ecosemiotics become more than theory. Ecological "signs" (for example, declining biodiversity, toxic alga blooms, sedimentation patterns, fire scars, or unusual atmospheric conditions) can be treated as indexical evidence indicators that ecosystems are being harmed. Building on ecosemiotics (Sebeok, Kull, and Maran), these signs are understood not as random occurrences but as part of broader systemic "communication" from the ecosystem itself. Still, for legal use, ecological signs cannot be read subjectively.

In Indonesia, incorporating ecological victimhood into environmental law remains limited. Law No. 32 of 2009 focuses on environmental management, but it still largely reflects an anthropocentric logic emphasizing human welfare, state revenue, and administrative compliance (Angkasa, 2020b). Environmental crimes are typically pursued as breaches of permits or as threats to economic interests, leaving ecological suffering mostly outside the court's reasoning. Even though Indigenous communities and environmental advocates have raised concerns for a long time, legal provisions and judicial practice rarely treat ecosystems as victims of crime. In this context, green victimology can offer a genuinely transformative pathway for Indonesian environmental criminal law helping rethink what counts as harm, how victimhood should be framed, and how legal responsibility can better match ecological realities today.

B. Reading the Signs of Nature's Suffering through a Semiotic Approach in Law

Legal systems typically depend on fixed rules, written texts, official documents, and formal testimonies to make sense of what is happening in

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society and, in some cases, in the environment. But much of environmental harm does not appear in language, it shows up instead through material and observable signs things like the smell of contaminated water, changes in landscapes, altered ecosystems, or shifts in where species can survive. For example, burning peatlands, polluted rivers, degraded soil, and disrupted species patterns reflect ecological suffering that "positive law" often struggles to capture through ordinary verbal or textual evidence. This is exactly the space where semiotics becomes useful, because it offers a way to read the non-verbal signals produced by damaged ecosystems and translate them into evidence that legal reasoning can recognize.

Semiotics as an academic field was shaped by two major thinkers: Ferdinand de Saussure and Charles Sanders Peirce. Both helped explain how meaning is created and communicated, but they did so through different models that work in complementary ways (Battistella & Bouissac, 1999). Saussure, a Swiss linguist, introduced a dyadic model of the sign. In this view, a sign is made of two inseparable parts: the *signifier* (the form of the sign such as a word, image, or sound) and the *signified* (the concept or idea the signifier points to) (Joseph, 2017). He also emphasized that the connection between signifier and signified is largely arbitrary there is nothing natural that makes a particular word automatically match the thing it refers to. Meaning comes from the way signs relate to each other within a larger system: what something "means" depends on how it differs from other words in that system. Peirce, an American philosopher and logician, offered a more triadic and dynamic model. For him, a sign consists of three parts: the *representamen* (the physical form of the sign, like a sound, image, or gesture), the *object* (what the sign refers to), and the *interpretant* (the understanding produced in the mind of the person interpreting it (Kilstrup, 2015). This triadic model highlights that meaning is not

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something fixed inside a sign. Instead, meaning is made through an ongoing, relational process one that depends on context and can be understood in different way over time. In other words, a sign works as part of interpretation, not as a standalone "message." Peirce also grouped signs into three main types, based on how the sign connects to what it refers to: *Icons,* signs that "look like" their object such as a map representing a place, or a portrait depicting a person; *Indexes,* signs that are directly linked to their object through a physical or causal relationship like smoke signaling fire, or footprints suggesting someone has pass through; *Symbols*, signs whose meaning comes from shared convention or learning like language, where words carry meaning not because they naturally match the things they describe, but because communities agree on codes and rules. Together, these ideas help explain how signs function across cultural, linguistic, and knowledge systems (Behera, 2024). Beyond classical approaches of Saussure and Peirce, more recent semiotics has also developed stronger tools for thinking about ecological communication how ecosystems "signal" harm and change. For example: John Deely's concept of physiosemiosis broadens semiosis beyond human thinking. It argues that meaning-making happens across living and non-living systems through relationships in the world; Thomas Sebeok's biosemiotics treats ecosystems as ongoing sign-processes, where organisms continuously interpret environmental cues to survive. From this view, ecological degradation can be understood as a disruption in those "communication" pathways between organisms and their environment; Scholars associated with Tartu School, including Kalevi Kull, develop ecosemiotics further by describing landscapes as semiotic spaces (matrices) where humans and non-human life interact and jointly produce meaning; Timo Maran adds the idea of "semiotic ruptures" visible breakdowns in communication that show up as altered animal behavior, disrupted nutrient

