



Building an effective and inclusive stewardship workforce

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Abstract

A skilled and inclusive stewardship workforce is vital for effective conservation, especially in the context of climate change and biodiversity decline. We must recognize the ecological, economic, and cultural value of the stewardship sector and support a workforce capable of addressing today's environmental challenges. Failing to promote well-paying, permanent stewardship jobs with opportunities for advancement weakens conservation efforts and reinforces economic inequality. Based on our experience, a horizon scan of stewardship training programs in California, and insights shared at an expert convening and in conversations with practitioners, we present perspectives on the importance of and pathways to building an effective and inclusive stewardship workforce. The importance of Indigenous knowledge and strategies to advance Indigenous stewardship is emphasized. We identify key barriers to workforce development and offer strategies and examples illustrating feasible steps toward fair compensation, durable training systems, inclusive workplaces, and stronger Indigenous-led stewardship. Proposed solutions include standardized job codes, clearer career pathways, and stronger alignment between training and on-the-job skills. Investing in the people who steward our lands and waters is essential to achieving a resilient environmental future.

KEYWORDS

ecological restoration, Indigenous stewardship, stewardship, workforce development

1 | INTRODUCTION

Unprecedented global challenges associated with climate change, land use change, and resource extraction have collectively impacted ecosystems leading to a global extinction crisis and loss of nature's benefits (Brondizio et al., 2019). In fact, the most extreme global greenhouse gas emissions scenarios could jeopardize approximately one-third of global species (Urban, 2024), and a review of

the literature reveals land-use change alters community composition (Davison et al., 2021). In response, over 190 countries have pledged to safeguard 30% of their land and waters by 2030 (Schloss et al., 2024). Increasing protected areas and the use of private land conservation covenants (including easements) is critical for biodiversity and ecosystem resilience, but protection from development alone is insufficient without ongoing stewardship because protected areas often degrade rapidly without

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sustained care and community involvement (Gatiso et al., 2022).

Approaches to conservation that aim to preserve current landscape conditions, often employed in protected areas, overlook the critical role of humans in shaping ecological dynamics (Boerigter et al., 2024). In the face of accelerating climate-driven changes, such as megafires and drought, this model is increasingly problematic (Jones et al., 2025). A shift toward proactive stewardship—intentionally managing for change rather than resisting it—is essential to sustain or improve ecological function, resilience, and landscape heterogeneity. As stated in Harty (2023), “stewardship and restoration efforts may mitigate some of the effects of climate change, especially in fire-dependent natural communities.”

Extensive areas of both terrestrial and aquatic ecosystems have been deeply shaped and tended by Indigenous people for thousands of years (Ellis et al., 2021). In fact, Indigenous stewardship practices have enhanced ecosystems and serve as keystone processes complementary to other natural processes. In light of this, honoring Indigenous relationships, knowledge, and traditions is key to effective stewardship and central to biodiversity conservation (Hankins, 2018), and is paramount to achieving climate resilience (Hankins, 2024). Integration of Indigenous stewardship knowledge with Western environmental management begins with attribution and requires grounding practices in respect and reciprocity with nature (Armstrong et al., 2024; Kimmerer, 2011). Indigenous peoples have long upheld stewardship through kinship systems, and these values—responsibility, reciprocity, and respect—offer transformative guidance for more equitable and effective conservation (Menzies et al., 2024). Indigenous leadership and the integration of diverse knowledge systems are also crucial for fostering inclusion in the stewardship sector (Chapin et al., 2011).

It is no surprise that many conservation values associated with protected areas are only effective if properly stewarded. Without necessary investment in stewardship, they risk becoming “paper parks”—designated protected but unmanaged and vulnerable to degradation. The International Union for Conservation of Nature stresses that active management and stewardship are essential to ensure protected areas meet conservation goals (Dudley, 2008; United Nations Convention on Biological Diversity, 2022). This applies to both traditional protected areas and working lands because well-stewarded private lands for forestry, agriculture, and range management can support biodiversity (Kremen & Merenlender, 2018).

Land and water stewardship is based on an ethic of care, involving responsible resource stewardship and planning for the future as is called for by the seventh-generation principle (Graham, 2008). Local

environmental stewardship encompasses actions by individuals, groups, or networks to sustainably manage the environment for both environmental and social outcomes (Bennett et al., 2018). In addition to benefiting ecosystems, stewardship is crucial for human well-being and contributes to broader societal goals such as climate resilience. Chapin et al. (2022) highlight the need for collaborative Earth stewardship across sectors, including government, business, and civil society, to create scalable sustainability efforts. Strengthening local stewardship by improving the sector overall is crucial for addressing ecological crises and enhancing biodiversity conservation (Heller et al., 2023). Here, we define stewardship as a principle and a practice that embodies an ethical responsibility to care for land and water through reciprocal relationships and place-based knowledge to advance ecosystem resilience, biodiversity conservation, and eco-cultural connections. Management, in contrast, reflects a more utilitarian and hierarchical orientation toward nature, frequently associated with the regulation and extraction of natural resources. It is our perspective that the failure to invest in workforce development to advance environmental stewardship undermines conservation and climate resilience efforts while reinforcing structural inequities. To meet today's environmental challenges, we must elevate the value of the stewardship sector and strengthen the systems that support a skilled and diverse stewardship workforce. Here, we define workforce development as a coordinated effort to strengthen the labor force by providing training, education, and support services that help individuals enter, advance, and sustain careers while meeting employer needs and strengthening economic opportunity.

