

California Conservation Banking: Motivations, Values, and Climate Change Considerations

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Considerations

Conservation banking is a market-based instrument and conservation tool designed to provide compensatory mitigation for impacts to endangered species. These banks provide both ecological and economic benefits, however their ability to continue providing these benefits is threatened by climate change. The motivational factors behind the decisions to establish a conservation bank may be related to how likely climate change is address in conservation bank management. California is home the majority of the conservation banks in the United States and is facing increasingly worrying climate change impacts such as severe drought, frequent wildfires, and sea level rise. This setting provides an interesting area in which to assess the relationships between conservation banking motivations, values, and climate change considerations. Specifically, this study seeks to answer the following questions: is the establishment of California conservation banks primarily driven by financial or environmental motivations and interests? Do California conservation banking practitioners view climate change as a threat to conservation banks? Do conservation bank establishment documents and management plans currently address climate change?

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## Introduction

Conservation banking is a market-based mechanism developed as a tool to help implement mitigation-related aspects of the Endangered Species Act of 1973. Conservation banks, alternatively called species banks or habitat banks, consist of areas of land that are protected in perpetuity and managed in support of certain species or habitats with the objective of offsetting impacts to in-kind resources elsewhere. Through this compensatory mitigation, these banks can provide both ecological and economic benefits; however, the degree to which a bank is deemed “successful” based on the provision of these benefits may be influenced by whether a given bank was developed with financial or conservation motivations at the forefront. The success of conservation banking as a practice is also challenged by the fact that the ability of banks to truly provide the needed supporting resources and conditions for species listed as endangered under the Endangered Species act in perpetuity may be threatened by processes such as global climate change.

In California, conservation banking has been employed as a tool to provide compensatory mitigation since the 1990s and is generally heralded as a successful mechanism for supporting conservation of threatened and endangered species habitat on private lands throughout the state. California is also experiencing worrying climate change impacts such as drought, sea level rise, and increasingly unpredictable severe weather patterns with more impacts predicted in the coming decades. This paper seeks to a) explore whether the establishment of California conservation banks is primarily driven by financial or environmental motivations, b) examine whether conservation banking practitioners view climate change as a threat to the state’s conservation banks, and c) determine if California conservation bank agreements and management plans currently voluntarily address climate change.

## General Background and Definitions

### What is Conservation?

The conservation of natural resources is a critical element of sustainable development. Sustainable development, defined in the United Nation’s 1987 Brundtland Report as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (World Commission on Environment and Development 1987, 41) has been a key topic of global conversation and the target of many regulations for several decades. Sustainable development is even more relevant following the UN’s recent adoption of a resolution that adds the “right to a clean, healthy and sustainable environment” to the UN Declaration of Human Rights (UN General Assembly 2022). This emphasis on balancing the interests of present and future generations is also included in the commonly cited definition of conservation proposed in the 1992 “Global Biodiversity Strategy” published by the World Resource Institute (WRI), the International Union for Conservation of Nature (IUCN), and the UN Environmental Program (UNEP). Under this definition, conservation is specified as “the management of human use of the biosphere so that it may yield the greatest sustainable benefit to current generations while maintaining its potential to meet the needs and aspirations of future generations” (WRI, IUCN, and UNEP 1992, 228). Redford and Richter (1999) distill this definition down to describe conservation as simply “consumptive and non-consumptive use without complete destruction/conversion” (1247).

## Conservation Meets Mitigation

An important element of conservation is the mitigation of negative impacts to natural resources caused by human use and development. Mitigation, as defined in a 2015 Memorandum issued to the federal Secretaries of Defense, the Interior, and Agriculture by President Barack Obama, “means avoiding, minimizing, rectifying, reducing over time, and compensating for impacts on natural resources.” Achievement of these goals is often guided by a tool referred to as the “mitigation hierarchy” which is applied during environmental impact assessments and other evaluations associated with natural resource management or development actions. This hierarchy was developed from the definition of mitigation put forth in the National Environmental Policy Act of 1969 and outlines the following general steps that should be taken to sustainably manage impacts to natural resources and ecosystem services: avoid impacts; reduce, moderate, or minimize impacts; repair, reinstate, or restore impacted resources; and offset or compensate for residual or unavoidable effects (PricewaterhouseCoopers LLP 2010). The overarching aim of compensatory mitigation – the final option in the mitigation hierarchy – is to balance the needs of development with conservation of natural resources (Grimm 2020).

In the United States, the Fish and Wildlife Coordination Act of 1934 assigned a mandate to federal agencies to provide for fish migration routes following the construction of dams, thus marking the first time that national resource management policies introduced requirements for mitigation to compensate for losses of species, habitat, or environmental function (National Research Council 2001). Today, the most important federal statutes related to compensatory mitigation are the Clean Water Act and the Endangered Species Act (Mann and Absher 2014). There are a variety of mechanisms through which compensatory mitigation can be achieved in the US, including conservation and mitigation banking, permittee responsible mitigation, in-lieu fees, and habitat exchanges. In general, these mechanisms are designed to offset negative impacts to critical habitat or protected species by preserving comparable resources elsewhere, and they can be grouped into two main categories: permittee-responsible mitigation and third party-responsible mitigation (National Research Council 2001; Carreras Gamarra and Toombs 2017).

## Defining Conservation Banking

Conservation banking is a type of third party-responsible mitigation whereby the value of habitat characteristics or species abundance is quantified as credits which can be purchased by individuals or other entities required to provide compensation for impacts to in-kind resources. The US Fish and Wildlife Service (USFWS) defines a conservation bank as “a parcel of land containing natural resource values that are conserved and managed in perpetuity, through a conservation easement held by an entity responsible for enforcing the terms of the easement, for specified listed species and used to offset impacts occurring elsewhere to the same resource values on non-bank lands” (USFWS 2003, 2). Conservation banking is distinct from mitigation banking which refers to market-based compensatory mitigation focused specifically on wetland resources. Figure 1, created by Theis and Poesch (2022) illustrates the difference between mitigation and conservation banking, as well as how both practices relate to the mitigation hierarchy.

## *Life Cycle of a Conservation Bank*

Conservation banks can be established on lands that contain endangered species or habitat that supports endangered species. Landowners may create conservation banks on land that was acquired

specifically for conservation banking or through several other avenues such as by obtaining legal protections (e.g., a conservation easement) for previously acquired land; restoring, enhancing, or creating new endangered species habitat on their land; or by adjusting management practices to emphasize specific biological characteristics (USFWS 2003). Once a landowner identifies a piece of land on which they wish to establish a conservation bank, they, and a bank sponsor (which can be the same entity as the landowner) must develop an agreement – a Bank Enabling Instrument (BEI) or Conservation Bank Agreement (CBA) – with state and/or federal agencies responsible for managing wildlife resources. In California, prospective conservation banks must go through an extensive application and permitting process to evaluate the natural resources within a bank and ensure that all the required elements for successful perpetual conservation are in place, including conservation easements and management plans.

Once a bank has been approved, the sponsor can begin to sell conservation bank credits to other entities within the conservation banking market. Often, not all of a bank’s potential credits are released for sale at the same time, and instead are released in stages with subsequent credit releases dependent on banks meeting management targets determined during the application and permitting phase (Grimm 2021). If management targets are not met, a bank may be “suspended” meaning no further credit sales can be made until issues are resolved. If a bank has been “sold out,” all potential credits within that bank have been purchased by entities seeking to mitigate impacts to in-kind resources.

The sale of conservation credits supports the perpetual management of conservation banks. Both the USFWS and the California Department of Fish and Wildlife (CDFW), the two agencies primarily responsible for approval and oversight of conservation banks in California, require that banks have a long-term assurance of funding. This requirement is met by the establishment of a designated non-wasting endowment. These endowments provide the funds for management of a conservation bank’s resources. Following an initial investment by the bank sponsor, endowments are funded by depositing portions of the proceeds from conservation credit sales into the account until it reaches an amount agreed upon in the banks BEI/CBA. At this point, the entity charged with managing the bank will continue operations with funding from the interest payments from the endowment fund, essentially operating as any other protected area in perpetuity barring any force majeure events, intervention from agencies, or other issues. This “life cycle” of a conservation bank is conceptualized in Figure 2.

#### Key Element: Conservation Easements

A key element that enables the establishment of conservation banks is the conservation easement. Conservation easements are legal instruments that “restrict the use of real estate for the purpose of retaining or protecting the natural, agricultural, scenic or open-space value of [a] property,” for the purpose of public benefit (Blackie 1989, 1187). They are essentially the result of three different common law devices – easements, real covenants, and servitudes – being combined (Harvey 2011). Unlike most property law in the US, the implementation of conservation easements is enabled by state-level statutes. California’s conservation easement statute, passed in 1979 and now codified within the state civil code, defines a conservation easement as “any limitation in a deed, will, or other instrument in the form of an easement, restriction, covenant, or condition, which is or has been executed by or on behalf of the owner of the land subject to such easement and is binding upon successive owners of such land, and the purpose of which is to retain land predominantly in its natural, scenic, historical, agricultural, forested, or open-space condition” (Conservation Easement Act, 1979). The Code further states that conservation



easements in the state must be perpetual and can only be held by tax-exempt nonprofits or other qualifying government agencies and recognized California Native American tribes (CA Civ. Code §815).

According to Blackie (1989), there is no such thing as a typical conservation easement. However, there are two general categories of conservation easements; they can either provide the public the right to use a property for a specific activity such as hunting or fishing (“positive” conservation easement) or restrict a landowner’s right to use their property in some ways such as prohibiting certain natural resource extraction practices or development (“negative” conservation easement) (Harvey 2011). The conservation easements associated with California conservation banks are established by deeds that specify the characteristics of use restrictions for each individual case, thus aligning them with the negative conservation easement category.

### Conservation and Climate Change

One of the greatest threats to conservation initiatives and planning is global climate change. As changes in global climate continue to cause shifts in species distributions, the timing of phenological events, and the composition and function of ecosystems, conservation practices, which have largely been based on static models, will need alterations to continue to be effective (Lawler, Watson, and Game 2015; Rissman and Wardropper 2021). Climate change and other threats to conservation can be addressed within a variety of frameworks. For example, Schmitz et al. (2015) suggest six key adaptation approaches for conservation planning, including protecting current patterns of biodiversity; protecting large, intact, natural landscapes; preserving the geophysical setting, or “stage” for conservation; maintaining and restoring connectivity within and between ecosystems; identifying areas that may provide future climate space for displaced species; and identifying and protecting climate refugia. Alternatively, Prober et al. (2019) propose a framework of “ecological renovation” wherein expectations of natural resource conservation are restructured to allow for potential ecological interventions rather than relying solely on management goals built to achieve past conditions. An important common element between these approaches is adaptation. Adaptive management, a framework for natural resource management that leans into adaptation and calls for hypothesis-based management processes that explicitly recognize and seek to reduce uncertainty will be an essential, systematic approach to addressing the wicked problems that may arise as climate change influences conservation (Rist and Moen 2013; DeFries and Nagendra, n.d.).

### Study Context

The history of conservation banking is firmly rooted in the state of California. The combination of high biodiversity and species endemism, increasing population and development, and strict enforcement of endangered species regulations in the state led to the emergence of conservation banking as a practice (Mann and Absher 2014; Grimm 2021). According to data available from the US Army Corps of Engineers (USACE) Regulatory In-lieu Fee and Bank Information Tracking System (RIBITS), 119 of the 177 approved conservation banks in the US are located within California as of May 2022. More than 80% of CA banks are owned by private entities, many of which are for-profit organizations that have specialized in conservation and mitigation banking (RIBITS; Fox and Nino-Murcia 2005; Mann and Absher 2014; Whipps 2015). The prevalence of conservation banks owned by private, for-profit sponsors who may be more likely to subscribe to the view that “the sole purpose of a conservation bank is to earn profits through the provision of conservation” (Parkhurst and Shogren 2003, 1141) presents an interesting backdrop against which to examine the motivations for conservation bank establishment in California.