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cycles, or damaged habitats. Overall, these frameworks make semiotics useful for more than analyzing human speech or symbols. They help explain how meaning is created, carried, and interpreted in wider semiotic environments including legal processes, ecological systems, and social life.

For example, in Kalimantan and Sumatra, forest fires often repeat year after year, but the legal system usually does not respond until there are clear human consequences like respiratory illnesses or even deaths (Aiken, 2004). From a semiotic point of view, though, this response is too late. Smoke that blankets the region, the eerie absence of birds, or ash settling on leaves are all signs that ecosystem is suffering. They should be read as indicators of environmental wrongdoing. If the legal system accepts evidence only through formal complaints or impacts that can be felt directly by humans, then the whole chain of ecological signals is effectively ignored even though those signals contain meaningful information about ongoing ecological harm.

These limitations also show up in court decisions. Environmental litigation often depends heavily on administrative documents and human testimony as the main forms of proof (Samosir et al., 2025). As a result, claims can be dismissed because courts say the evidence is insufficient to show "direct harm," even when the disputed areas have already suffered serious ecological damage based on observations and data. The problem is not that harm did not happen it is that legal institutions are still built around what can be written and spoken in legal language. In practice, only what affects people tends to count as legally relevant. Nature's suffering is left unacknowledged because it cannot "speak" in the kind of language the law recognizes.

Semiotic analysis offers a different way of knowing. Instead of treating ecological realities as facts that only matter when they are translated into human-centered terms, semiotics treats environmental harm as part of a system

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of signs something that can be interpreted and then used in legal reasoning. Under this approach, ecological damage is not only physical destruction; it is also a kind of "story" told through signs symbols, indexes, and visible traces in the environment. That means environmental criminal law can build tools to read the "ecological texts" that appear in different forms: a river turning discolored, changes in soundscapes, or spatial patterns left on the land (like the disappearance of nocturnal animals). Together, these signs communicate a clear message: something is being wrongfully done to nature.

From a practical, methodological standpoint, using a semiotic approach in environmental criminal law means we cannot just "read" nature's signals we have to translate them into forms the legal system can use. That requires developing new analytical tools and shared methods between disciplines. Legal scholars alone cannot do it; the process typically needs input from ecologists, environmental anthropologists, and sometimes even visual specialists like artists, GIS mappers, or cartographers. Take a simple example, spatial mapping that tracks land-cover change over the last five years can act as the *representamen* the visible, measurable sign of ecological damage. From that evidence, the *interpretant* (the legal understanding) could be something like: "ecosystem degradation has occurred to a degree that should be treated as criminal wrongdoing." In this sense, the semiotic approach is meant to be more responsive than waiting until people file complaints or until a health disaster forces the issue.

That said, a major challenge is the risk of subjective or selective interpretation. Ecological signs especially when they are visual, sensory, or ambiguous can be misread due to aesthetic bias ("it looks polluted"), incomplete data (missing baselines), or disagreements between experts. To reduce that risk, semiotic evidence in legal reasoning still needs procedural

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safeguards, such as: (1) minimum thresholds for what counts as meaningful ecological deviation (so minor fluctuations do not become "oroof"); (2) triangulation using independent datasets (different studies or monitoring sources should point the same way); (3) cross-disciplinary expert review (not just one scientific discipline or one type of testimony); and (4) a requirement that any semiotic conclusion be tied to reproducible measurements, not intuition.