In this perspective paper, we provide insights drawn from practice-based experience, an assessment of stewardship training programs, and dialog with experts that provide examples we use to illustrate key points rather than as part of a formal empirical study. In the sections that follow, we identify key barriers to workforce development and propose ways to address these including mechanisms for funding, policy changes, and additional training and research.

1.1 | The stewardship sector

A wide variety of work contributes to stewardship, including ecological restoration, skilled trades, land use planning, scientific monitoring, community engagement, and environmental policy. For example, positions include field-based jobs like restoration ecologists and prescribed and cultural burn crew members to skilled trades such as heavy equipment operators and landscapers. Other examples

include conservation planners, wildlife biologists, naturalists, Tribal environmental staff, and program managers in environmental policy and administration. The ecological restoration economy in the United States was estimated in 2015 to support 221,000 jobs and generate \$24.9 billion in economic output annually (BenDor et al., 2015). This sector outperforms traditional industries like coal mining in job creation per dollar invested. For a more recent example, the United States wetland and stream compensatory mitigation industry generated over \$3.5 billion in direct revenue in 2019, supporting 53,000 jobs and contributing \$9.6 billion in total economic impact (BenDor et al., 2023). Similarly, the regional contributions of ecological restoration can be significant. With \$892 million in funding, the San Joaquin River Restoration Program created over 11,000 jobs in California's San Joaquin Valley, a region with historically high unemployment, through infrastructure improvements, fish reintroduction, and water management, according to a study by UC Merced economist Kantor (2012). This program also provided workforce training opportunities in construction, engineering, environmental consulting, and ecological restoration, offering long-term economic and environmental benefits.

In recent years, global efforts have focused on workforce development programs to equip individuals with the skills for "green jobs" that address environmental sustainability and climate change (Tănasie et al., 2022). Civil construction and other green jobs can benefit environmental efforts and local economies (Bassi & Guidolin, 2021). However, "green jobs" don't necessarily advance biodiversity conservation (Ruault et al., 2022). Skilled trade workers in these fields often work in the built environment (e.g., solar infrastructure), and those working in natural areas often lack training in environmental issues and natural ecosystems, increasing the potential for unintended consequences. So, we need to prioritize outcomes monitoring to ensure the work done is resulting in improved environmental conditions.

Stewardship workforce development efforts support all three pillars of sustainability: the environment, economy, and society. For example, the US EPA announced over \$20 million in grants to 13 organizations to expand career opportunities in the drinking water and wastewater sectors (U.S. Environmental Protection Agency, 2025). Similarly, NOAA's Climate-Ready Workforce initiative has invested \$60 million in climate resilience jobs, especially in coastal and Great Lakes regions (National Oceanic and Atmospheric Administration, 2025). Unfortunately, the persistence of these programs is in question under the current US Federal administration due to broad spending cuts and decreased support for climate-related initiatives.

In Canada, EcoCanada's Environmental Employability Pathway Program has distributed over \$176 M in subsidies,

helping fill 16,775 jobs (EcoCanada, 2025). The state of California has made investments in stewardship workforce development too. The Department of Conservation's Regional Forestry and Fire Capacity program is one example. It provides block grants to support capacity building for forest health and to address wildfire resilience through regionally based block grant recipients. In 2023, the state awarded \$72 million to regional and statewide partners including resource conservation districts and intertribal organizations (California Department of Conservation, 2025). These initiatives highlight the growing recognition of workforce development's role in addressing environmental challenges and promoting sustainability.

Here, we propose ideas to advance the stewardship sector and its workforce, informed by our understanding from working in stewardship across California. This is a state which has the world's fourth-largest economy (California Governor's Office, 2025), includes 39.53 million residents (California Department of Finance, 2025), and has conserved over 26% of its land area (over 41 million hectares) (California Natural Resources Agency, 2023). At the same time, we recognize that the ideas and examples we include here to support our perspective do not necessarily represent all contexts, despite drawing from a broad spectrum of input from stewardship practitioners.