California is located on the western coast of the United States and is the third largest state in the nation by land area but the largest by population with a total area of 163,695 square miles and a population of nearly 40 million residents (McNamee 2022; “US States: Area and Ranking” n.d.). As of 2019, California had a \$3.1 trillion economy, earning it the ranking of the fifth largest economy in the world as measured by GDP (Aguilar and Symonds n.d.). The largest industry sectors within the state based on contribution to GDP include finance, insurance, and real estate; trade, transportation, and utilities; professional and business services; manufacturing; information; and tourism and the arts (Aguilar and Symonds n.d.). Agriculture is another critical sector of the California economy, despite its minimal contributions to the state’s GDP (less than 10%), as the state produces more than 400 agricultural commodities and is the largest agricultural producer and exporter in the US (Ross et al. 2021; McNamee 2022). In 2020, agriculture sales in California equaled more than \$49 billion, and the state supplied more than half of the fruits and nuts and over 60% of the vegetables produced in the United States (Ross et al. 2021).

Thanks largely to its varied physical geography – from coastal kelp forests and estuaries to inland valleys and snow-topped mountain ranges – California is a globally recognized biodiversity hotspot. In fact, the state supports a larger number of plant and animal species than any other state in the US, with 6,500 taxa of native plants, more than 600 species of birds, and hundreds of species of reptiles, amphibians, mammals, and fish (“California Biodiversity Initiative: A Roadmap for Protecting the State’s Natural Heritage” 2018). As the largest political unit within the California Floristic Province, which is distinguished by particularly high levels of plant endemism, the state is home to many rare plants such as the giant sequoia and coastal redwood (“California Floristic Province - Species” n.d.). The government of California has recognized the importance biodiversity holds to the state, as well as the businesses and people who depend on it, and has acknowledged the critical need to protect it by enacting programs such as the Biodiversity Initiative and Roadmap which emphasizes collaborative and comprehensive action in the face of climate change, population growth, and other threats (“California Biodiversity Initiative” 2018).

California is already experiencing an array of worrying impacts from global climate change and is considered a “climate-challenged” region subject to extremely variable conditions (“California’s Changing Climate: A Summary of Key Findings from California’s Fourth Climate Change Assessment” 2018). Average daily high temperatures in the state are predicted to increase from the historical average by 8.8°F by 2100 under a scenario in which greenhouse gas emissions are not reduced. The natural infrastructure of the state – from rangelands and forests to riparian and coastal areas – are at risk from a variety of climate change-related threats including increased wildfire frequency and severity, water deficits, and sea level rise (“California’s Changing Climate: A Summary of Key Findings from California’s Fourth Climate Change Assessment” 2018). Recent research suggests that, despite years of severe droughts being the primary water woe on the minds of most Californians, the risk of incredibly destructive “megastorms” and “megafloods” that impact the entire state is increasing (Huang and Swain 2022).

Against this backdrop of change, California’s conservation banking program may face increasing challenges. Regardless of motivations underpinning bank establishment, successful compensation for impacts to endangered species through the production and sale of conservation credits may not be possible if climate realities are not acknowledged. However, the nature of motivations for bank

establishment, more environmentally focused or more financially focused, may influence the likelihood such realities are acknowledged in bank management practices.

## Research Questions

1. Is the establishment of California conservation banks primarily driven by financial or environmental motivations and interests?
2. Do California conservation banking practitioners view climate change as a threat to conservation banks?
3. Do conservation bank establishment documents and management plans currently address climate change?

## Research Objectives

### Research Question 1

- a. Characterize the primary motivations for conservation bank establishment in California.
- b. Assess the degree to which financial and environmental interests influenced decision making regarding the establishment of California conservation banks.
- c. Evaluate the importance of financial and environmental related capacities are to the management of conservation banks.

### Research Question 2

- a. Determine whether California conservation banking practitioners characterize bank resources as at risk from climate change.
- b. Assess whether California conservation banking practitioners believe climate change will threaten the ability to meet conservation goals in perpetuity.

### Research Question 3

- a. Identify what management practices designed to address climate change may already be in place for California conservation banks as reported by conservation banking practitioners.
- b. Determine the frequency with which the term “climate change” is referenced within California conservation bank documentation.
- c. Evaluate whether conservation banks established with environmental motivations are more likely to voluntarily address climate change in bank management than those banks established with financial motivations.

## Conservation Banking Background

### The Development of Conservation Banking

Conservation banking has been described as “a line of convergent thinking between the business and conservation communities” (Albanese 2008, vii) that can bring benefits to endangered species, habitat conservation, and industries (Wolfe and Gelbs 1993). Ultimately, the concept represents a public/private and business/environmental partnership (Wolfe and Gelbs 1993). Conservation banking is modeled on and has been called “the logical extension” of wetland mitigation banking, a framework that has been used to provide compensatory mitigation for unavoidable harm to wetland habitat in the US since the

early 1970s (Ruhl, Glen, and Hartman 2005; Burgin 2010; D. A. Bunn, Moyle, and Johnson 2014; Theis and Poesch 2022).

The practice of conservation banking began in the US with the establishment of the Coles Levee Ecosystem Preserve in Kern County, CA in 1992 (Mead 2008). Even though this preserve was not established as a conservation bank in name, it provided compensatory mitigation for the disturbance of threatened and endangered species habitat in the San Juaquin Valley by obtaining a perpetual conservation easement deeded to the California Department of Fish and Game (now CDFW) and included an arrangement that allowed the bank owners to sell “compensation acreage” to third parties (Wolfe and Gelbs 1993). The first official conservation bank is widely recognized as Carlsbad Highlands Conservation Bank in San Diego County, CA, established in 1995 (Mead 2008; Mann and Absher 2014). This section outlines the regulatory framework and economic forces that led to the development of these early banks, and the conservation banking market of today in the US. This section also briefly examines the distribution pattern of conservation banks around the country.

### Regulatory and Economic Development

The Endangered Species Act of 1973 (ESA) (16 USC 1531 *et seq*) provides the legal authority for the establishment of conservation banks as a tool for endangered species mitigation and recovery. Additionally, state-level statutes, such as the California Endangered Species Act (CESA), provide further legal legitimacy for conservation banking (Rea 2017; Poudel, Zhang, and Simon 2019). The ESA requires USFWS and the National Marine Fisheries Service (NMFS) to determine which plant and animal species should be designated as threatened or endangered based only on scientific considerations and not an evaluation of relative costs and benefits of protection (Shogren 2007; Gardner 2008). This means that each species is valued equally before the law, regardless of the degree of benefits it brings to humans or the economic costs that may be introduced by designating it as threatened or endangered could inflict (Shogren 2007). USFWS and NMFS are also responsible for designating critical habitat for species listed as endangered under the ESA, but in doing so must consider the potential economic consequences (Gardner 2008).

The ESA establishes a strict legal compensation framework built around the concept of ‘taking’ threatened or endangered species and/or their habitats (Grimm 2020). In the context of the ESA, to take means “to harass, harm pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct,” where “harm” has been deemed by USFWS to include significant habitat modification or degradation (16 USC §1532(19); Gardener 2008). Such taking is prohibited unless authorized with an incidental take permit issued by USFWS or NMFS in line with Section 7 (for federal-nexus projects) or Section 10 (for non-federal entities) which both require conservation measures to be implemented by the entity applying for a permit (USFWS 2003; Ruhl, Glen, and Hartman 2005; Gardner 2008). In issuing an incidental take permit, the federal agency tasked with reviewing the proposed project can suggest that compensatory mitigation be added as a condition of incidental take permit issuance (Ruhl, Glen, and Hartman 2005).

Unfortunately, the ESA also ended up creating disincentives for conservation of endangered species habitat due to the way costs and benefits of species protection are distributed throughout society (Shogren 2007; Gardner 2008; Rodriguez et al. 2012). One of the principal debates related to the ESA is centered on the dynamic between the national-scale accrual of benefits from species protection (e.g., ecosystem services such as existence value) and the bearing of associated costs (e.g., lost development

opportunities) primarily by private landowners (Shogren 2007). In extreme cases, landowners may react beyond not managing their land for the benefit of species and instead take action to completely avoid regulation through the “shoot, shovel, and shut-up” strategy whereby a candidate endangered species or their habitat is destroyed by the landowner before it can be regulated under the ESA following species listing (Shogren 2007; Rodriguez et al. 2012).

Conservation banking in the US began as a state-level policy instrument for implementing the ESA. In 1995, the California Resources Agency and California Environmental Protection Agency jointly issued the first official policy on conservation banking, clearly distinguishing conservation banks from wetlands mitigation and providing a “broad sketch” of the agencies’ expectations for program operations in support of meeting directives (Wheeler and Strock 1995; Mann and Absher 2014, 77; Carreras Gamarra and Toombs 2017). Then in 2003, federal guidance on conservation banking was issued by USFWS (US Department of the Interior Fish and Wildlife Service 2003). In 2006, federal and state agencies with the authority to approve conservation banks in California established a Memorandum of Understanding (MOU) that initiated a coordinated approach to conservation banking in the state; this MOU was reaffirmed and updated in 2011 (CDFW 2019; Grimm 2021). The federal-level legal framework that facilitates conservation banking in the US is for the most part structured on guidance issued by USFWS rather than by statutes and regulations (Gardner 2008). However, in California, conservation banking has been codified within state statute. In 2012, State Senate Bill 1148 was passed, adding to the California Fish and Game Code a standard process for review and approval of mitigation and conservation bank applications by CDFW as well as an outline of fees associated with document review, administration, and other program services (Fish and Game Commission: Department of Fish and Game, 2012; CDFW 2019; D. Bunn, Lubell, and Johnson 2013). Another critical piece of statute that facilitates conservation banking in California is the state’s conservation easement law (Conservation Easement Act, 1979), which provides for the strong perpetual protections from use of bank lands in ways that are at odds with resource conservation and species recovery goals. Figure 3 provides a timeline overview of these and other key developments in the practice of conservation banking in the US.

The extent to which conservation banking has flourished in California is due to a unique combination of biological, social, and political factors. The high level of biodiversity and endemism present in California, coupled with intense population growth over recent decades essentially creates a “perfect storm” for endangered species listing. Strict enforcement of the Federal ESA and more stringent requirements under the California Endangered Species Act came into conflict with demand for urban expansion, leading to delayed projects, dead-lock, and lawsuits (Mann and Absher 2014; Grimm 2021). Out of this conflict, conservation banking emerged as an effective policy solution, and though met with some criticism and complaints about unreasonable bureaucratic burdens, it has changed over time “to adjust the policy to local biophysical and socio-cultural context conditions and insure institutional interplay to reach the policy’s main objective: sustainable species habitat protection” (Mann and Absher 2014, 79).

The conservation banking market in the US is an example of how regulations can facilitate the establishment of credit markets. This facilitation process, referred to by some researchers as “command-and-commodify,” has also led to the development of markets for carbon credits and other biodiversity offset credits whereby an “authoritative and economic dimensions of power [are brought] together under a single institutional roof” (Rea 2017, 24). The goods that are traded within the conservation banking market are conservation credits; these credits quantifiably and economically estimate the values of

ecological functions and services provided both by banks and the areas for which impacts must be mitigated (Figure 4). Conservation credits are an example of a “peculiar good” because their monetary value is assigned as a result of state-directed environmental regulations that have been integrated with market structures in an attempt to internalize environmental externalities (Rea 2017). The sale and purchase of conservation credits requires the intervention of a state or federal agency and the monetary value of acreage (and the associated ecological services) that is represented by credits can be determined on a bank-by-bank basis (Figure 4, pathways C and H) (Bauer, Fox, and Bean 2004). Thus, conservation banking does not represent a free market, and some researchers question whether it is truly a market at all (Bauer, Fox, and Bean 2004; Boisvert 2015).