A sobering example is the Citarum River in West Java. For years, it showed obvious, early signs of ecological distress visible changes in water color, strong smells, and worsening conditions that anyone could recognize. Yet the legal system often stayed inactive (BSc, 2016). Over decades, the river shifted from relatively rich and functional to something dramatically degraded: waters gradually turned from murky brown to nearly black, industrial sludge coated the surface, and toxic odors could be detected from far away. Fish, amphibians, and other aquatic life gradually vanished, leaving parts of the river biologically lifeless. Even as this unfolded, enforcement did not follow early warning signs. That delay was not because harm was absent it was because the system tended to rely on human-centered triggers before taking action, such as formal complaints, visible health crises, or regulatory inspections. In other words, the harm was already there in the ecosystem's "signals," but the law did not treat those signals as actionable evidence until they were converted into human-interpretable impacts. Without citizen complaints, class action lawsuits, or formal investigations and audits by environmental agencies, the worsening conditions of the Citarum River effectively disappeared from the law's attention it was not treated as "proof" of anything, even though everyone could plainly see it. But through a semiotic lens, the river was not silent at all. It was communicating. Its changing color acted like an indexical sign a direct indicator

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that the water's chemistry had shifted. The intense, foul smell signaled biological breakdown and the presence of toxins. And the disappearance of aquatic life was not just an unfortunate side effect; it was a clear "alarm," signaling deep, systemic ecological imbalance. In that sense, these were not merely symptoms. They were messages embedded in the landscape, pointing to ongoing sources of harm and deterioration. The tragedy is that the legal system did not treat these signs as enough to trigger scrutiny. That reveals a serious mismatch between ecological reality and legal recognition. The river's degradation unfolded step by step through escalating signals that could have supported early investigations and preventive action. Yet because the system required a human-centered trigger (like a formal complaint or clear human injury), those ecological indicators were ignored. As a result, meaningful intervention was delayed, and in some areas the damage became harder something impossible to reverse. By the time enforcement finally gained momentum, the situation had already reached catastrophic levels. Along the riverbanks, industrial zones had discharged toxic waste into the water for years. Informal settlements added more pollution through unmanaged domestic waste. Instead of being treated as a living system capable of signaling distress, the river was treated as background scenery only noticed when its toxicity directly threatened people. Overall, the Citarum case shows why early warning signals like color changes, smells, and species loss should be built into legal reasoning. Their meaning is not just "the environment looks worse." They are concrete signs that harm is already in progress. If the legal system does not recalibrate to respond to those signals, environmental crimes like those on the Citarum River can continue for years in plain sight until the final, human-centered consequences becomes undeniable.

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To avoid methodological ambiguity, this article develops a practical four-step semiotic framework that translates ecological change into legally recognizable evidence. It begins with identifying ecological "signs" by systematically detecting material indicators of harm such as fire scars, spikes in sedimentation, species deaths, or toxic blooms through remote sensing, biomonitoring, and field observation. Next, each sign is scientifically verified against ecological baselines using measurements taken across time and, where added, and laboratory testing, so that naturally occurring variations can be separated from human-driven damage. After verification, the legal step translates those signs into relevant statutory categories of environmental harm, allowing judges to treat them as an evidentiary account that connects specific actions to ecological injury. Finally, interpretive safeguards are built in through cross-expert review, interdisciplinary triangulation, and judicial protocols that reduce the risk of subjective or "aesthetic" misreadings of environmental change.

Applied in this way, semiotic thinking has important epistemological implications for environmental criminal law. It pushes law to move beyond treating proof as something that only comes through verbal statements and formal documents. Instead, law must be able to read ecological reality as a system of signs and interpret what ecosystems are communicating through patterns of change. That shift also requires legal institutions to remain open to knowledge forms that sit outside strict positive-law doctrine, including environmental science, ethnobotany, and even Indigenous cosmologies where ecological understanding is often conveyed through symbolic and narrative ways. For example, in some Indigenous communities, the disappearance of a particular bird species may be understood as a sign that the forest ecosystem is

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under stress semiotic knowledge that can exist independently of, and even precede, the theoretical accounts associated with Peirce or Saussure.