2 | THE STATE OF STEWARDSHIP WORKFORCE DEVELOPMENT IN CALIFORNIA

We draw insights from members of the California Biodiversity Network (CBN) Stewardship Roundtable, which includes representatives from diverse public agencies, non-profits, Tribal communities, and academic institutions across the state. This group helped guide our exploration of stewardship workforce development in California, identifying key issues and opportunities that shaped the perspectives shared here.

To understand the state of stewardship workforce development, we identified over 85 training programs that included some information related to stewardship and talked to some of the program staff to learn more about their challenges. We heard about their program goals and approaches to recruiting participants. We heard how their programs addressed equity and inclusion, supported employment pathways, and navigated opportunities and challenges related to preparing a diverse workforce for land and water stewardship.

These conversations provided insights into program challenges, and we include some approved quotes to surface practitioner perspectives. These conversations improved our understanding of the structure, scope, and

focus of existing stewardship training opportunities as well as critical needs.

For the training programs that were both stewardship and workforce development-focused, we explored key program characteristics such as target populations, skills taught, and employment trajectories (see list of programs in Table S1). This exploration revealed the need to expand opportunities to build certain skills as well as the need for broader inclusion. There are also some common challenges such as difficulties connecting participants to job opportunities and a demand for additional resources to support Tribal members and underserved community members.

To help extend information and awareness on available training opportunities in California, we set up an online searchable (California Biodiversity Network, 2025). This is intended to help link job seekers, employers, and funders with relevant programs. The database, which includes program details like location, populations served, skills taught, and job placement rates, continues to grow as more programs contribute information, offering a valuable resource for career seekers, counselors, and employers across California. To illustrate the range of training emphases, we grouped programs into the following categories: fire management, habitat restoration, forestry, invasive plant control, climate resilience, sustainable farming practices, water, and environmental education. These topics were evenly spread across the various training opportunities, with fewer focusing on sustainable agriculture, which reflects our focus on environmental stewardship and not farming or agriculture per se (Figure 1).

In September 2024, we held an expert convening, “Breaking Silos and Taking Action,” bringing together leaders from training programs, employers, funders, and policymakers. This event helped us understand key barriers to success and actionable solutions. We developed a

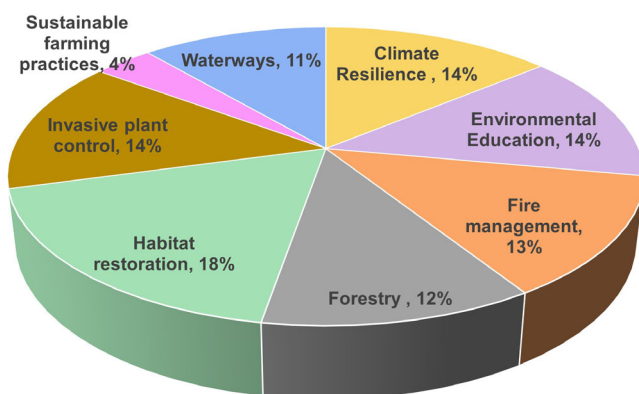


FIGURE 1 The percentage of programs offering information in each focal area ($N = 49$).

systems map to help guide the discussions, and with input from the participants, Figure 2 now graphically reflects our perspective of the overall system.

3 | BARRIERS, STRATEGIES AND INTERVENTIONS WITH EXAMPLE ACTIONS

Building on this overview of stewardship workforce development in California, we turn to the structural barriers that limit the growth, stability, and inclusiveness of the sector. These challenges are widely recognized by practitioners and policymakers alike, yet they persist due to entrenched funding structures, workforce norms, and administrative constraints.

An important purpose for sharing our perspective is to outline strategies aimed at addressing the barriers we identified from our horizon scan of stewardship training opportunities, personal experience, and lessons learned from practitioners on ways to advance a healthy stewardship workforce (graphically illustrated in Figure 3). Below, we organize our perspective around key barrier types and explicitly link these to strategies that have