Regardless of such criticism, several authors have characterized and assessed the regulatory environment and other forces that impact the demand and supply in conservation banking markets. It is generally agreed that the regulatory conditions, particularly those related to the ESA, are the primary driver of conservation bank development and operations (Denisoff 2008; W. White 2008; van Teeffelen et al. 2014; Poudel, Zhang, and Simon 2019; 2018; T. B. White et al. 2021; Theis and Poesch 2022). Some specific factors related to regulatory conditions that influence trading activity in conservation banking markets include differences in the presence of species listed as threatened or endangered under state or federal legislation; the opportunity costs of mitigation, where larger differences in costs between purchasing conservation credits versus fulfilling mitigation requirements through other means stimulates the conservation credit market; the degree to which environmental policies such as the ESA are enforced, with greater demand resulting from stricter enforcement; and interpretation of ecological similarity requirements between impacted and conserved habitat, with stricter interpretation negatively impacting trading activity; local land use zoning; and transaction friction caused by time-consuming documentation requirements, (Denisoff 2008; van Teeffelen et al. 2014; Poudel, Zhang, and Simon 2019; 2018). Non-regulatory factors that influence market activity include trends in regional population growth and economic development, and a stark lack of market transparency which makes it difficult to obtain information about credit sellers or buyers and can lead to increased credit prices (Denisoff 2008; van Teeffelen 2014; Poudel, Zhang, and Simon 2018, 2019).

### An Econometric Model

Poudel, Zhang, and Simon (2018) presented the first econometric model of the US conservation banking market. In this model, they identified the ecological and economic factors influencing the supply of and demand for conservation credits within the market (Table 1). Theoretically, each conservation banker will seek to earn the highest possible price for the conservation credits they are selling while developers will seek to minimize the costs sustained by complying with the Endangered Species Act or other regulations (Poudel, Zhang, and Simon 2018). Demand for conservation credits is specifically a function of the availability of alternative development that would not require mitigation, the relative cost of self-mitigation, and expectations of future regulatory requirements, and is shifted by the level of economic development and number of listed threatened or endangered species (Poudel, Zhang, and Simon 2018). The authors determined that the supply of conservation credits, measured as the number of credits a bank would offer under the assumption of perfect competition, is a function of a) the price of conservation credits which is controlled by the costs of production, including start-up costs, annual management and monitoring costs, and b) opportunity costs associated with using the land for other purposes. The supply is shifted by the value of land and size of land within a conservation bank (Poudel, Zhang, and Simon 2018). Their framework is aligned with observations made by other researchers who

have highlighted how costs and revenues incurred or gained from the production and sale of conservation credits depend on the location of the bank (Teresa 2008).

Some of Poudel, Zhang, and Simon's (2018) findings from their econometric evaluation were unexpected. For example, while it was not surprising that as the area of a conservation bank increased the credit supply also increases, the finding that increased development activities within a region seemed to be associated with decreased demand for conservation credits was unanticipated (Poudel, Zhang, and Simon 2018). The authors posit that this could be due to substitution effects whereby developers choose to compensate for impacts individually rather than buying conservation bank credits. Expected results include the finding that credit demand is higher in private than public banks, largely reflecting the greater number of private banks that have been established, and that as land value increases the supply of credit decreases (Poudel, Zhang, and Simon 2018). Overall, Poudel et al. concluded that the US conservation banking market has inelastic demand and price, meaning that a change in credit price does not result in a proportional change in demand for conservation credits, thus indicating that pricing does not strongly influence the market for conservation credits. This conclusion reflects the strong role regulatory requirements play in conservation banking.

### Economic Success

Conservation banking in the US is generally considered to be economically successful as measured by the number of credit transactions overall and the number of banks that have been sold out (Mead 2008). In fact, the US conservation banking market was recently estimated to have an annual market value of \$354.2 million (White et al. 2021). However, in depth financial analysis of conservation banks is rare and is made difficult by the fact that most private conservation banks treat credit transaction and management costs as proprietary. Authors of the single published financial analysis conducted to date were only able to obtain cost and revenue data for 26 California conservation banks (Poudel and Pokharel 2021b). This limited data provides a glimpse into the degree of economic success banks may achieve, with the authors reporting an average net present value (NPV) calculated with a 4% rate of return of \$4,205.90 per acre but a range of NPV from negative \$2,933.7 to positive \$67,611.12 per acre (Poudel and Pokharel 2021). Although state and federal wildlife agencies see conservation of species and habitats as the overarching goal of conservation banking, most agency-connected practitioners recognize that economic success is important to consider as it provides the incentives for bank sponsors to follow through with management activities that promote conservation (US Department of Interior Office of Policy Analysis 2016). This recognition of the economic motivations of conservation bank sponsors and managers is realistic, as surveys have indicated that as much as 90% of banks were established with financial motives as their foremost objective (Fox and Nino-Murcia 2005).

The success of conservation banking as a policy for habitat and endangered species conservation has led to the emergence of a for-profit environmental management industry "that involves the private sector in a non-consumptive utilization of natural resources," (White 2008, 38). As of 2019, the majority of conservation bank credits in the US were sold by private companies rather than by public conservation banks or individual private landowners (Poudel, Zhang, and Simon 2019). Companies such as Wildlands Inc., Westervelt Ecological Services, and Mitigation Solutions USA hold a very large market share likely because they are able to concentrate capacity and expertise, thereby reducing their transaction costs (Poudel, Zhang, and Simon 2018).



## Geographic and Chronological Expansion

Just as the history of conservation banking is firmly rooted in the state of California, so are the majority of conservation banks in the US physically located in California. Of the 194 approved and pending conservation banks reported on RIBITS as of May 6, 2022, 133 banks are located within California. The state with the next most banks listed in RIBITS is Florida with 18 conservation banks (RIBITS). Figure 5a illustrates the chronological and spatial expansion of conservation banking. Although the US conservation banking market has expanded to new states in recent years, California has the most extensive state program (Figure 5b).

## Benefits of Conservation Banking

Conservation banking guidance issued by state and federal agencies as well as related academic literature suggest that conservation banking offers distinct benefits over alternative compensatory mitigation mechanisms.

### Ecological Benefits

Conservation banking is touted as an ecologically superior approach to providing compensatory mitigation for impacts natural resources compared to alternative approaches such as in-lieu fees or project-by-project mitigation. The California Department of Fish and Wildlife highlights four key ecological advantages that come with selecting conservation banking over another compensatory mitigation mechanism:

1. Advance mitigation supports no temporal loss of habitat value or function.
2. Larger reserve compared to project-by-project mitigation leads to more ecologically intact reserves and fewer edge effects.
3. Effective long-term management and positive conservation outcomes are more likely to occur because banks facilitate improved use of resources for management on account of the technical expertise that has accumulated within the conservation banking industry.
4. Adjacent conservation areas may be enhanced when conservation banks are established next to already preserved land, thus improving conservation outcomes on both sites (CDFW 2020).

Authors such as Ruhl et al. (2005), White (2008), and Grimm (2022; 2021) similarly point to the increased size of preserves created by conservation banks compared to piecemeal mitigation projects, greater habitat connectivity, and compatibility with regional species recovery strategies – all of which theoretically should lead to improved conservation outcomes – as the key ecological benefits of conservation banking.

### Socio-political Benefits

The socio-political benefits associated with conservation banking include regulatory efficiencies and improved public relations for bank owners. In the agency's 2019 update to the state's Conservation and Mitigation Banking Guidelines, CDFW highlighted regulatory efficiencies as one of the primary benefits of the California conservation banking program (CDFW 2019). These efficiencies are borne from conservation banks providing pre-approved mitigation acreage, therefore requiring less permitting work every time a project needs mitigation, requiring fewer signatory parties than other conservation frameworks such as California's Natural Community Conservation Plans, and economies of scale (Wolfe & Gelbs 1993; Bunn et al. 2013; Grimm 2021). Researchers and proponents also highlight the potential



for conservation banks to provide public relations benefits for individuals or entities establishing conservation banks on their land. This benefit is especially true for conservation banks established by the entity whose actions may be impacting the same endangered species for which the bank is established to protect (Wolfe & Gelbs 1993; Bauer et al. 2004). For example, when the pre-official conservation bank Coles Levee Ecological Preserve was established, it was recognized that the oil and gas company that owned the land would be viewed as practicing “corporate citizenship” by preserving an ecologically valuable area (Wolf & Gelbs 1993).

### Economic Benefits

Conservation banking provides both direct and indirect economic benefits. As described by Poudel et al. (2018), the direct economic benefits are realized through the trade of conservation credits. In California, direct economic benefits are also realized by CDFW on account of fees paid by prospective bank sponsors to complete the conservation application and approval process that are designed to cover the agency’s costs of program administration (Figure 4) (CDFW 2019). A variety of indirect economic benefits, such as costs savings compared to other mitigation approaches and reduced costs to taxpayers, may also be realized (White 2008; Poudel, Zhang, and Simon 2018). Conservation banking also essentially “restack[s] the economic cards in favor of conservation on private land,” because it provides a framework within which landowners can view endangered species on their property as an asset rather than a liability (see pathway G, Figure 4) (Bauer et al. 2004, 10719; Fox & Nino-Murcia 2005; USFWS 2003). Moreover, by internalizing the environmental externalities caused by development activities that otherwise would impose costs only on the public in general, conservation banking theoretically results in more efficient allocation and use of resources (Boisvert 2015; Rea 2017).

### Critiques of and Challenges to Conservation Banking

#### Critiques

Although some view conservation banking as the perfect pairing of environmental and business interests, the practice is not without critique. When conservation banks do not incorporate restoration of habitat into management plans or if the land comprising the bank was not in immediate danger of development, there may be a net loss of habitat (Fleischer and Fox 2008). Though agencies and researchers point to the potential for conservation banks to make up for net area loss by providing higher quality habitat or larger reserves with better management, these theorized advantages, and indeed even the degree to which banks contribute to species recovery, have yet to be systematically investigated and would require long-term studies comparing the ecological outcomes of compensatory mitigation achieved by various approaches to compensatory mitigation (Fleischer and Fox 2008; Poudel et al. 2019; Grimm 2021).

Another ecologically-focused critique of conservation banking is that credit calculations frequently do not include measures of habitat quality nor does the process require bank owners to provide evidence of additionality, and instead rely only on the area of habitat conserved (Carreras Gamarra and Toombs 2017). With this practice, an acre of land with high quality habitat in an area with high potential to be developed is valued the same as an acre of land with lower quality habitat that was not at risk of being subject to land use change. However, in the early days of conservation banking in the US, Fox and Nino-Murcia (2005) found that nearly half of the conservation banks established as of 2003 protected

habitat that “would most likely have been destroyed or seriously degraded by competing land uses if banking had not been an option” (1001).

A key socio-political critique of conservation banking is that the public often lacks the opportunity to review or comment on bank proposals, as guidance on conservation issued by USFWS has not included an invitation for public comment (Bauer et al. 2004). However, even though public review is not required for conservation banks approved by USFWS, the agency can elect to issue a public notice of intent to approve a given bank if there is a reason to expect controversy over the decision (Ruhl et al. 2005). Conservation banking also receives criticism similar to that which is leveled at other market-based offset approaches. Namely, some researchers consider conservation banking to just be a “part of a neoliberal project to reregulate human relationships with nature in ways that enrich capitalists and serve as ‘environmental fixes’ to crises of accumulation in other economic sectors” (Rea 2017, 28).