Adopting a semiotic approach also changes how we think about what counts as legal evidence in environmental criminal law. Evidence does not have to be limited to documents, witness statements, or confessions. It can also include physical traces, spatial patterns, and visual signals changes in land, water, or ecosystem that can be read both scientifically and, in a broader sense, interpretively. In practice, this enables the legal system more preventive and responsive. Instead of waiting to punish offenders only after serious damage has already happened, law can act on early warning signs of ecological suffering. Overall, semiotics provides both the conceptual basis and practical direction for building legal tools that better match the environment's fast and complicated dynamics.

It can also support environmental advocacy, which often gets stuck because of the strict burden of proof required in court. Activists and communities may struggle to meet formal evidentiary standards, especially when the harm is documented through observations that don't fit neatly into conventional legal formats. Semiotics helps clarify that ecological signs people record like shifts in water color, recurring die-offs, or changes in local biodiversity are not just personal opinions. They can be understood as part of a wider ecological communication system that can be translated into legal standards. In that sense, semiotics works like a bridge between lived ecological experience and the legal arena.

In sum (without formally concluding), the semiotic approach broadens what law can "read" as reality. It encourages legal system not only to rely on reports and statutory texts, but also to recognize the sky turning red from pollution, the smell coming from contaminated rivers, and the silence left when

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a once-living forest loses its sound. These are all signs of suffering—and if law can learn to interpret and acknowledge them, it can shift how crimes against nature are understood and addressed.

C. Reconstructing Ecological Justice in Criminal Law through Semiotics and Green Victimology

Modern criminal law systems have often been shaped by a retributive approach one that focuses mainly on punishing offenders for wrongdoing (Bazemore & Umbreit, 1995). In that model, the victim is frequently treated as secondary or passive, while the law centers on the perpetrator and the act itself. This becomes especially difficult in environmental cases, because the "victim" is not always a human being. The injured parties may be rivers, forests, air, or whole ecosystems entities that typically have no direct representation in court. Because of that gap, there is a real need to rebuild criminal law so it can respond more fairly to ecological suffering. One promising way is to combine semiotics with green victimology, both as guiding ideas and as methods for how cases can be recognized and proved.

A semiotic approach in criminal law helps explain and interpret ecological realities that often cannot be expressed through ordinary verbal testimony. Environmental harm like a river turning discolored, thick haze from recurring forest fires, or the disappearance of certain species communicates something without using human language. Semiotics encourages the law to treat these not as neutral facts to be ignored unless someone files a complaint, but as meaningful signs embedded in particular context (Cheng et al., 2014). With this perspective, the legal system does not just wait for formal reports or human-centered triggers; it can become more proactive, reading ecological signals as early evidence of harm that deserves a legal response.

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At the same time, green victimology pushes the law to rethink who counts as a "victim." In other criminal justice models, only human beings were typically seen as capable of suffering and therefore as deserving legal protection. Green victimology expands the victimhood to include nature itself and its components. In other words, it asks the legal system to recognize non-human suffering as real victimization, both morally and legally. When paired with semiotics, this becomes even stronger: ecological suffering is not just a theory it can be observed, documented, and interpreted through the signs nature displays.

Reconstructing ecological justice in criminal law also requires a shift in the overall purpose of criminal justice. Instead of relying on a retributive model (punishing an offender mainly as retribution), the law would move toward a more restorative, ecological approach. Under this model, criminal law would still hold offenders accountable, but it would also aim to repair what was damaged, acknowledge the ecological harm that occurred, and prevent further damage. Restoration here means more than fixing broken ecosystems in a physical sense it also involves restoring the ecological and symbolic values that were violated by the crime, and repairing the relationship between humans and the natural world.

Finally, this shift should also change how we understand *delict* what counts as a criminal offense in environmental law. Traditionally, many environmental harms are framed as administrative violations or as wrongdoing only because they affect humans or the state. That framing is too narrow because it overlooks offenses that harm nature as an independent entity (Nurse, 2017). With a semiotic and green victimology perspective, delicts can be defined around suffering shown through readable signs signs that appear in ecological, spatial, and visual form. These might include changes in land cover, loss of

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biodiversity, contamination of water sources, and other measurable indicators that point to environmental crimes.

