

The Death Profit Paradox

How to detect tree death without creating incentives for tree killing. Token freeze mechanics, asymmetric stakes, and death as a public good.

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Abstract

Any conservation mechanism that ties token value to tree survival must also detect when trees die. But any mechanism where someone profits from reporting death creates an incentive to cause death. This paper presents the resolution of this paradox through three interlocking design decisions: the permanent token freeze (making death universally costly), asymmetric staking (making false reports costly and true reports unprofitable), and the classification of death detection as a public good funded through ongoing holder fees rather than bounties.

1. The Paradox

The Arboreal Capital mechanism depends on a simple premise: your token has value while the tree lives, and no value when the tree dies. This creates the conservation incentive—token holders want the tree to survive because their money depends on it.

But the system must also *know* when a tree dies. Someone must report it. Something must verify it. And the moment you introduce a reward for reporting death, you have introduced an incentive to cause death.

This is not a theoretical concern. Consider the naive design: a bounty system where anyone who reports a dead tree and is verified correct receives a reward. An attacker buys a small position in a tree, destroys the tree, reports the death, collects the bounty. If the bounty exceeds the position cost, the attack is profitable. Even if the bounty is small, an attacker with no position at all can destroy trees for the reward alone.

The same logic eliminates short selling, put options, and prediction markets on tree death. Any instrument that allows someone to profit from a tree dying is an instrument that pays someone to kill trees. These were explicitly removed from the Arboreal Capital design after this analysis.

The Paradox: *The system must know when trees die. But it must never pay anyone for trees dying. These two requirements appear to be in direct conflict.*

2. The Token Freeze

When a tree is confirmed dead, the token does not lose some value. It does not become a discounted historical artifact. It does not enter a secondary market for dead-tree memorabilia. The token freezes permanently. All transfer functions revert. The token cannot be bought, sold, or moved. The holder's investment is irrecoverably locked.

This is implemented at the smart contract level through an override of the ERC-721 transfer function. When a tree's status is set to dead, the contract's `_update` function checks the tree's alive flag and reverts if it is false. No governance vote can unfreeze the token. No admin key can override it. The freeze is as permanent as the death.

2.1 Why Freeze, Not Burn

An alternative design would burn (permanently destroy) the token upon tree death, removing it from the supply entirely. We chose freeze over burn for three reasons.

First, a frozen token serves as a permanent record. The token's metadata—coordinates, minting date, ARES fingerprint—remains on-chain as an immutable monument to a tree that once existed. This has archival value.

Second, burning creates a deflationary pressure that could make death economically useful to holders of other tokens. If a tree's death reduces total supply and thereby increases the value of remaining tokens, holders of unrelated trees have a perverse incentive to welcome or even facilitate death. The freeze avoids this: the token continues to exist, occupying its slot in the registry, creating no supply reduction.

Third, the freeze creates the maximum possible psychological and financial pain for the holder. The token sits in your wallet, permanently, as a reminder of what was lost. You cannot sell it. You cannot hide it. This is deliberate. The mechanism is designed so that every token holder viscerally understands what tree death means for them, personally, before it happens.

2.2 The Circulating Supply Caveat

A frozen token remains in total supply but exits circulating supply. If the market prices tokens based on circulating supply rather than total supply—and markets typically do—then each tree death produces a mild deflationary effect on remaining tradeable tokens. This is a smaller effect than a burn, but it is not zero. We consider this acceptable for one reason: at scale, the effect is so diffuse across millions of tokens that no individual holder has a meaningful financial incentive to target a specific tree. The marginal value gained by any single holder from one tree's death is negligible. The mechanism requires that the cost of killing a tree (legal risk, logistics, moral weight) vastly exceeds the distributed benefit to any individual—and at any reasonable scale, it does.

3. Asymmetric Staking: Reporting Without Incentive

If death cannot be profitable to report, how does the system learn about dead trees? The answer is asymmetric staking: reporting a death is not rewarded, but reporting a false death is severely punished.

3.1 The Death Claim Process

Anyone may submit a death claim for any tree. To do so, they must stake a significant amount—denominated in the protocol's native token or stablecoin—as collateral. This stake is not a fee; it is returned if the claim is validated. If the claim is found to be false, the stake is slashed entirely.

A validated death claim returns the reporter's stake and nothing else. No bounty. No bonus. No percentage of the frozen token's historical value. The reporter breaks even at best. This means

the only people who will file death claims are those with a civic or ecological interest in accurate record-keeping, or those who stumble upon a dead tree and feel obligated to report it—the same motivations that drive reporting to any public registry.