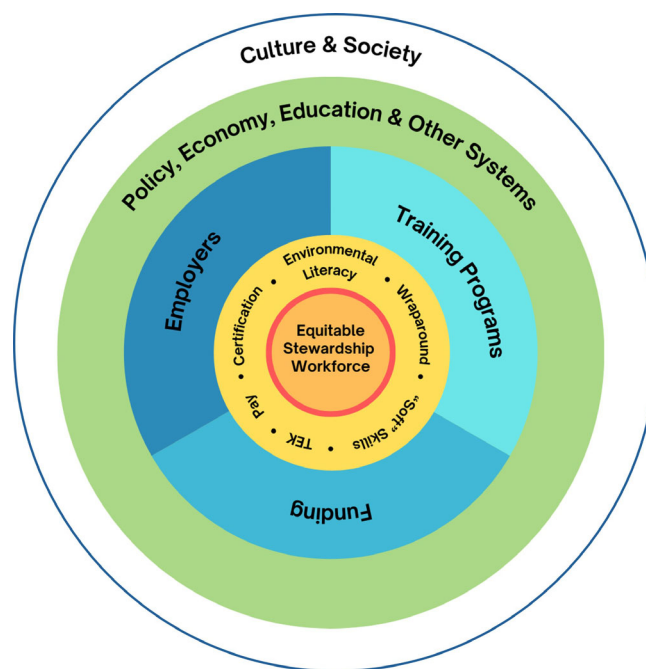


FIGURE 2 Stewardship Sector Map: A systems map depicting the factors influencing the development and growth of an equitable stewardship workforce, highlighting the roles of culture, society, policy, economy, education, and the actors—employers, funders, and training programs—along with key success factors including wraparound services (e.g., counseling, transportation, job placement), environmental literacy, certification, pay, traditional ecological knowledge (TEK), and soft skills.

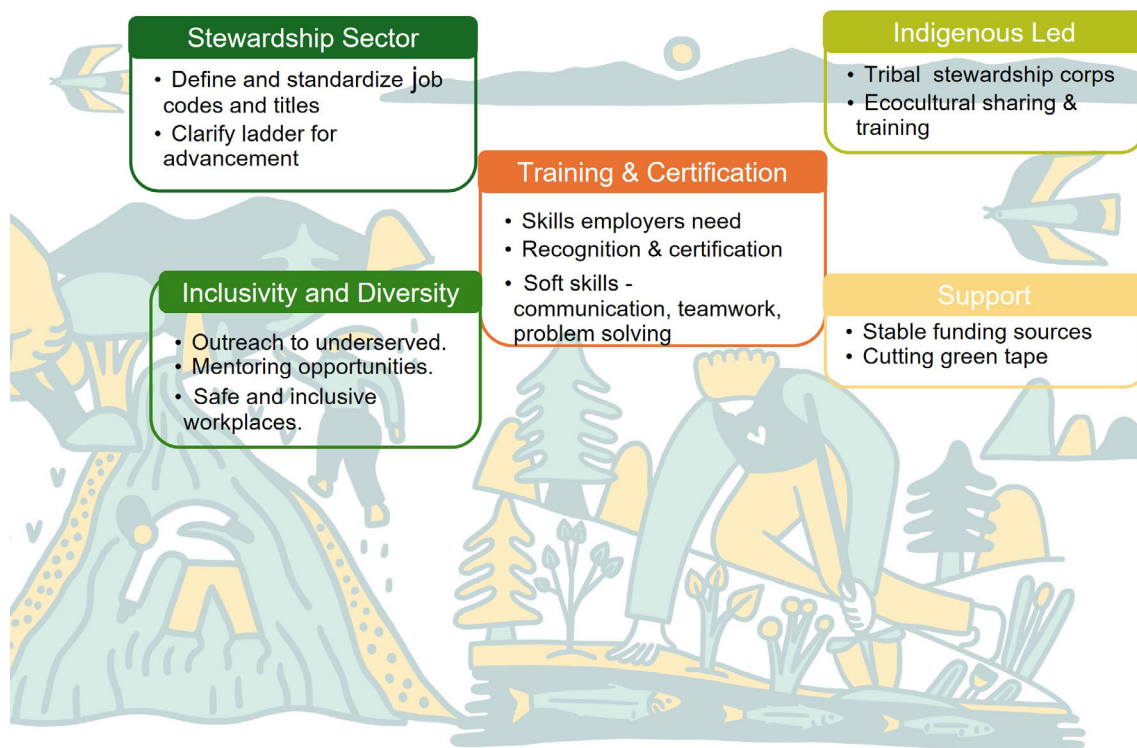


FIGURE 3 Recommendations for advancing the stewardship workforce.

emerged from our work together, and proposed interventions based on where progress has been made in real-world settings accompanied by recommended actions. These interventions and example actions exemplify concrete ways to address the barriers and implement the strategies described below. Together, they offer replicable examples, new policy directions, and specific funding mechanisms aligned with stewardship principles described above. While the examples are rooted in our experience in California, the underlying approaches are likely to be relevant and adaptable to other regions and situations.

3.1 | Low wages, seasonal employment, and limited career pathways

Despite the growing need for skilled environmental stewards, there is an insufficient number of well-paying jobs, and existing efforts are largely underfunded. Many entry-level stewardship positions are seasonal, temporary, low-paid, and often lack benefits, with few career development and advancement pathways. Low wages and the seasonal nature of many positions make it difficult for workers to achieve economic stability and long-term career growth. The high cost of living and limited availability of housing in many areas where stewardship

work occurs further restrict access for urban and low-income workers. According to Tyler Pitts, Chief Program Officer of Conservation Corps North Bay (with permission to quote), “The model that the industry is based upon is seasonal work, but that does not promote the goals of equity—something we hope the industry can change.” Additionally, stewardship workforces, despite their similar activities, remain siloed into sectors like forestry, fire, and restoration, diluting their combined economic status. There are some exceptions where living wage jobs are more available such as skilled restoration construction and some fire and forestry-related positions. In California, for example, publicly funded restoration projects offer prevailing wages to restoration construction crews. Yet many manual labor or trade workers are not recognized as part of the broader environmental community and sector, despite their vital contributions.