Just as important, environmental criminal law needs a rethink of its sanctions. Sanctions should not be understood only as punishment for the offender. In an ecological restorative justice framework, they should also work to restore what was harmed both in the ecosystem and in the shared values that nature represents. That can mean obligations to rehabilitate damaged environments, pay ecological restitution, or contribute to community-based ecological work. More broadly, sanctions can be designed to be educational and transformative, helping offenders and the wider public better understand ecological harm and why it matters. In this way, the symbolic meaning of ecological suffering becomes part of what makes punishment more thoughtful and meaningful, not just punitive.

Building a criminal policy model that combines semiotics and green victimology can also look like a legal system that responds to early warning signs of degradation. Governments could create ecological indicators that function as triggers for timely legal actions for example, rising temperatures, worsening air quality, the disappearance of endemic species, or noticeable changes in wildlife behavior. With such a system, enforcement does not have to wait until the harm becomes massive and undeniable. Legal action can be based not only on complaints, but on the ability to read ecological signs and treat them as legitimate grounds for intervention.

Some countries have already started moving in this direction. In Ecuador and Colombia, recognizing the rights of nature as legal subjects has helped open space for green victimology within law. In New Zealand, the Whanganui River is recognized as a legal entity, and local communities can act as its guardians guided by spiritual and ecological relationships through which they interpret

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the river's suffering (Hutchison, 2014). While these efforts may not always use semiotics explicitly, they show that interpretations of nature's harm can be translated into legal rules and public policy (Finlayson, 2019).

Building a criminal law system that truly delivers justice for nature requires more than tweaking environmental rules it demands a deeper change in how law thinks about harm, responsibility, and who (or what) counts as a victim. This shift has to happen across several legal dimensions at once. Five key ideas provide a starting point for that reconfiguration. First, the law needs a broader definition of the "victim." Most traditional criminal law system recognize victims mainly as human beings (or sometimes legal persons like corporations or states). That anthropocentric framing overlooks the very entities most harmed by ecological destruction rivers, forests, wildlife, and entire ecosystems. A more ecologically just system would recognize these non-human beings and natural systems as victims in their own right, grounded in their intrinsic value and in the reality that they can suffer harm. Expanding the category of victim is not just symbolic; it also helps open the door for these harms to be represented in court, potentially through guardianship models or other ecocentric legal standing approaches. Second, the system must treat ecological signs of damage—like deforestation patterns, loss of biodiversity, water contamination, and climatic shifts—as legitimate forms of evidence. Environmental harm often unfolds gradually and across systems rather than appearing only as a single, dramatic incident. It courts learn to treat ecological signals as valid proof, justice can shift from a mostly reactive mode to a preventive one. That also means legal actors prosecutors, judges, investigators need more than doctrines training; they require ecological literacy and the ability to interpret environmental change through a semiotic or sign-reading lens. Third, criminal offenses need to rewritten so that ecological suffering is

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explicitly built into the offense itself. Too often, environmental crimes are defined in regulatory terms violations of permits, emissions limits, or zoning rules rather than in terms of the harm done to nature. An ecological justice-oriented system would redefine crimes to reflect the moral and biological consequences of actions such as destroying habitat, driving species to extinction, or collapsing ecosystems. This redefinition helps the law sound more like what communities actually experience when ecosystems are breaking down. It gives courts clearer language to recognize, identify, and name environmental harm. The fourth step is to rethink what punishment is for in environmental cases. Instead of focusing mainly on blame and incarceration, an ecological justice model emphasizes restorative and educational sanctions designed for environmental wrongdoing. That could mean requirements to restore damaged ecosystems, support community-based environmental project, or require public acknowledgment of the harm caused. Educational sanctions, in particular, matter because they do not just address one offender they can shift attitudes and cultural beliefs about what environmental responsibility looks like, encouraging long-term stewardship. Finally, the fifth step is to build semiotic-based early detection into how environmental enforcement works. Environmental harm usually does not arrive all at once. It tends to show up gradually through patterns like declining water quality, unusual animal behavior, or changes in air composition. These signs should be treated as meaningful warnings, not just background noise. If agencies institutionalize them as "legal red flags," they can intervene before damage becomes irreversible. Doing this may involve partnerships between legal institutions and scientific experts, sensor-based monitoring technologies, and incorporating Indigenous ecological knowledge into surveillance and early-warning systems. Taken together, these five elements offer conceptual a

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blueprint for reimagining criminal law as something more than a tool for human-only justice. They point toward ecological justice a broader cultural and legal shift away from anthropocentrism and toward an approach that is more inclusive, more responsive, and more preventive, with nature treated not only as the object of protection but also as a subject deserving legal recognition and rights.