3.2 Why Anyone Would Bother

If there is no profit in reporting death, why would anyone risk their stake to do so? Three mechanisms drive reporting.

First, ongoing verification fees (described in Section 4) fund random spot-checks that will eventually discover dead trees through routine audits. Death claims from individuals simply accelerate this process.

Second, community norms. In any system with a large enough user base, some participants will report dead trees for the same reason some people report potholes: because the system works better when information is accurate. The stake requirement filters out pranksters while allowing genuine reporters.

Third, adjacent financial interest. A token holder in a neighboring tree may report a death to maintain the credibility of the verification system—because a system that fails to detect dead trees loses market confidence, which devalues all tokens. The incentive is indirect but real: accurate death detection preserves system-wide trust.

Design Principle: *The reporter of a dead tree gets nothing except their stake back. The reporter of a falsely-claimed dead tree loses everything. The asymmetry eliminates profit motive while preserving information flow.*

4. Funding Verification: The Three-Tier Model

If death detection is not funded by bounties, it must be funded by something else. The naive approach—a flat annual fee paid by all holders—fails because it creates a free-rider problem: rational holders stop paying when the discount for non-payment is smaller than the fee. A transaction fee model fails because it aligns the protocol with trading volume rather than conservation, and incentivizes wash trading to inflate the verification pool. The solution requires matching the funding mechanism to the natural behavior of each token class.

4.1 Three Tiers, Three Behaviors, Three Funding Mechanisms

Bulk trees (millions of commodity-class old-growth tokens) are the liquid layer. They trade frequently, like index fund components. A small mechanical spread (0.3–0.5%) is built into the smart contract: buy price is always fractionally above sell price. This spread is not a fee

charged by a platform—it is a market mechanic embedded in the token itself. The spread proceeds fund the collective verification pool for all bulk trees. High volume across millions of tokens generates substantial funding. Bulk trees are verified by random statistical sampling, not individually—making per-tree verification cost negligible.

Premium trees (emotionally significant, locally known old-growth) trade less frequently. A moderate spread (1–2%) funds verification when trades occur. Additionally, the premium tier supports voluntary verification contributions—holders who want their specific tree verified more frequently can fund it directly. This is not an obligation; it is an identity function. The person who owns the token for the oak in their hometown park has a personal relationship with that tree’s continued verification.

Hero trees (Hyperion, General Sherman, Methuselah—the cathedrals) rarely trade. A buyer acquires Hyperion and holds it indefinitely. The spread is irrelevant because volume is near zero. Instead, hero trees fund their own verification through an endowment established at mint: a percentage of the mint price is allocated to a per-tree verification reserve denominated in stablecoin. The reserve generates yield; the yield funds that tree’s individual verification in perpetuity. The endowment control architecture for hero trees is under active design (see Section 6.3).

Design Principle: *The funding mechanism matches the natural behavior of each tier. Bulk liquidity funds the commons. Hero mint prices fund cathedrals. Premium holders fund their own backyard. No single tier’s failure collapses the system.*

4.2 Why Spreads, Not Fees

A spread discourages unnecessary trading and rewards holding—exactly the behavior the conservation mechanism requires. A transaction fee, by contrast, creates a revenue stream that grows with volume, which implicitly incentivizes the protocol to encourage speculation and volatility. The spread aligns the protocol’s economic interest with the conservation mission: the protocol does not benefit from churn. Holders who trade frequently fund the system. Holders who hold patiently benefit from a well-verified registry without paying anything beyond their original spread at purchase.

4.3 Random Spot-Check Sampling

The verification pool funds random audits of tree status. A subset of trees are selected for verification each cycle. Selected trees are assigned to verifiers who must physically visit the tree’s coordinates and submit timestamped, geolocated photographic evidence of the tree’s continued existence.

Verifiers are geofenced—assigned only to trees within a reasonable travel distance of their registered location. This creates a distributed network of local verifiers rather than a centralized audit team. It also creates economic opportunity for rural communities near forests: verification work is paid work, funded by the spread pool.

4.4 The Default Assumption

A critical design choice: the system assumes trees are alive until proven dead. The burden of proof is on the death claim, not on the life claim. This is the opposite of most financial verification systems, which require ongoing proof of existence.