3.1.1 | Strategies

A key step in building a sustainable stewardship workforce is defining the stewardship sector. Recognizing all jobs involved in stewarding nature will help quantify the economic impact of stewardship, driving public and private investment. We recommend creating North

American Industry Classification System (NAICS) codes and Standard Occupational Classification (SOC) codes that reflect the range of stewardship roles, from entry-level positions to skilled laborers and leadership roles. NAICS codes are used to group businesses based on the main type of economic activity they perform. Government agencies rely on NAICS codes to track and evaluate trends in the business sector. We propose developing a NAICS Stewardship Industry code and sub-codes for all stewardship activities.

SOC codes are designed to categorize individual workers according to their specific job functions. These codes help both public and private entities assess and compare workforce and employment data across different occupations. Creating SOC codes appropriate for the stewardship sector will help create clearer career pathways and validate public investment in workforce development for environmental stewardship. These codes will improve workforce tracking and formal recognition of stewardship careers.

Clear advancement pathways in stewardship are needed so workers can progress from entry-level roles to higher-paying leadership, skilled, technical, or community engagement positions. Career growth relies on training, mentorship, and hands-on experience. A strong career ladder includes opportunities to deepen ecological skills, learn from and respect Indigenous knowledge, and build leadership abilities. At the same time, alternatives to the traditional “ladder” approach are helpful, where advancement is not based solely on climbing the ladder but also on having more lateral options such as different skills development. Equity is essential—advancement should be based on transparent criteria to ensure success for all backgrounds. Well-trained supervisors are crucial for goal setting and connecting workers with opportunities. Finally, recognition matters: fair pay, stable jobs, and acknowledgment of those who care for land and waters are critical.

3.1.2 | Interventions and example actions

- Adopt Federal North American Industry Classification System and California Standard Occupational Classification codes for the stewardship sector.
 - The California Natural Resources Agency and Labor & Workforce Development Agency and industry representatives could co-develop these codes.
- Develop regional labor market assessments.
 - Example: Identify workforce gaps in specific ecological services, such as prescribed fire, floodplain restoration, and cultural monitoring.
- Define and formally recognize the Ecological Stewardship Sector in California state workforce and economic development plans.
 - Example: Direct the California Natural Resources Agency and Labor & Workforce Development Agency to co-develop a classification that includes skilled labor, Indigenous cultural practitioners, and community engagement roles; and advance workforce development for trade jobs with ecological and compliance awareness.
- Dedicate a portion of environmental bond funding to stewardship.
 - Example: Prop 4 provides \$10 billion for a climate bond approved by California voters in November 2024, including \$80 million for vegetation management and \$5.83 billion for environmental projects, creating 1900 trade positions but does not provide ongoing stewardship (without ongoing stewardship funding, the long-term success of these important projects is far from certain).
- Tie stewardship funding directly to land acquisition and conservation project grants.
 - Example: The “Environmental protection: 30 × 30 goals: land conservation: stewardship” assembly bill (AB 900, 2025) directs the California Natural Resources Agency to reduce barriers and expand support for stewardship and allows the Wildlife Conservation Board and other State funders to provide up to 3 years of stewardship funding to be included with property acquisition grants funded through the Proposition 4 climate bond (Papan, 2025).
- Continue support for State Agency programs that fund stewardship efforts.
 - Example: California Department of Food and Agriculture’s Weed Management Area Grant Program that provides funding to local Weed Management Areas to implement integrated weed management efforts including invasive species control, habitat restoration, and public education across various counties (California State Government, 2024).

3.2 | Fragmented and undervalued training efforts

Environmentally knowledgeable skilled laborers are essential to achieving positive ecological outcomes—for example, understanding the complex permitting restrictions under which they work, proper equipment operation in sensitive habitats, possessing foundational knowledge of native plants and phenology to guide stewardship actions and their timing. However, the training

required to develop this expertise is frequently undervalued and often entirely absent across roles, from project managers to equipment operators. Many training programs are fragmented and lack support. Those attempting integration into comprehensive workforce development programs (e.g., conservation corps) or to be included in on-the-job training are often not recognized as essential or worthy of investment. Additionally, the lack of coordination among programs and the larger stewardship sector makes it difficult to ensure that necessary skills and environmental knowledge are being taught. This is particularly important as there are many stewardship practices that need to be adapted to local and sometimes site-specific conditions.