In Indonesia, making this reconstruction real would require a few concrete changes in how environmental criminal cases are handled. First, ecological victims need to be represented in court. Since ecosystems cannot file complaints, give testimony, or directly ask for restoration, representation has to come through legal and institutional actors for example public prosecutors, environmental agencies, court-appointed ecological guardians, affected communities, Indigenous groups, or qualified environmental experts. Second, the way evidence is assessed in environmental criminal cases should be broadened. Courts should be able to rely on scientifically verified ecological "signs," such as satellite images, hotspot and environmental monitoring data, laboratory testing results, water and air quality indicators, evidence of biodiversity decline, sedimentation patterns, and expert ecological evaluations. These signs should not be treated as background material; they should be read as meaningful chains of information that can help show causation, seriousness, and the continuing nature of ecological harm. Third, sanctions also need to be redesigned. The goal should not be only to punish offenders, but to restore what has been damaged. That can include orders for ecological restoration, rehabilitation of polluted rivers or burned peatlands, efforts to recover biodiversity, ongoing environmental monitoring obligations, reforms to corporate compliance systems, and community-based forms of ecological repair. With measures like these, environmental criminal law shift from an

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approach that is mostly punitive and administrative toward an approach that is genuinely ecological and restorative.

Conceptually, the broader change is that criminal law must evolve into a system that protects people from environmental harm and protects the environment from human wrongdoing. Nature not be seen only as a passive object that the law protects; it should be treated as something with its own value—something that can be harmed and therefore deserves recognition within legal justice. In this shift, semiotics helps explain how ecological signs can be read and understood, while green victimology provides the ethical and moral justification for recognizing nature as a kind of victim. Together, they offer a more complete framework for rebuilding criminal law so it is ecologically fair. This is not an abstract proposal: with the climate crisis worsening and global ecosystems continuing to be degraded, it becomes a real normative necessity to move beyond the older, human-centered assumptions of criminal law.

IV. CONCLUSIONS

This study finds that the combining semiotics and green victimology offers a practical way to rebuild environmental criminal law. First, green victimology helps shift the law's focus toward the actual sufferers of ecological harm. It supports recognizing rivers, forests, species, peatlands, and ecosystems as ecological victims cases where damage does not always need to be proven through human injury first. Examples from places like the Atrato River, Vilcabamba River, and Whanganui River show how non-human nature can be represented through guardianship, community involvement, and restoration duties that courts can enforce. Second, semiotic analysis improves how environmental cases can be proven in court. It makes it possible to treat

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ecological signs such as fire scars, contaminated rivers, toxic algal blooms, sedimentation, biodiversity loss, and satellite-detected environmental changes as legally meaningful evidence. In this approach, ecological signs go through four steps: identifying the signs, verifying them scientifically, translating them into legal terms, and adding interpretive safeguards to avoid guesswork. These safeguards matters because they keep semiotics from becoming speculative. The system requires things like ecological baselines, expert confirmation, consistency across time and space, and environmental measurements that can be reproduced. Third, the study argues that Indonesian environmental criminal law should move beyond an anthropocentric, administrative model. That means recognizing ecological victimhood, allowing scientifically verified ecological signs as evidence, strengthening court procedures that can speak for non-human victims, and designing sanctions that focus on ecological restoration. Overall, the contribution of this article is that it offers an "operational bridge" between ecological signs, victimology-based ethical theory, and the practical reconstruction of criminal law. Within this framework, environmental criminal law can become more than a tool for punishment—it can also support ecological repair, prevention, and justice.

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