Despite the positive view of conservation banking’s potential to provide simultaneous biological and economic benefits held many agency and industry practitioners, there are several areas of critique related to the economic elements of conservation banking. The first economic critique is related to the practice of assigning monetary values to biological resources or ecosystem services by assigning a market price to a conservation credit. The ‘value’ of resources is subjective in nature and can be incredibly complex to determine if there are no material benefits or obvious market value to be derived from a given biological resource or ecosystem service that does provide cultural services (Small, Munday, and Durance 2017). Authors such as Boisvert (2015), push back against the assumption that economic rationality and market categories can be appropriately applied to natural resources.

For conservation banking specifically, the valuation process has emerged as a point of criticism. Metrics used to determine value of credits are currently neither standardized nor consistent, but rather are essentially part of a negotiation process meaning agencies ultimately decide prices rather than market forces (Grimm 2020). Boisvert (2015), was equally critical of this lack of standardization with her characterization of the conservation banking market not so much having a price for credits but “rather something like bargaining mediated by money” (139). A final economic critique of conservation banking relates to how market and policy dynamics interact. Some authors point to increasing interest in conservation credits by actors with a primarily profit-oriented perspective as the cause of a mismatch between conservation banking policy and the socio-cultural and ecological conditions in which it is implemented (Mann & Absher 2014). As powerful actors within the conservation banking market, for-profit consulting groups and bank management companies have cultivated political influence and now have the potential to influence the placement of conservation banks to align with their financial motivations rather than with areas of greatest conservation need (Mann & Absher 2014).

### Challenges

There are multiple challenges associated with the establishment and management of conservation banks. One of the most critical of these is the challenge of planning for perpetual management of natural resources that provide conservation and economic value to the conserved area. Not only does perpetual management present economic challenges related to how much funding needs to be set aside, but the inherent uncertainty associated with natural resource management makes it impossible for anyone to answer with certainty whether banks truly offset impacts to species or if they will maintain ecological function over time (Fleisher & Fox 2008). In addition to the uncertainty of ensuring perpetual management and protection for conservation banks, enforcement of access restrictions can be challenging.

For example, at one of San Diego County's conservation banks, Carlsbad Highlands, there is a "turf war" between bank managers and trespassing mountain bikers (Brennan 2019). Moreover, many agencies are not equipped to cope with the increased workload associated with monitoring conservation banking outcomes to enforce restrictions and determine whether or not banks are meeting management requirements (Fleisher & Fox 2008). In a survey of conservation banking practitioners in California, Bunn, Lubell, and Johnson (2013) found that preventing unauthorized use of conservation bank lands was viewed as one of the barriers to long-term viability of bank properties.

Other practical challenges associated with conservation banking include limited capacity of agencies in general, a reported tendency for inconsistent and at times ambiguous interpretations of policies between different regulatory agency offices, and the overall complexity of the dynamic socio-ecological systems in which banks are situated. All these factors combine to create layers of uncertainty (T. B. White et al. 2021). A final challenge, introduced by Rhul et al. (2005) is that conservation banking may lead to "hot spot" concentrations of conserved land which may not be acceptable for all involved because it could limit the future opportunities for rural communities to grow and obtain their own compensatory mitigation as needed.

From an ecological perspective, a challenging aspect of conservation banking involves ensuring that both the credits released for sale by conservation banks, and the number of credits entities creating impacts are required to purchase accurately reflect natural resource values (Fox and Nino-Murcia 2005). This challenge is particularly pertinent when agency representatives determine the compensation ratio for a given project; the compensation ratio can refer both to the number of credits awarded to a bank and the number of credits needed to mitigate adverse impacts (Bauer, Fox, and Bean 2004). Though the conversion rate for conservation bank credits is typically one credit for one acre impacted/conserved, leading to a 1:1 compensation ratio, variability in habitat quality between the site where impacts take place and where a bank preserves resources may either higher or lower ratios more appropriate. For instance, in a case where a bank is determined to contain particularly ecologically important resources, a regulating agency may issue the bank credits with a ratio of 1 credit to 0.1 acre (Bauer, Fox, and Bean 2004).

Many of the most critical challenges associated with conservation banking are related to the economic aspects of the practice. Perhaps the most significant challenge within the US conservation banking market is a lack of transparency and the absence of a centralized database for reporting both bank establishment and credit transactions. This makes it difficult to analyze bank effectiveness and presents a barrier to stakeholder engagement and more effective policy development (Carreras Gamarra and Toombs 2017). Economically, without transparency or a standardized transaction database, buyers and sellers will not have enough information to make informed decisions and the market for conservation credits becomes less efficient (Poudel, Zhang, and Simon 2018). Moreover, the determination of credit ratios, already a challenge in itself, is made more difficult when transactions are kept private. The key ratios under consideration for conservation banking are the ratio of credit area to conservation bank land (of interest for bank owners), ratio of credits that must be bought to offset developed/impacted land (of interest to credit purchasers). If impact assessments and valuation of natural resources are conducted with different methods at each of these sites, the ecological values may not be appropriately compared (Fox and Nino-Murcia 2005).

Successful financial management is as critical as biological management when it comes to the perpetual stewardship of the natural resources within conservation banks; however, planning for

management of these natural resources in perpetuity is incredibly difficult due to inherent uncertainty and the site-specific nature of management activity requirements and costs (Fleischer and Fox 2008; Teresa 2009). For example, it is difficult to estimate how much funding should be set aside for a bank's endowment in order to provide continued financial support for long-term management (Fleischer and Fox 2008; Teresa 2009). This challenge is further compounded by the uncertainty associated with future funding being tied to economic conditions (i.e., future credit sales and/or investment market performance) and the fact that many conservation bank managers lack expertise in financial matters or access to advising resources from signatory agency offices (Fleischer and Fox 2008; Teresa 2009; T. B. White et al. 2021). Requiring that bank managers place endowments in a state-backed investment fund rather than managing funds themselves may provide a solution to part of this challenge, however these types of investment funds typically do not offer the flexibility or return on investment potential that a third-party organization may be able to achieve (Fleischer and Fox 2008).

The bankruptcy of The Environmental Trust clearly illustrates the importance of developing clear expectations of financial responsibility and ensuring that bank management entities are well equipped to meet the challenge of perpetual management with solid understanding of their financial obligations. The Environmental Trust was a private land management group that held conservation easements for and managed several preservation and mitigation areas in San Diego County, including conservation banks, but following mismanagement of endowment funds, filed for bankruptcy in 2005 (Kancler 2006; Teresa 2006; 2009; Fleischer and Fox 2008; Mann and Absher 2014). For many involved in the conservation banking industry, this event was eye opening and highlighted that public and private entities involved in conservation banking are truly part of a “business of conservation” where business practices must be considered alongside environmental ones (Teresa 2006). The Environmental Trust bankruptcy also inspired critiques on the ability of third-party organizations to effectively invest and manage a conservation bank's endowment which prompted the local and state agencies to implement additional regulations related to financial requirements and reporting for conservation banks (Kancler 2006; Fleischer and Fox 2008; Mann and Absher 2014).

## Conservation Banking and Climate Change

As discussed earlier, global climate change presents an existential threat to conservation initiatives, such as conservation banking, that rely on static protected areas. Key entities involved in the facilitation and regulation of California conservation banks have recognized the significance climate change will have on the potential to meet conservation objectives. In 2010, the USFWS stated in a document titled *Rising to the Urgent Challenges of a Changing Climate: Strategic Plan for Responding to Accelerating Climate Change in the 21<sup>st</sup> Century*, that climate change is the “greatest challenge to fish and wildlife conservation in the history of the Service” (2) and emphasized that it is “the transformational conservation challenge of our time” (8) (USFWS 2010). More recently, the USFWS has discussed climate change with a more resigned tone, recognizing that tough decisions regarding conservation priorities have to be made for the Service's network of wildlife refuge systems in the face of climate change impacts (Morse 2021). The CDFW has adopted a “multi-pronged approach” to safeguard California's natural resources in the face of climate change by seeking to improve resilience of the state's natural landscape, promoting the storage of carbon in natural lands as well as the mitigation of greenhouse gas emissions, and emphasizing collaboration among other state and nongovernmental organizations (CDFW n.d.).

For California's conservation banks, potential climate change impacts may be both ecological and economic. As it is currently formulated, the conservation banking system in the US “externalizes the

reality that many species can or must move from their current habitats in the coming decades” as climate change progresses (Whipps 2015). This is because the price of conservation credits does not account for the loss in value that would occur once an acre of conservation bank land that was originally intended for the perpetual conservation of a given species no longer supports that species, thus requiring new land to be acquired and/or further restoration activities to be undertaken to provide conservation value within the species new range (Whipps 2015). This loss in value, or mismatch in value if previously approved credits are still being sold while the bank acreage they represent no longer has the climate conditions necessary to sustain the listed species being impacted, presents a major challenge as it means compensatory mitigation required under the ESA is mitigation on paper only. Despite this obvious challenge and regulating agencies’ acknowledgement of the threat climate change presents to conservation initiatives, California conservation banks undergoing the CDFW approval process are not required to address climate change in their applications nor final bank agreements (Lisa Gymer, informational interview, May 5, 2021).

## Values and Motivations in Conservation and Conservation Banking

The conservation of natural resources can be described with terms of social or economic values. As a type of natural resource conservation, the practice of conservation banking is guided and influenced by these values.

### Economic Value of Conserved Natural Resources

When viewed through an economic lens, the environment and the individual natural resources that comprise it are assets that provide, directly or indirectly, services that contribute to human well-being. There are four types of services provided by ecosystem assets (“ecosystem services”): material inputs, such as timber or seafood; life-supporting services, such as clean water and hospitable climate conditions; amenity services, including recreation opportunities and scenic views, and waste receiving services (Freeman 2003). These services can be assigned economic value to help demonstrate their importance to human well-being or to improve public policy and natural resource management decision making processes that employ cost-benefit analyses (Freeman 2003; Tietenberg and Lewis 2018). There are multiple types of values comprising the total economic value of the environment or natural resources: use value, option value, and nonuse/passive use values. Use values are derived from the direct use of a natural resource or environmental service, meaning one has used at least one sense to experience the resource in some way, and include things such as extraction of ground water for drinking and irrigation or harvesting flowers for use as decor. Option value represents the value attributed to the ability to use a given environmental service or resource in the future. Nonuse/passive use values refer to the values derived from a natural resource where the resource is valued regardless of if it used or not or it is not consumed in the process gaining that value. Many ecosystem services, such as water filtration provided by undeveloped watershed land, are associated with passive use values. Two specific types of nonuse values include bequest value, where a resource is valued for the potential that it will be available for use by future generations, and existence value, where a resource or service is valued simply because it exists with no interest in using the resource now or in the future (Tietenberg and Lewis 2018).

The total economic value of conserved natural resources is the sum of the values maintained by preserving the specific collection of services provided by the given resources. For conservation banks, the focal values are those associated with the presence and continued existence of species listed as threatened or endangered under state and/or federal policies. Explicitly acknowledging the variety of values embodied in and provided by natural resources in natural resource management of conservation planning

processes can help make such planning efforts more effective (Wallace 2012). These values are oftentimes referred to as the “conservation value” of a given piece of land. However, the term “conservation value” can be confusing as it is an actively evolving concept that has been used in various contexts, is infrequently explicitly defined, and has been associated with eight different categories of meaning across a variety of fields (Capmourteres and Anand 2016).

## Social Values and Conservation

Sustainability is often described as being built on three pillars: the environment, economics, and social well-being. Thus, social values, defined in Jepson and Canney (2003, 271) as “sets of ideals and beliefs to which people individually and collectively aspire and which they desire to uphold,” are critical to consider in the pursuit of sustainable conservation and they play an influential role in the development of conservation policy and regulations. Statutory instruments, such as the ESA, that call for and direct conservation planning ultimately are built on the social values that are “sought by governments on behalf of their communities of interest, the electors” (Wallace 2012, 3). Social values are more diverse than economic or scientific values. This diversity has been observed even within groups that on the surface may appear to be driven by the same values. Sandbrook et al. (2011) investigated the diversity of values held by conservation professionals, and found that rather than being a monolithic group, conservation professionals have “strongly divergent ways of thinking about conservation” (292). Differences in social values related to natural resources can result in conflict over conservation initiatives and policies. For example, Parkhurst and Shogren (2003) described the ESA as being “the front line” in a conflict pitting activists who strongly value private property rights against those who believe the common good would be better served through protecting biodiversity and wildlife resources over potential development.