3.2.1 | Strategies

We propose clear certification pathways to help define skills for various stewardship roles. These certifications should be accessible to workers without advanced degrees and reflect the full range of necessary skills. As Jim Robins, Principal at Alnus Ecological, notes, “developing opportunities for certifications in specialized aspects of construction and environmental stewardship provides an important pathway to well-paid employment in this field.” Certifications will ensure that workers are well prepared, and employers can easily identify qualified candidates.

On-the-ground experience is key to securing employment. We recommend paid internships, apprenticeships, and mentorships to bridge the gap between training and employment. Stronger partnerships between training programs and employers will align job market needs with skills taught, ensuring a smoother transition from education to employment. Expanding paid training opportunities and offering on-site education for existing personnel will reduce the risk of environmental harm. In many cases, lack of affordable housing for these localized on-the-ground opportunities may limit who can participate and suggests a need to provide or assist with housing.

In addition to acquiring technical competencies, soft skills—communication, teamwork, problem-solving, and adaptability—are vital for success. Effective communication fosters collaboration among planners, field crews, and project partners, and is also essential for teamwork and workplace safety. Problem-solving is not only essential in the day-to-day needs of any job, but it also has bigger implications for developing creative solutions to the climate and biodiversity crises. Adaptability is crucial in the dynamic nature of environmental work. As Daniel Knapp, Executive Director of the Conservation Corps of Long Beach, explains, “self-discipline and commitment is

the biggest factor that employers are looking for—employers will hire and train them on technical skills, but they need people who will show up willing to work.” Studies show that employers often struggle to recruit young adults with these soft skills (Brudevold-Newman & Ubfal, 2024).

3.2.2 | Interventions and example actions

- Reserve a percentage of all public restoration and conservation grants for education and training.
 - Example: The California Oak Conservation Fund managed by the California Wildlife Conservation Board, allowed 20% of the bond funds to be allocated to education, outreach and technical assistance (McCreary, 2004).
- Incentivize contractors to provide environmental compliance training for their staff.
 - Example: Reward applicants who employ workers with training certifications in requests for proposals, contractor bids, grant awards, and project permitting processes.
- Integrate recognized environmental certifications into workforce development programs and employee training—including soft skills training—across community-based, Tribal, and correctional education and reentry programs.
 - Incorporate established certifications such as the UC Certified California Naturalist and Climate Stewards programs help (UC Agricultural and Natural Resources Division), Certified Ecological Restoration Practitioner credential (Society for Ecological Restoration), and Workplace and Personal Skills Certificate (Associated General Contractors of California) into employee training and existing workforce programs offered, for example, by conservation corps, community colleges, and trade schools.
- Evolve academic curricula to better support stewardship-focused training by partnering with private and public organizations to offer paid apprenticeships and internships that create clear pathways from classroom learning to employment.
 - Example: The Department of Environmental Studies at UC Santa Cruz offers internships sponsored by private and public agencies that provide hands-on skills and real-world work experience.
 - Example: The Higher Education Fire Training (HEFT) initiative—linking Chico State, Feather River College, and other partners—integrates academic instruction, field-based training, and job placement in fire and stewardship careers (Feather River College, 2025).

- Better align formal and informal training efforts with environmental employer needs.
 - Example: Set up advisory groups for training programs made up of working professionals in ecological services and land conservation, including forestry, restoration, and species recovery.
- Build and expand the training program database with job types and skills assessment.
 - Example: Expand CBN stewardship training database with job descriptions, requirements, and gaps, including new job types and training focuses (California Biodiversity Network, 2025).

3.3 | Financial instability for training providers and programs

Paid training and workforce development opportunities are vital, particularly for those from low-income communities. Training program staff shared with us the importance of funding holistic support, including housing, transportation, and overcoming logistical barriers that can be exacerbated by low wages. However, many stewardship training programs face significant financial challenges and often rely on short-term funding, making it difficult to support participants. Programs also lack financial resources to scale up and expand outreach. As Daniel Knapp, Executive Director of the Conservation Corps of Long Beach, stated (with permission to quote), “challenges, especially looking at serving underserved communities, include providing incentives for the training process to make sure they aren’t losing income during the training.” Many organizations struggle with tight budgets and lack staff to pursue new funding streams, hindering their ability to maintain or grow their services. Also, some new funding sources, such as the High Road Training Partnerships: Resilient Workforce Program (California Workforce Development Board, 2025), offer financial support but these funds can end up being inaccessible to some local organizations and smaller Indigenous communities due to bureaucratic hurdles.

3.3.1 | Strategies

Sustainable funding is essential to expand training programs, ensure fair pay, and create long-term career pathways. Sustained investment in these programs is necessary, and government policies may need to change to allow for longer funding commitments.