The rationale is biological. Old-growth trees do not die frequently or suddenly under normal conditions. A healthy 500-year-old redwood has an extremely high probability of surviving any given year. The default assumption of life is statistically correct for the vast majority of tokenized trees in any given verification cycle. Requiring continuous proof of life for millions of trees would be prohibitively expensive; requiring proof of death for the small number that actually die is tractable.

4.5 Satellite as Supplement, Not Foundation

Satellite imagery from providers such as Planet Labs, Sentinel, and Maxar is used as a supplementary data source for verification. However, the system is explicitly designed to survive the loss of satellite infrastructure. A Kessler syndrome event (cascading orbital debris), a Carrington-class solar storm, or simple commercial failure of satellite providers would not disable verification. Ground truth from human verifiers is the bedrock layer. Satellites make verification cheaper and faster when available, but the system does not depend on them.

5. Excluded Mechanisms

The following financial mechanisms were considered and explicitly rejected because each creates a pathway for profit from tree death:

Mechanism	Attack Vector	Status
Short selling	Short the tree, destroy it, profit from price collapse	Excluded
Put options	Buy puts, destroy tree, exercise option at pre-death price	Excluded
Death bounties	Destroy tree, report death, collect bounty	Excluded

Prediction markets	Bet on death, cause death, win bet	Excluded
Insurance payouts	Insure tree, destroy it, collect insurance	Excluded

The common thread is that each mechanism creates a financial position that appreciates when a tree dies. The Arboreal Capital design permits no such position within the protocol. The only way to profit from the system is to hold tokens in living trees.

5.1 The External Insurance Question

The protocol can exclude shorts, puts, and bounties from its own design, but it cannot prevent a third party from offering tree death insurance to token holders. A holder who insures their token against tree death has effectively reconstructed a put option through the back door. Does this break the mechanism?

We believe it does not, for two reasons. First, the kill incentive transfers to the insurer, not the holder—and the insurer is pricing actuarially across a diversified portfolio of policies. No rational insurer commits arson to pay out a single claim when they hold exposure across thousands of trees. The kill incentive is diffused to actuarial irrelevance, the same logic that makes the circulating supply effect of the freeze acceptable (see Section 2.2).

Second, insurance does not eliminate the holder's conservation incentive. Insurance has premiums, deductibles, and coverage limits. It is never free. The rational holder still prefers the tree alive (full token value, no premium costs) over the tree dead (insurance payout minus premiums and deductible, plus a permanently frozen token in their wallet). Insurance reduces the pain of death; it does not make death profitable.

5.2 Market Stress Resilience

The verification funding model must survive adverse market conditions. The three-tier design (Section 4) is deliberately resilient to this. Bulk tree verification is funded by spreads on stablecoin-denominated trades—spread revenue scales with activity but is insulated from token price volatility because the spread is a percentage of the trade, not a fixed amount. Hero tree endowments are denominated in stablecoin with yield generated from low-risk sources—principal is preserved regardless of token or ETH price movements. In a severe market downturn, trading volume may decline, reducing bulk spread revenue. However, verification costs also decline in this scenario: fewer active participants means fewer contested death claims and lower demand for spot-checks. The system scales its costs with its revenue naturally, without requiring governance intervention.

6. Governance: Who Controls What?

Two governance questions must be resolved: who can freeze a token when a tree dies, and who controls the verification endowment. Both questions share the same fundamental tension: mutable systems can adapt but can be corrupted; immutable systems resist corruption but cannot adapt. The solution is to separate the two—making the things that must never change immutable, and the things that must adapt mutable.

6.1 Freeze Authority: Progressive Decentralization

Phase 1 (Multisig): Freeze authority is held by a multisig wallet requiring agreement from multiple independent signers (e.g., 4-of-7). No single party can unilaterally freeze a token. Signers must present verifiable evidence of tree death—satellite imagery, geolocated photographs from independent verifiers, or corroborating third-party reports—before signing. Evidence requirements are published and auditable.

Phase 2 (On-Chain Arbitration): Freeze authority transitions to a smart contract. A death claim, submitted with the required stake, triggers assignment of multiple independent verifiers. If a supermajority confirms death, the freeze executes automatically. No human administrator is in the loop.

Phase 3 (Full Decentralization): The protocol itself, executing deterministic logic based on verifier consensus, is the sole authority. This is the design requirement articulated in Research Note 001: the mechanism must survive the disappearance of its creator.