The conservation of natural resources can also be viewed as a social movement. In light of this perspective, some researchers have proposed that social values should be emphasized in initiatives and planning to allow conservation to move beyond a focus on survival enabled through services and products and instead be led by aesthetic and ethical conservation values (Jepson and Canney 2003). Rea (2017) theorized that conservation banking and other command-and-commodify instruments emerged when social conflicts between environmental activists and actors within extractive and development industries reached a point at which it made “more sense” for the actors to participate in what activists pushed for as the morally right practices even if the actors did not share the same social values regarding natural resources. Despite the importance of social values to conservation planning and initiatives, it is beyond the scope of this paper to examine the social values of conservation banking practitioners.

## Motivations for Pursuing Conservation on Private Lands

Individuals may be motivated to pursue conservation measures on private property, such as the establishment of a conservation bank, by a variety of factors. There are two general motivational types: intrinsic motivations, which are derived from an individual’s beliefs, values, ethics, and attitudes, and extrinsic motivations, which are derived from external incentives that are a result of economic, social, legal, and physical contexts (Messick, Serenari, and Rubino 2021). For example, a frequently cited intrinsic motivational factor for the pursuit of private lands conservation is environmental stewardship (Messick, Serenari, and Rubino 2021), defined as actions taken “with various motivations and levels of capacity, to protect, care for, or responsibly use the environment in pursuit of environmental and/or social outcomes in diverse socio-ecological contexts” (Bennett et al. 2018, 599). Intrinsic motivations have been directly linked to the establishment and operation of conservation banks, with Fox and Nino-Murcia (2005) reporting that several of the conservation bank owners they surveyed “expressed intrinsic value of owning property that made a spiritual and ecological contribution to the larger landscape” (1003).



Alternatively, extrinsic motivational factors for undertaking conservation actions supporting endangered species on private lands, such as the decision to establish a conservation bank, may include the potential for landowners to earn a profit (e.g., Fox and Nino-Murcia 2005), qualify for significant tax breaks (Parkhurst and Shogren 2003; McLaughlin 2005), or improve their public image or public relations (Wolfe and Gelbs 1993; Bauer, Fox, and Bean 2004).

Understanding the mix of motivational factors influencing decisions behind private land conservation is critical to ensure that programs designed to encourage greater conservation on private lands are effective. Regulatory programs focused on private lands conservation introduce an extrinsic motivational factor but also represent some intrinsic motivations. Statutory instruments such as the Endangered Species Act that call for and direct conservation planning “reflect the values sought by governments on behalf of their communities of interest, the electors” (Wallace 2012, 3). By directing conservation planning towards specific habitats or species, such instruments present an extrinsic motivational factor that may push individuals to conserve their private land for public benefit. However, it is important to consider that intrinsic motivations, including ethics, morals, values, and beliefs, mediate individuals’ interaction with institutional conservation initiatives and may present barriers to widespread endangered species conservation participation (Messick, Serenari, and Rubino 2021).

## Study Methods

### Survey Development and Distribution

Two surveys were developed and distributed for this project using Qualtrics digital survey platform. Questions were designed to gain an understanding of what motivations drove the establishment of conservation banks and what characteristics of conservation banks were valued by asking what interests influenced the decision to establish a bank.

The first survey (“county survey”) was developed for and distributed to the listed contacts for conservation banks in San Diego County. Contact information was compiled from RIBITS, as well as the CDFW, and San Diego County conservation banking program websites (20 emails total). Surveys, with recruitment letters attached were delivered by email on February 1, 2022. A reminder email was sent on February 14, 2022. Two responses were returned. This was determined to be an insufficient amount of data to proceed with quantitative or qualitative analysis so a second survey targeting a wider pool of potential respondents was created.

The second survey (“statewide survey”) was distributed to contacts listed for conservation banks throughout the entire state of California. The survey had generally the same content with some slight revisions to reflect the expanded range and an additional question to identify the name of the bank for which the respondent was answering in relation to since several contacts were associated with multiple conservation banks.

Statewide conservation bank contacts were compiled from RIBITS by querying the database to display all sites located in California that are classified as a conservation bank. Contact information for the “Bank Sponsor” and “Bank Sponsor POC” was identified from the main summary page for each bank (see Figure 6 for example). The listed “Regulatory Contacts,” which are associated with the agencies that approve banks, were not included in the distribution list. A total of 90 email contacts were identified with no overlap between the distribution list for the first survey. The links to the online surveys, with a recruitment letter included in the body of the email were sent on February 16, 2022. A follow-up reminder email was not sent for the second survey on account of researcher forgetfulness. Seven emails

“bounced” and so did not reach the intended recipients, thus resulting in a successful distribution to 83 contacts. Precise question text, response options, and survey flow information is included in Table 2.

## Survey Response Analysis

### Qualitative Analysis

I used an inductive coding approach to identify themes within respondents’ textual responses to survey questions related to primary motivations of bank establishment (Question 11), and why such use of the land was thought to be the most effective management option (Question 14). The codes that developed from reading the responses are outlined in (Figure 7).

### Quantitative Analysis

Quantitative analysis for survey responses consisted solely of basic count analyses. No statistical testing was conducted.

## Bank Documentation Collection and Review

Following initial review of the response to the statewide survey, I compiled a list of the reported names of banks with which survey respondents were associated. I then searched for each bank by name on RIBITS to a) confirm the banks were indeed conservation banks, and b) download available documentation (as of June 16, 2022) from the cyber repository section of each bank’s profile. A total of 159 bank documents were downloaded for review.

For the reported sites determined to be conservation banks I used NVivo to qualitatively analyze the documentation with a mixed coding approach where deductive codes included “direct references to climate change” or “direct changes to adaptive management” and I allowed specific codes related to the previously determined theme of “climate concepts” to emerge through review (Figure 7). Direct references to “climate change” included derivative terms such as “climatological change” and “change in climate.” Direct mentions to “adaptive management” and derivative terms such as “adaptively managed” or “adaptive grazing” were also noted because adaptive management is a management framework through which protected areas such as conservation banks can potentially address impacts of climate change.

## Findings

### Survey and Document Analysis Overview

#### Survey Response Summary

Two individuals responded to the first survey distributed exclusively to San Diego County conservation banking contacts. While this equates to a 20% response rate, because there were so few contacts on the distribution list these responses were not sufficient for analysis purposes. Seventeen individuals responded to the second survey distributed to state-wide conservation banking contacts. This also comes out an approximately 20% response rate. Of the 19 survey responses received across both distribution lists, there were several that were incomplete. Two respondents did not answer any questions beyond the introductory section. One respondent did not answer any questions beyond 17. The number of recorded responses for each question is indicated in Table 2.



The most reported single role held by survey respondents was that of conservation bank manager. Many respondents reported holding several roles related to conservation banking. Five respondents reported that they were landowner, manager, and bank sponsor. Six respondents reported that they held other roles within the conservation banking realm. Of these “other” roles, the most commonly reported role was consultant. Most respondents reported performing work for more than one conservation bank. However, the single most reported number of banks was one. Respondents overwhelmingly reported that the bank they chose to reference in their survey responses is a private-commercial bank (n = 12); only two respondents chose to reference public commercial or single-client banks, and one respondent identified that they were associated with a combination public/private bank.

A total of 14 specific conservation banks were highlighted in the responses to the statewide survey (Table 3). These banks represent the sample of California’s 137 conservation banks that were considered in this study. The number of banks specified is lower than the number of survey respondents for several reasons: a) one respondent did not provide a bank name, b) two respondents provided the same bank name, and c) one respondent included the name of a mitigation bank that only provides waters of the State and waters of the US credits which does not meet the definition of a conservation bank employed for this study. The reported size of these 14 banks ranged from 23 acres to “around 5,000” acres. The average size of these banks based on values recorded in RIBITS is 887.54 acres. This is generally similar to the range (5 to 6,059 acres) and average (639.5 acres) size of all California conservation banks recorded in RIBITS.

The majority of conservation banks highlighted in survey responses have an “approved” status in RIBITS. Four of the 14 banks were pending approval, and thus are not yet officially established. The oldest bank in the group, Ohlone Preserve Conservation Bank, was Sold-Out as of 2018. The percentage of banks in the sample that are classified as approved is comparable to the proportion of all California banks that are classified as approved. However, the percentages of banks classified as pending or sold-out differ between the sample and all California banks with Pending banks more heavily represented and Sold-Out banks underrepresented in the sample compared to state percentages. Additionally, there were no suspended or withdrawn banks represented in the sample of banks highlighted by survey respondents (Table 4). For banks in the survey sample that are approved or sold-out, the year of establishment ranged from 2001 to 2017. The single year in which the most banks were established was 2014. This distribution is more skewed toward recently established banks than the distribution of establishment year for all California banks (Figure 8).

Of the banks for which Question 8 was answered (n = 13), all provide compensatory mitigation under the Federal Endangered Species Act (ESA) and ten provide compensatory mitigation under the California ESA (CESA). Respondents reported several other statutes that provide legal authority for the sale of credits for compensatory mitigation, including the Clean Water Act (CWA) sections 404 and 10, the California Environmental Quality Act (CEQA), and the California Lake and Streambed Alteration Agreement.

#### [Bank Documentation Review Summary](#)

A total of 159 documents associated with the sample of 14 conservation banks identified in the statewide survey responses were reviewed for the qualitative analysis portion of this study. The documents reviewed were a mix of bank establishment documents such as the BEI body and associated

exhibits or bank prospectuses, and monitoring documents, including conservation easement annual reports and wildlife monitoring reports (Table 5).

## Motivations and Values of Interest – Financial Vs Conservation Interests

### Primary Motivations for Bank Establishment

Several distinct themes related to the motivation for conservation bank establishment emerged from the qualitative analysis of survey responses. In analyzing responses to Question 11 (“Please briefly describe the primary motivations behind the decision to establish the conservation bank with which you are associated”), five motivational themes were identified: financial, regulatory, conservation/natural resources, finance in support of conservation, and socio-cultural. All responses to Question 11 arranged by motivational theme are presented in Table 6.

The financial motivation theme was typified by responses such as “*establishment for long term investment purposes*” (Respondent 1). An interesting aspect of several of the responses within this theme was the explicit disconnection between the respondent as an individual and their response explaining the motivation. For example, Respondent 11, a consultant, emphasized that they were not responsible for the decision to establish the bank with which they were associated and so were only guessing at motivations which they believe are financial in nature (“*I am not responsible for this decision, the following are guesses at others’ motivations: saving city funds*”).

The conservation motivational theme was defined by responses that centered natural resources elements such as species or habitat. Most of the responses within this theme explicitly included terms such as “conservation,” “preserve,” or “recovery.”

The regulatory motivation theme included two sub-themes that touch on elements of regulation associated with endangered species protection. The first of these sub-themes involves a focus on supply and demand dynamics of the conservation credit market and is typified by the response “*...urgent need for conservation banking locations in service region, high rate of regional development...*” (Respondent 12). The second sub-theme focuses on the difficulties that property owners may face if the land they own – and may wish to develop – is determined to be home to a threatened or endangered species. For example, the primary motivation behind the establishment of another bank was because managing the land as a conservation bank was reportedly the “*highest and best land use given property value and presence of endangered species/Critical Habitat*” (Respondent 17).