While state and federal investments in climate resilience are substantial, they are not always matched by a workforce prepared to implement them, and funding is

subject to political shifts. Aligning workforce development with diverse revenue streams through strategic investments and initiatives is crucial to building a skilled and sustainable workforce.

3.3.2 | Interventions and example actions

- Allocate Greenhouse Gas Reduction Funding for land and water stewardship.
 - Example: The California Air Resources Board could focus on long-term stewardship as a core strategy for resilience in its funding criteria.
 - Example: The Yurok Tribe leveraged California’s cap-and-trade program to sell carbon offset credits generated from improved forestry practices—such as prescribed burns—and used the revenue to help purchase and sustainably manage 60,000 acres of ancestral lands, create positions within their forestry program, and reinforce cultural stewardship on the land (California Forest Carbon Coalition, 2011; Yurok Tribe, 2021).
- Sponsor bonds, taxes, and fees.
 - Example: Measure AA, passed by local voters in June 2014, approved a 30-year, \$300 million bond to protect land, improve access, and restore forests, streams, and coastal ranch areas overseen by the Midpeninsula Regional Open Space District. This long-term funding has supported the creation of numerous restoration and land-management positions (Ruiz, 2024).
 - Example: Cache Creek, sand and gravel mining operations voluntarily agreed to pay five cents per ton of gravel sold to fund the Cache Creek Conservancy’s stewardship work (Cache Creek Conservancy, 2025).
- Track economic impacts of public and private financial investment.
 - Example: Track economic impacts of ecological projects, including job creation and local wages from programs funded by California’s Proposition 4.

3.4 | Diversity, inclusion, and safe and supportive work environments

Another pervasive issue is the lack of diversity in the stewardship workforce. Women, people of color, and Indigenous peoples have historically, and in some places, continue to face systemic barriers to entry and advancement in stewardship careers, particularly in leadership roles. Daniel Knapp, Executive Director of the Conservation Corps of Long Beach, shared a concrete example,

stating (with permission to quote), “there is a major barrier for many programs and opportunities in not having a driver’s license, a good driving record, or insurance.” He elaborated that some trainees from low-income families sometimes did not have access to a car to practice or take the driver test. Structural inequities such as poverty, which disproportionately impact Black, Indigenous, and People of Color, contribute to the persistent lack of diversity in stewardship careers. This not only limits representation but also restricts the benefits of diverse perspectives and knowledge systems.

3.4.1 | Strategies

Many skilled laborers in equipment operations and other trades can be trained in environmental work by enhancing their technical and ecological knowledge. Mark Cederborg, Director of Policy and Advocacy, Ecological Workforce Initiative, emphasizes the power of training programs (with permission to quote), “Ecological Workforce Initiative training builds career pipelines to good paying, long-term ecological restoration trade work careers and is elevating awareness that the highly diverse laborers and equipment operators who implement stewardship projects are part of the environmental community.”

Expanding outreach to underrepresented communities, particularly youth, women, and people of color, will create a more inclusive workforce. Becky Rittenburg, Director of Climate and Stewardship, Parks California, points out (with permission to quote) that “community-based, local partnerships are more successful in connecting with underrepresented communities and more successful in building local pathways.”

Ensuring a safe, welcoming workplace for all people and addressing bias in the workplace is crucial for enabling effective work and career progression. This means that training for employers is often needed to change practices, structures, norms, and ultimately culture. Mentorship programs and leadership development opportunities can help bridge opportunity gaps for individuals from historically excluded communities to advance in the sector.

3.4.2 | Interventions and example actions

- Increasing training for people in general labor positions and integrating them into the broader stewardship sector is essential for diversifying the workforce.
 - Example: The Ecological Workforce Awareness and Compliance training program provides skilled

laborers with the understanding required to work effectively in sensitive vegetation communities like wetlands, rivers, lagoons, grasslands, forests, and meadows.

- Train supervisors in land management agencies such as fire protection and forestry and other employers on ways to ensure a welcoming and healthy workplace environment.
 - Example: Diversity, Equity, and Inclusion Training in the Workplace Program is offered by Continuing and Professional Education, UC Davis. This course is designed for supervisors or anyone committed to actively building an open and equitable workplace environment with the goal of supporting inclusiveness in an organization.

3.5 | Indigenous-led stewardship

Although Indigenous stewardship is increasingly recognized by those working in conservation, significant barriers persist (Clark et al., 2021; Clark et al., 2024). These include lack of access to ancestral lands, limited resources for integrating traditional ecological knowledge (TEK) or Indigenous knowledge (IK) into conservation, challenges meeting federal and state program requirements or limitations due to confounding policies, and a dearth of culturally relevant training programs (Hankins, 2024; Hankins et al., 2025). In some cases, Indigenous led organizations have developed their own programs to support culturally relevant training, mentorship, and upward leadership movement spanning on-the-ground stewardship, planning, and program oversight.