6.2 Endowment Architecture: The Immutable/Mutable Split

The hero tree endowment (described in Section 4.1) holds principal that must be preserved in perpetuity. This creates an acute governance problem: any entity that controls the endowment can drain it. The solution draws on a legal precedent established in November 2024.

In *Van Loon v. Department of the Treasury*, No. 23-50669 (5th Cir. 2024), the United States Court of Appeals for the Fifth Circuit ruled unanimously that immutable smart contracts are not property. The court held that because immutable contracts cannot be owned, controlled, or altered by anyone—including their creators—they fall outside the legal definition of property. OFAC subsequently delisted the sanctioned contracts in March 2025.

The critical legal distinction: **mutable** smart contracts (those with admin keys, upgrade paths, or proxy patterns) are property and can be owned and regulated. **Immutable** smart contracts (those with no mechanism for alteration) are not property—they are autonomous code that belongs to no one.

The Arboreal Capital endowment exploits this distinction by splitting into two contracts:

The Principal Contract (immutable). Holds endowment funds. Contains no withdrawal function—not a locked withdrawal function, but the complete architectural absence of one.

Deployed through a public irreversibility ceremony modeled on the Tornado Cash trusted setup, in which admin access is permanently and verifiably destroyed. After the ceremony, no individual, company, DAO, or government can extract the principal, because no mechanism to do so exists in the code. Under *Van Loon*, this contract is not property. It belongs to no one. It cannot be seized, sanctioned, or compelled. The principal generates yield by depositing into whitelisted yield sources.

The Allocation Contract (mutable). Governed by the same progressive decentralization roadmap as freeze authority. Controls which yield sources the principal is deployed to and how yield is distributed across verification activities. Can be updated to adapt to new stablecoins, new yield protocols, or changing verification costs. This is the adaptive layer.

6.3 The Whitelist Constraint

The immutable principal contract can only route yield to addresses on a whitelist. The mutable allocation contract manages the whitelist. Governance can steer yield to new verification contracts or updated yield sources, but the whitelist is type-restricted to verification-related contracts. Governance cannot add itself—or any non-verification address—as a recipient.

The worst case: governance is captured and directs all yield to a single corrupt verifier. The principal is untouched. The misallocation is visible on-chain. The community deploys a replacement allocation contract. The immutable principal is indifferent—it continues generating yield regardless of who governs the allocation layer.

***Design Principle:** Immutable contracts govern what must never change (the principal cannot be withdrawn). Mutable contracts govern what must adapt (where yield is directed). The separation ensures that the endowment survives both corruption and obsolescence.*

7. Conclusion

The death profit paradox is resolved not by finding a clever way to reward death reporting, but by designing the system so that death reporting requires no reward. The token freeze makes death universally costly. Asymmetric staking makes false reports costly and true reports unprofitable. The verification tax funds routine detection as a public good. And every financial instrument that could create a profit motive for tree destruction has been explicitly excluded from the design.

The result is a system where the only way to make money is to keep trees alive. This is not a side effect of the design. It is the design.

References

Van Loon v. Department of the Treasury, No. 23-50669 (5th Cir. Nov. 26, 2024). Holding that immutable smart contracts are not property because they cannot be owned, controlled, or altered by anyone. Reversed district court; OFAC delisted Tornado Cash Mar. 21, 2025.

Loper Bright Enterprises v. Raimondo, 603 U.S. ____ (2024). Overturning Chevron deference; applied in *Van Loon* to independently interpret IEEPA's definition of "property" without deference to OFAC.

Tornado Cash. "The Biggest Trusted Setup Ceremony in the World." May 13, 2020. 1,114 contributions (450 identified, 664 anonymous). Operator address set to zero, rendering contracts permanently immutable.

ERC-721: Non-Fungible Token Standard. Ethereum Improvement Proposal 721. W. Entriiken, D. Shirley, J. Evans, N. Sachs. January 2018. The `_update` override used for token freeze is based on this standard.

ERC-4626: Tokenized Vault Standard. Ethereum Improvement Proposal 4626. J. Bebis et al. December 2021. Standard API for yield-bearing vaults; applicable to endowment yield generation.

Nouns DAO. Continuous NFT auction mechanism with 100% of proceeds trustlessly deposited to DAO treasury. Fork of Compound Governance. <https://nouns.wtf>

See also: Arboreal Capital Research Note 001, *The Permissionless Instrument* (March 2026), for securities analysis and legal framework.