The most frequently identified theme within responses to the primary motivation question was financial motivations. The second most frequent theme identified was regulatory motivations, with seven responses coded. Conservation/natural resources motivations were identified in five of the 16 survey responses for which Question 11 was answered. Finance in support of conservation and socio-cultural motivations were identified for only one response each (Figure 9). Eight of the 14 banks identified in survey responses for which Question 11 was also answered had exhibited two motivational themes and five exhibited only one theme. No bank had more than two motivational themes reported. Reported motivations varied depending on the role within conservation banking that a given survey respondent held. Those who identified themselves as a landowner, manager, and bank sponsor for a given bank were more likely to report a conservation-minded primary motivation. Those who identified solely as bank managers were most likely to report a regulatory-minded primary motivation, while those who identified as consultants (an ad hoc role category that emerged following initial analysis of survey responses) reported only financial and regulatory motivations (Figure 10).

## Values of Interest in Bank Establishment and Management

Themes surrounding the values of interest in conservation bank establishment were also revealed through analysis of responses to several questions that asked respondents to consider the interests behind the establishment of banks (Questions 12.1 and 12.2) and the capacities for which banks in California are managed (Questions 13.1 and 13.2). Additionally, responses to the question of why managing the land as a conservation bank is the most effective use of the land reveal what values are associated with California conservation banks.

Seventeen respondents rated the influence that financial, conservation in general, and species recovery interests had on the establishment of the conservation bank with which they are associated. All three interest options – conservation in general, financial interests, and species recovery interests – were reported to be at least “a little influential”. Financial interests were the most frequently highly rated interests with eight respondents indicating that the financial value of the bank was “extremely influential” (Figure 11). The prospect of contributing to the recovery of a specific threatened or endangered species was the lowest rated influence on the establishment of the conservation banks represented by the respondents to this survey.

Other interests reported by survey respondents emphasized some alternative themes including the value of regulatory efficiency that conservation banks can introduce (i.e., “*ease of permitting*” - Respondent 13), while others touched on themes already revealed in assessment of the primary motivations for bank establishment. For instance, conservation interests – particularly “*personal conservation interest of internal staff members...*” (Respondent 16) influenced the establishment of one bank, and regulatory motivations focused on the supply and demand of conservation credits influenced the establishment of another (“*Lack of availability of mitigation credits for city projects*” – Respondent 11).

Seventeen respondents rated the importance of profit generation and natural resource preservation capacities. Natural resource preservation is of at least average importance to all conservation banks represented in this sample, with nearly half of the respondents rating this capacity as “absolutely essential” to the management of the conservation bank which they are associated (Figure 12). Profit generation capacity was indicated to be “very important” or “absolutely essential” to the management of conservation banks by more than half of the respondents. However, the range of reported levels of agreement was wider distribution of rates was broader than for responses to natural resource preservation capacity since profit generation was reported to be not at all important to the management of conservation banks with which three respondents are associated (Figure 12).

Other capacities reported by respondents illustrate the variety of values provided by land that comprises conservation banks. Nine respondents shared additional capacities for which banks are managed to maintain. The most commonly reported additional capacity was livestock grazing and agricultural capacity. Several respondents also touched on “[o]pen space values” (Respondent 11) and associated non-extractive use values such as “*private recreation for landowners*” (Respondent 18) and “*public education through docent-led tours*” (Respondent 5). One respondent highlighted a socio-political capacity that is maintained through managing a conservation bank: “[a]lignment with regulatory agencies (CDFW, USFWS) [and] strong working relationships with them” (Respondent 8).

All respondents (n = 17) indicated that they either “mostly” or “completely” agreed that managing the conservation bank with which they were associated as such is the most effective use of the

land. The explanations offered for these affirmative responses (Question 14.2; n = 11) further illustrate the variety of values embodied in and provided by conservation banks which were coded and organized into eight themes: biodiversity, species recovery, general conservation values, ecosystem services, agricultural values, mitigation or regulation, financial values, and socio-cultural values (Figure 13). These themes include a mix of use and non-use values (Figure 7). The most frequently coded values were financial values, mitigation or regulation values, and species recovery values, which were each observed four times. The greatest number of values associated with a single response was four values (Figure 13).

#### *Use of the term Conservation Value in Bank Documentation*

The term “conservation value” was frequently included in establishment and monitoring documentation for the sample of California conservation banks considered in this study. The term was used in 67 of the 159 total documents reviewed with 43% of bank establishment documents and 41% of monitoring documents including the term at least once. The term was particularly prevalent in association with conservation easement documents. All of the conservation easements reviewed for this study included the term conservation value multiple times. The initial descriptions of “Conservation Values” included in the conservation easements for each bank are summarized in Table 7. The frequency with which the term is employed in conservation easement documents is not surprising because the purpose of a conservation easement is to “restrict the use of real estate for the purpose of retaining or protecting the natural, agricultural, scenic or open-space value of the property,” (Blackie 1989, 1187).

#### *Climate Change Considerations*

##### Does climate change pose a threat to California conservation banks?

To investigate whether climate change presents a threat to California conservation banks, conservation banking practitioners were asked to indicate the degree to which they agree or disagree with the assertion that conservation bank resources are at risk from climate change (Question 15.1). All but two of the respondents to this question (n = 17) indicated that they at least slightly agreed that the resources the conservation bank with which they were associated protects are at risk from climate change (Figure 14). The respondents who indicated they did not agree that conservation bank resources are at risk from climate change offered little explanation, simply stating that “*they [the resources] are not*” (Respondent 9) at risk or that “*[t]he habitat is rather hearty*” (Respondent 2).

The majority of respondents also indicated that climate change may impact the ability of California conservation banks to meet perpetual resource conservation goals mandated by bank establishment documents (Question 17.1). However, the degree of agreement was not as strong as that for Question 15.1.

Several climate-change related factors were identified as contributing to climate change risk and impacting banks’ ability to meet the goal of conservation in perpetuity. The most frequently cited factors were drought (e.g., “*drought has impacted this annual grassland habitat*” – Respondent 10) and shifting precipitation patterns (e.g., “*vernal pool and wetland resources on the property, as well as the species living in them, are under threat due to changes in precipitation patterns...*” – Respondent 12). Other factors identified included phenological shifts that would impact plants endangered species are dependent on for survival and reproduction, increasing temperatures or sea level, and wildfire risk. One respondent emphasized that the shift in suitability for various resources would lead to the bank maintaining conservation values overall but with different combinations of resources.

## Does the management of California conservation banks already address climate change?

Twelve of the 17 California conservation bank practitioners whose responses were included in this study reported that the bank they are associated with has a management plan that includes provisions for adaptations in management practices to address potential climate change impacts. Many of the specific adaptations reported to be available to practitioners within the bounds of current management plans dealt with either water management to maintain proper hydrologic conditions for amphibian and other vernal pool- or wetland-dependent species (e.g., *“Inflowing tidal waters can be managed via six slide gates; water levels inside the bank can, therefore, be managed”* – Respondent 5). Another management adaptation available to and previously used in California conservation banks includes modification to grazing intensity (e.g., *“Removing livestock grazing in low rainfall years has been the only measure implemented to prolong hydrology in pools. Potential longer term considerations for prolonged drought include artificially flooding salamander breeding habitat”* – Respondent 14). One of the respondents associated with the bank that was referenced twice emphasized that climate change impacts would be addressed at the bank because the management plan includes an adaptive management framework. The other respondent associated with this bank shared that the bank is essentially addressing climate change impacts from the start by *“pools...being designed a little deeper to retain water for the required breeding time needed by CTS”* (Respondent 13).

Though the responses describing management practices that could be implemented to address climate change seemed generally neutral or positive, one respondent pointed out that *“...if rainfall drops below a certain level, there is NO adaptation strategy that could protect California tiger salamander”* (Respondent 11).

Of the five respondents who indicated that the bank with which they are associated does not have a management plan that includes provisions to adapt to potential climate change impacts, two provided responses to Question 16.2b which inquired whether they would consider voluntarily implementing such management measures. Within these responses, a theme of somewhat limited flexibility in bank management – both financial and regulatorily – emerged. For example, one indicated that the bank could have adaptive management measures put in place *“especially if alternative funding sources were available (e.g., grants)”* (Respondent 17). The other respondent, a consultant, indicated that even though they may wish to implement adaptive management measures aimed at addressing climate change they were not able to independently do so in their role and the decision would require input from and approval of the bank sponsor and the interagency review team.

### *References to climate change within conservation bank documentation*

The frequency with which the term “climate change” was referenced within conservation banking documents was examined to assess whether or not the banks identified by survey respondents consider climate change in establishment or management processes.

Within the 159 available bank establishment and monitoring documents downloaded from RIBITS for the 14 California conservation banks identified in survey responses, the term “climate change” (and derivatives such as “climatic change” or “changing climate”) was referenced in documents for half of the banks. There were 19 references overall, the large majority of which were found in bank establishment documentation for seven of the identified banks; only two banks referenced climate change within available monitoring documents (Table 8).

There were two general types of references to climate change encountered in the documents reviewed: formulaic and descriptive. The formulaic references are those that use exact, or near exact wording to template conservation bank establishment documents provided by the CDFW. Descriptive references to climate change are those that incorporated descriptions of bank characteristics and other local context which were found in the monitoring documents and biological resources exhibits. A summary of the text including direct references to climate change found within the 159 conservation bank documents reviewed for this study is included at Table 9.

The frequency with which climate change references were made within the context of nearly identical sentences was not surprising as the CDFW and USFWS encourage bank sponsors to utilize the publicly available template documents.

### *Connections Between Climate Change References and Motivations*

Examining the connections between motivational themes and the two measures of climate change considerations incorporated in this study – survey responses and direct references to the term within bank documentation – allows the question “*are banks established with environmental motivations more likely to already address climate change in bank agreements and management plans?*” to be addressed. The primary motivations behind bank establishment for banks that directly reference climate change within bank documentation are evenly distributed between three motivational themes: conservation, financial, and regulatory. The reported primary motivations associated with establishment of banks that do not reference climate change within documentation are more varied; the most frequently coded motivational theme was as financial motivations, followed by regulatory motivations, and then conservation motivations (Figure 15). Additionally, the proportion of banks with documentation that referenced climate change was greater within the group of banks for which survey respondents reported conservation motivations (0.6) than within the group for which conservation motivations were not reported (0.5) (Figure 16a).

A similar pattern was observed when considering the distribution of responses to survey question 16.1 (“Does the management plan for this conservation bank include provisions for adaptations in management practices to address potential climate change impacts”) for banks reported to be established with conservation motivations and those for which that motivational theme was not identified. A larger proportion of banks established with conservation motivations were reported to consider climate change in bank management practices (0.75) than among banks for which the conservation motivational theme was not identified (0.625) (Figure 16b).

## Discussion

### Survey Response Rate and Bank Representation

The literature on conservation banking in the US includes multiple studies and reports that incorporate surveys of conservation banking practitioners. The 20% response rate observed in this study, while less than ideal, is not out of the ordinary when compared to survey response rates reported in other studies contacting conservation banking professionals. For example, Poudel, Zhang, and Simon (2019) reported an overall response rate of 21.9% for their mailed survey designed to obtain information regarding conservation bank transactions. The authors cited a general sensitivity to information sharing as well as a “reluctance to provide credit-pricing information” as an explanation for this low response rate (Poudel, Zhang, and Simon 2019). In 2016, the Department of Interior’s Office of Policy Analysis (DOI



OPA) conducted a nationwide survey of conservation bank sponsors and managers in partial fulfillment of a request from USFWS for the Office to review data related to the Service’s conservation banking program. More than 50% of the 122 conservation bank managers and sponsors the DOI OPA contacted for this study returned survey responses (US Department of Interior Office of Policy Analysis 2016). The greater response rate achieved by the OPA researchers may be due to a mix of factors such as the obvious name recognition and authority associated with emails arriving from a government agency, and a more thorough study design that included first speaking with potential respondents on the phone to confirm their eligibility and multiple email reminders distributed after the initial survey email. Changes to the research methods employed for this study that may have resulted in an improved response rate include ensuring that reminder emails are sent and potentially cold-calling bank sponsor contacts for which phone number information was available to introduce the study to them rather than relying solely on introductory emails.