Full-time, living-wage positions for cultural monitoring positions are scarce. Similarly, maintaining traditional cultural responsibilities for stewardship activities often requires significant time commitments that employers could better accommodate. For example, M.K. Youngblood, Chief Officer of Safety and Emergency Management, California Tribal Emergency Response & Relief Agency pointed out that, “Co-management of public lands with Tribes should include full-time positions for cultural conservation and monitors.” Tribal communities face unique financial barriers, with many programs, such as those focusing on Indigenous knowledge and stewardship, struggling to secure or sustain funding.

3.5.1 | Strategies

We emphasize the need to uplift Indigenous-led workforce development programs and foster intergenerational

learning of Indigenous stewardship and culture. For example, the Native Land Conservancy, founded as the first Native American-led land conservation group east of the Mississippi, centers Wampanoag stewardship values through land care activities such as trail maintenance, invasive species removal, cultural burns, and food sovereignty (Native Land Conservancy, 2012). Their programs provide hands-on restoration experience, foster intergenerational knowledge exchange, and connect community members with their homelands. We recommend expanding these types of programs to support Indigenous stewardship through paid opportunities to engage in intergenerational learning opportunities and stewardship of ancestral lands. These programs are essential for incorporating Indigenous cultural practices into environmental stewardship.

In addition, structural and policy reforms are needed to formally recognize and support Indigenous stewardship roles within public land management and restoration efforts. Cultural monitors, traditional cultural practitioners, and other Indigenous stewardship professionals should be explicitly recognized as eligible, budgeted personnel in publicly funded stewardship, restoration, and climate resilience projects. Formal recognition of Indigenous stewardship and cultural monitoring roles within employment classification and funding systems is essential to support equitable compensation and strengthen long-term career pathways. This recognition would ensure that cultural stewardship responsibilities are compensated and integrated alongside ecological objectives rather than treated as voluntary or ancillary contributions. In parallel, granting agencies should reduce or waive matching fund and administrative requirements that can exclude Tribal governments and Indigenous-led organizations. Addressing these structural barriers will help ensure Indigenous stewardship practitioners are fully integrated into restoration and climate resilience efforts while advancing Tribal sovereignty and workforce development.

3.5.2 | Interventions and example actions

- Reduce or remove matching fund requirements, streamline reporting requirements, and provide assistance and technical support for grant applicants from Indigenous-led organizations and community-based organizations.
 - Example: The Tribal Nature-Based Solutions grant program provided applicants with useful guidelines, templates, and help sessions in 2024 and resulted in 33 grants to Tribes (California Natural Resources Agency, 2023).
- Continue and expand funding of Tribal stewardship efforts including corps programs, training opportunities, and fellowships.
 - Example: California Tribal Unilateral Apprenticeship Program (CalTerra, 2025) and Tribal Conservation Corps funded through the California Natural Resources Agency's Tribal Nature-Based Solutions grant program support Tribal Conservation Corps programs, provide paid training opportunities, but are limited by resources and administrative capacity.
 - Example: Native Stewards Fellowship workforce development program, run by The Tribal EcoRestoration Alliance (Tribal EcoRestoration Alliance, 2025), integrates traditional knowledge with wildfire resilience, vocational skills, and ecocultural stewardship to prepare individuals for careers stewarding ancestral lands.
- Explicitly include Indigenous stewardship roles such as cultural monitors and traditional cultural practitioners in workforce classification codes (North American Industry Classification System and Standard Occupational Classification).
- Conduct research into effective partnerships that include Indigenous and non-Indigenous stewardship models.
 - Example: Examine existing co-stewardship agreements to identify lessons learned that will facilitate and improve future co-stewardship agreements between government agencies and Indigenous communities.

4 | CONCLUSIONS

We are at a critical point in addressing climate change and biodiversity loss. The demand for a skilled, diverse, and well-supported stewardship workforce is urgent. We appreciate that the challenges we face are easier to identify than to solve, and they can exist despite good intentions and existing investments, but we can learn from successful interventions. It is critical that those working in conservation prioritize these interventions because successful conservation depends on building a workforce capable of maintaining biodiversity, restoring ecosystems, installing nature-based infrastructure, and stewarding protected and working lands.

The stewardship workforce must be shaped by collaboration across sectors—government, non-profits, Indigenous communities, and private industry. This requires systemic change and a cultural shift in how we value all stewards, from skilled laborers and practicing scientists to volunteers.

Land protection is important, but not enough; we need to expand stewardship actions and invest in the

people doing the work across all ecosystems and communities to protect biodiversity and our future.

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DATA AVAILABILITY STATEMENT

The stewardship workforce program data summarized here is available at <https://cabiodiversitynetwork.org/stewardship-workforce-training/>

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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