The sample of conservation banks for the qualitative document review segment of this study provided approximately 10% coverage of all California conservation banks. This sample is relatively small, and due to the overrepresentation of pending conservation banks was not very representative of California conservation banks. Additionally, due to updated survey questions following the expansion to a statewide distribution list, conservation banking practitioner contacts from the initial San Diego County distribution list were never asked to specifically identify a conservation bank with which they were associated. Thus, no San Diego County conservation banks were included in the study sample. As of May 6, 2022 San Diego County contained 20 banks, roughly 15% of conservation banks in the state (RIBITS). This is a significant limitation, as one of the primary regional clusters California conservation banks is located in the South Coast area of the state – which includes San Diego County. Setting aside this limitation, the spatial distribution of banks included in the study sample generally aligns with the distribution of regional clusters of California conservation banks identified by Bunn, Lubell, and Johnson (2013) (Figure 17). It would be beneficial for future studies to ensure that all the regional clusters are represented.

## Key Themes and Research Question Answers

### Motivations for Bank Establishment Go Beyond Financial/Environmental Dichotomy

I set out with this project to specifically examine financial and environmental motivations and interests associated with conservation banking in California. However, the survey responses from conservation banking professionals indicated that the motivations behind the establishment of conservation banks are more nuanced than a finance/environment dichotomy. This is clearly illustrated by the fact that a unique, but equally finance- and environment-focused motivational theme, “finance in support of conservation,” emerged from analysis. Likewise, open-ended responses to Question 12.2 – “*What other (if any) interests influenced the decision to establish this conservation bank*” – made it clear that financial and environmental concerns were not the only thing on the minds of California conservation banking professionals when considering bank establishment (e.g., “personal conservation interest of internal staff members” and “ease of permitting”). Financial motivations were ultimately the most frequently reported motivational theme for conservation bank establishment and financial interests were more often ranked as extremely influential to bank establishment decisions, suggesting that on a surface level, the establishment of California conservation banks is primarily driven by financial motivations and interests. However, the regulatory motivational theme – which can reasonably be traced back to environmental-centered motivations at its foundation because the state and federal regulations that led to the emergence of conservation banking are decidedly environmentally-centered themselves – featured prominently in survey responses. Additionally, the fact that more than 50% of survey respondents

provided statements that indicated more than one theme associated with the primary motivation behind establishing a given conservation bank makes it clear that the values associated with conservation banking in California are multifaceted.

The greater frequency of reported financial motivations compared to environmental motivations is not surprising. In their early investigation of the US conservation banking market, Fox & Nino-Murcia (2005) found that more than 90% of banks were established with financial motives. The authors also found that most of these financially motivated banks were private commercial banks owned by for-profit organizations. Likewise, in this study the large majority of instances where the financial motivational theme was indicated as a primary motivation for bank establishment were associated with private commercial banks (Figure 18), suggesting that the prevalence of financial motivations among private commercial banks has continued over the past 20 years. While I did not originally consider compliance with regulatory requirements to be a potential motivating factor when formulating my research questions, it is also not surprising that this motivational theme featured so prominently in survey responses as it aligns with the “command-and-commodify” nature of the conservation program in California and the rest of the US (Rea 2017). The observed variation in primary motivational themes based on the role of the survey respondent was also not surprising given the results of studies such as Sandbrook et al. (2011) that discuss value plurality among conservation professionals. Differences in social values can lead individuals to attribute more importance to different potential outcomes of conservation banking.

One complicating factor in analyzing the true motivation behind the establishment of the sample of California conservation banks considered in this analysis is that several of the respondents, though listed as official points of contact in RIBITS, did not hold positions where they were responsible for the decision of bank establishment. For example, respondents 12, 14, and 18 clearly separated themselves as individuals from the decision by discussing the landowner’s or their client’s motivation. Respondent 8 emphasized specifically that they were guessing at other’s motivations (Table 6). Future research could address this weakness by focusing specifically on conservation bank landowners for interviews or surveys.

Based on comparison of the survey responses to questions 12.1 and 13.1, there seems to be a slight shift in interests from a more financial emphasis in establishment phase to more of a conservation focus within the management phase. However, from a theoretical point of view this conservation focus may be better described as “conservation in support of finance” due to the fact that the potential to profit from conservation credits is often directly linked to the accomplishment of set conservation objectives, with the threat of credit sales being suspended in the future if management does not appropriately address natural resource preservation capacities. Future research should investigate this dynamic with more carefully worded survey questions or by collecting data through interviews which would allow for better clarification and follow up questions to better reveal nuance.

#### California Conservation Banks Provide Multiple Values

Survey questions 13.2 and 14.2 (Table 2) elicited responses that highlighted a variety of values embodied in and provided by the sample of California conservation banks (Figure 13). These values represented a mixture of use, both consumptive and non-consumptive, and non-use values. Additionally, through my qualitative analysis of bank documentation I made note of sections that described management practices, such as adaptive grazing to maintain appropriate vernal pool conditions, and interpreted what values seemed to be the focus of such practices. The analysis of bank documentation also highlighted the frequency with which the term “conservation value” is utilized in conservation bank establishment and monitoring documents. Several survey respondents also employed this term in their descriptions of why management of conservation bank land as a bank was the most effective use of the



land (Respondent 17) and the degree of risk climate change presents to bank resources (Respondent 14). When used within conservation banking documentation, conservation value seems to be employed primarily with meanings that fall into the categories Capmourteres and Anand (2016) describe as 1) the “provision of habitat and food to sustain wildlife populations,” and 2) a “tool to prioritize conservation efforts” (4).

California conservation banks provide flows of monetary value to bank sponsors and/or landowners through the sale of conservation credits. The flows of monetary value from the sale of conservation credits can be viewed as a quantification of non-use values – such as ecosystem services or biodiversity values – embodied in and provided by conservation bank land through a sort of revealed preference for the value of maintaining land in an undeveloped state to support threatened or endangered species and their habitat. A secondary flow of monetary value from grazing and cattle production that is compatible with or may even facilitate bank management for species conservation was present for several banks within the sample considered for this study. For example, Dutchman Creek Conservation Bank, North Bay Highlands Conservation Bank (NBHCB), and SMUD Nature Preserve Mitigation Bank, among others, operate grazing leases that allow for various levels of livestock production as part of their long-term management plans. Grazing and livestock production on conservation bank lands was also revealed to be connected to socio-cultural values with Palo Prieto Conservation Bank reportedly providing financial flexibility that has allowed the landowners to maintain a family ranching operation that had been passed down through generations for over 140 years.

Credit stacking is defined as “acquiring credits under multiple market-based strategies on a single area of property, where all credits can be sold independently” (Fox 2008, 172). For example, Fenston Mitigation Bank, if approved with the proposed credit scheme included its prospectus submitted in February 2021, will offer stacked credits for areas that qualify as both Clean Water Act 100ft wetland buffer and appropriate habitat for different threatened or endangered species such as the California tiger salamander or burrowing owl. Another example is the Sacramento Municipal Utility District’s Nature Preserve Mitigation Bank (SMUDMB) which has reserved the right to request the authorization of carbon sequestration credits for the potential planting of nearly 4,000 oak trees within bank boundaries. In this way, banks could provide multiple streams of monetary value to bank sponsors and landowners through different regulatory mechanisms. In cases where credits are stacked, it is essential for banking practitioners and agency representatives to ensure that the ecosystem services underlying the overlapping credits are unbundled, meaning the multiple services provided by a given area of land are considered separately, to avoid “double-dipping.” Double-dipping occurs when more than one credit type earned through the same management activity on a piece of land is sold, meaning that full mitigation is not achieved because the same ecological values were sold twice (Fox 2008).

Regardless of whether credits associated with different environmental market systems are stacked within conservation banks, I believe there is a “stacking of value” within conservation banks whereby the bank provides landowners/bank sponsors with multiple streams of benefit – monetary and nonmonetary – through the same management activities. For example, NBHCB provides potential monetary value flows both through the sale of red-legged frog conservation credits, and from rent earned from operating a grazing lease on the bank property. On top of this, the NBHCB conservation easement allows for the landowner to maintain a lease with the San Antonio Gun Club for deer hunting on the property. And finally, the landowner is also permitted to conduct recreational activities that are compatible with the banks management objectives such as hiking or camping, thus benefitting from non-extractive use values.

## Climate Change as a Threat to California Conservation Banks

California conservation banking practitioners generally seem to consider climate change to be a threat to conservation bank resources and the ability for banks to meet the mandated goal of perpetual conservation. However, the perception of the severity of the threat is variable. Respondents seem to be less concerned with the potential long-term impacts of climate change on the conservation banks with which they are associated as indicated by the lesser degree of agreement to Question 17.1 compared to Question 15.1 (Figure 14). Documentation for a few of the sampled conservation banks specifically highlight changing climate as a potential threat to conservation bank resources with statements such as:

*“Fog and low-stratus clouds might also decrease over the next 50 to 100 years and beyond if the temperature of the surface of the ocean increases as a result of global climate change (Carbone et al. 2012). The fog drip is important for plants and animals in the Santa Barbara Region as it adds moisture to the ground. The fog also keeps the temperatures low, thus minimizing evapotranspiration. A reduction in fog could have significant negative effects on the many plants and animals on the Ranch”*  
(La Purisima Conservation Bank, BEI Exhibit H – Biological Resources Report).

One response to Question 17.2, which asked respondents to explain why they thought climate change may impact the ability of conservation banks to meet the mandated goal of perpetual conservation, stood out amongst the rest and lends itself to interesting discussion in relation to conservation value under changed conditions. Respondent 1 indicated that *“resources will still be conserved, it will just be a shift in what resources are viable on the bank property.”* I believe that this would still result in a mismatch of value between conservation credits and on the ground resources, thus meaning the bank was unable to meet the goal of conserving the specific natural resources in perpetuity.

### Assessing if Climate Change Is Currently Addressed

This study investigated whether climate change is currently addressed in conservation bank management and establishment with two measures: survey responses (Question 16.1) and references to the term climate change within bank documentation. Considering the first measure, survey responses, suggests that climate change is widely addressed in conservation bank management as the large majority of respondents indicated that “yes,” their bank’s management plan included provisions to address potential climate change impacts. However, when considering the second measure, the frequency with which climate change is considered is much smaller with documentation for only half of the banks in the study sample containing direct references to climate change, most of which were formulaic in nature. There is a clear disparity between these two measures, with more banks reported by practitioners to consider climate change not directly referencing climate change within documentation than those that do (Figure 19). However, this difference may be skewed due to incomplete bank document availability in RIBITS. Additionally, as most of the bank document references to climate change were observed within the definition of adaptive management, it could be argued that with every mention of adaptive management within bank documentation, climate change is implicitly being considered.

Climate change could also be viewed as being implicitly considered in by conservation banks that are established in connection with California’s Natural Community Conservation Plans (NCCPs). NCCPs provide larger ecological context for conservation bank establishment and banks provide mechanisms for regional preserve network creation (Mann and Absher 2014). According to the CDFW, the NCCP Act, “inherently includes principles to help accommodate climate change,” such as requiring protected areas within NCCPs to include monitoring and adaptive management efforts, and facilitation of diverse,

connected preserve networks that allow for species to shift distributions and utilize habitat refugia (“NCCPs and Climate Change” n.d.).

## Options Available If Climate Change Impacts Prevent a Bank from Meeting Conservation Objectives

In addition to questions about motivations/interests and climate change risk and management, the survey distributed for this study also asked respondents to contemplate what options are available to potentially restore ecosystem functions and habitat characteristics that provide conservation value to a given conservation bank should climate change cause a bank to fail to meet conservation objectives (Table 2, Question 18). There were a mix of positive and pessimistic outlooks represented, with responses ranging from simply indicating that no options are available to descriptions of specific restorative management practices such as artificial irrigation. One response suggested the conservation bank professional was confident that climate change would not critically impact the ability of their bank (pending approval) to meet conservation objectives because it will take climate change into account with the initial design. Several respondents shared practical approaches that are extensions of the adaptive management framework already in place at the banks. However, responses did acknowledge that beyond certain climate thresholds, there would be no adaptation options for restoring ecological function (e.g., *“Endowment funds could be used for re-excavating breeding ponds to extend hydroperiod, but below a certain rainfall level there are no options”* – Respondent 11). These responses also suggest that sufficient funding would be critical for implementing any such adaptive management-focused options (e.g., *“Artificial irrigation of the ponds is allowed in the easement but there is not itemized funding for this in the endowment. However, there is a ‘adaptive management’ task in the endowment that builds until needed that could be used for this.”* – Respondent 17). Some more pessimistic responses pointed to biological characteristics of the bank resources, such as dependence on aquatic habitat, that limit options in the face of climate change even if necessary geologic conditions remain.

Three responses to Question 18 stood out among the rest because of their focus more on the regulations of and responsibility within California conservation banking rather than physical characteristics of individual banks (Box 1). The primary tools state and federal agencies can employ to compel bank sponsors to implement remedial management practices that support listed species following “Extraordinary Circumstances” that cause damage to a bank’s conservation values is the suspension of further credit sales or releases, or the modification of approved credit allocations. For example, the most recent bank enabling instrument template available on the CDFW’s website, published by the California Multi-Agency Project Delivery Group in May 2021, states that if “there may be an Extraordinary Circumstance in which the Bank can no longer serve its intended purpose as compensatory mitigation, in whole or in part, for the specific resources for which it was established” signatory agencies may “direct Bank Sponsor[s] to

### Box 1: Question 18 Responses That Highlight Key Policy Questions and Challenges

*“Bank will be sold out”* (Respondent 9)

*“Endowment funds could be used for re-excavating breeding ponds to extend hydroperiod, but below a certain rainfall level, there are no options. To be fair, below this threshold, the impacted habitats which were mitigated for also would have lost all habitat values, so this loss of value is not the fault of the conservation bank – those values would have been lost with or without the impacts and mitigation.”* (Respondent 11)

*“Per the terms of the BEI, the IRT cannot go back and require additional funding and work from the Bank Sponsor beyond what is allocated in the endowment.”* (Respondent 18)

suspend Sale and/or Transfer, prohibit the release of additional Credits, and/or reduce the number of Credits allocated to the Bank in proportion to such damaged area unless and until” the damage is appropriately resolved. However, if a bank is sold out, there’s not many actions agencies can take (Lisa Gymer, informational interview, May 5, 2021). The comment from respondent 18 similarly touches on rules written into BEIs that limit the extent to which wildlife agencies can place responsibility for meeting conservation outcomes under changing conditions on the bank sponsor following bank approval and sale of credits.

A key question that remains, and was not addressed by any of the survey respondents, is what is allowed to happen to the land within a conservation bank if the bank no longer serves its designed conservation purpose? If conservation banks that were established to provide specific conservation values in perpetuity can no longer do on account of species becoming locally extinct, are bank sponsors required to continue implementing long term management plans? Or could landowners argue that climate change is an “Extraordinary Event” or a “Force Majeure” that allows them to be relieved of obligations agreed BEIs? Is there any way for the public to recoup the natural resource values lost from this failed compensatory mitigation? These questions can begin to be answered by examining how conservation easements, one of the central elements of conservation banks, may withstand changing physical conditions, and considering some proposed innovations within conservation banking policy realm.

### *Conservation Banks and the Doctrine of Changed Conditions*

The doctrine of changed conditions is a common law principle that refers to decisions where a court can “terminate a real covenant or equitable servitude when changed conditions in or around the burdened land frustrated the purpose of the restriction or created an undue hardship on the owner of the burdened land” (Blackie 1989, 1188). There is debate among experts whether conservation easements, such as those facilitating the creation of conservation banks, may be subject to termination under this doctrine. Some believe that easements should not be terminated as long as the stated purpose is still served, but the nature of the stated purpose – specifically whether it considers broad or narrow conservation objectives – will influence how easily this determination could be made (Blackie 1989; Harvey 2011). Others argue specifically that the *cy pres* (“as near as possible”) doctrine which is a part of charitable trust doctrine should apply to balance the accrual of public benefits with landowners’ desires to control land use in perpetuity in a reasonable approximate of the purpose originally assigned to the conservation easement (“Cy Pres: Charitable Trusts” n.d.; McLaughlin 2005). With this argument, if conservation values that remain within a conservation bank following the local extinction of a focal listed species are “as near as possible” to those specified in the bank’s conservation easement, it would be reasonable to say that the conservation bank is still providing public benefits as intended and so should not be terminated. This line of thinking aligns with that expressed by survey Respondent 1 in this study who commented that even a conservation bank would still meet the goal of conserving resources in perpetuity because, “*it will just be a shift in what resources are viable on the bank property.*”

### *Alternative Banking Approaches and Recent Conservation Banking Policy Updates*

Conservation banking, though innovative at the time, is now turning into an aging policy instrument facing challenges not imagined at the time of its inception. Is it time to shift policy out of the 1980s and into the reality of the 21<sup>st</sup> century? What should a modernized conservation banking policy framework look like? Several authors have proposed ways to begin reimagining and restructuring the conservation banking framework in California and the rest of the US to better meet challenges such as climate change.

## Future Habitat Banking

One of the simplest adjustments that could be made to conservation banking programs to better address the needs of threatened or endangered species facing climate change impacts would be to allow the issuance of conservation credits for land which the species is expected to inhabit in the future. Conservation banks established to protect “future habitat” would be located within the range a species is likely to exist in the future based on ecological and climatic modeling (Kimbrell 2010). Discussion of future habitat banking was included in survey responses for this study. Specifically, Respondent 18 criticized the current California conservation banking program for not allowing bank owners to seek approval for future habitat credits as a way state and federal agencies do not support, stating in response to Question 19.2 that:

*“If agencies want banks to better consider and plan for climate change, they need to offer financial incentives for bank sponsors to do so and/or change the regulations to better reflect climate change objectives. For example, areas that are currently uplands that are likely to convert to tidal wetlands with sea level rise are currently given no credit by agencies for bank sponsors protecting them. This provides no incentive for bank sponsors to protect areas that allow for sea level rise accommodation/retreat.”*

Promoting preservation of potential habitat on private land by allowing the sale of future habitat credits as financial incentive may help to ensure that species have new space to occupy once the current habitat range is unsuitable. However, this approach has several weaknesses. First, future habitat credits purchased by developers to compensate for current impacts would not truly provide the mitigation until a future date when a species colonizes the land, resulting in a time lag. Second, there is considerable uncertainty involved in climate and habitat modeling which may influence the accuracy of models to an unacceptable degree (Kimbrell 2010).

## Dynamic Innovations: “Stepping-stone” Conservation Banking and “Climate Banking”

Climate change presents a challenge to conservation banks and other static protected areas because it is likely to cause the ranges of protected species to shift beyond preserve boundaries. If a species a conservation bank was established to provide conservation credits for experiences a range shift therefore becoming locally extinct, it is impossible for the bank to meet the objective of perpetual conservation. This means that the values of conserved natural resources which were supposed to offset impacts from development or other activities are lost. More dynamic approaches to conservation area establishment may help conservation programs keep pace with ecological change (D’Aloia et al. 2019).

Kimbrell (2010) proposes a “stepping-stone” approach to conservation banking to ensure species are protected in the longer-term, rather than only as long as a given conservation bank land provides suitable habitat. As defined by Kimbrell (2010), a stepping-stone approach to conservation banking would incorporate clauses written into conservation bank enabling instruments that would make it so if a conservation bank’s focal species goes locally extinct, a “conservation bank owner must buy land where the species currently exists and must create a conservation easement for those new lands, or buy credits for that species in another conservation bank where the species currently exists” (146). With this approach, the required compensation for the take of threatened or endangered species caused development or other actions would be perpetual as habitat and/or populations are protected step-by-step even as their ranges may shifts, a distinct advantage to relying solely on singular static conservation banks. Theoretically, the stepping-stone acquisition of new conservation easements or the purchase of new conservation credits could continue until the species goes globally extinct. Kimbrell also believes that this

approach has several other strengths including financial benefits for bank owners who could potentially sell a second round of conservation credits representing conservation value for newly established species for the original conservation bank area and a decreased likelihood that courts may terminate the conservation easement for the original conservation bank area if it is still in use for conservation credits targeting new species. These strengths and advantages may lead to the stepping-stone approach to conservation banking more effective at fulfilling ESA requirements than a simple future habitat banking approach (Kimbrell 2010).

The stepping-stone approach has received criticism from other authors. Whipps (2015) asserts that Kimbrell's proposed adjustment to the conservation banking system, which he characterizes as a "continuous purchase provision" that will scare off potential bank owners, is likely to fail for several reasons. First, the stepping-stone approach does not account for banks that are set up to provide conservation credits for multiple species, such as the majority of the California banks included in this study's sample. Second, species movement is unpredictable, which would likely make decisions regarding the purchase of new land for the second stepping-stone bank difficult logistically and financially, especially when considering banks with multiple species that may respond to altered climate regimes in different ways. Third, because it would require landowners to purchase new land and/or credits as species ranges shift, which may necessitate the sale of the original conservation bank land, Whipps claims that the proposed stepping-stone approach "ignores the subjective attachment that landowners have with their land" (578). Such attachments are clearly important to some California conservation bank owners as evidenced by the socio-cultural motivations behind bank establishment observed in this study (Table 6). Finally, Whipps also argues that this approach would invite significant litigation into the conservation banking industry which would serve to waste funds that could be better spent on actually facilitating species conservation.

To remedy these and other shortcomings, Whipps (2015) has proposed an alternative system dubbed "climate banking." The ultimate argument behind Kimbrell's stepping-stone conservation bank proposal is that "global climate change and ecological interactions will cause protected species to move, conservation banks should be forced to move as well" (2010, 157). This logic is also present in Whipps's proposed climate banking system, but the process for achieving this goal is different. As proposed, climate banking is built on the foundation of the conservation credit system, but instead of credits representing the resource values present at a fixed location (i.e., a conservation bank), developers would purchase credits from a "climate banker" that has entered an agreement with the appropriate state and/or federal agency to follow a target species as it moves by providing species monitoring and implementing conservation measures where the target species is found. Unlike with the stepping-stone approach, a climate banker would not need to purchase the land a target species moves into but would simply need to obtain permission to implement the appropriate conservation activities on the private lands the species is inhabiting (Whipps 2015). This logically represents significant cost savings as one of the main elements of conservation bank start-up costs is land acquisition (Poudel, Zhang, and Simon 2018). Whipps (2015) suggests that one way permission could be obtained is through the ESA's incidental take permitting system, with permits written to include conditions requiring the private landowner to allow a climate banking organization to access the private land to conduct conservation activities.

Climate banking is not proposed as a complete replacement for conservation banks and other static preserves, but instead would be employed alongside them as a dynamic area-based management tool to provide links between key protected area nodes (Whipps 2015; D'Aloia et al. 2019). A somewhat similar approach has been employed in California with the implementation of BirdReturns, a program run by The Nature Conservancy that creates "pop-up wetlands" along the paths of migratory birds in the state's Central Valley by paying farmers to flood their fields (a standard agricultural practice) earlier in



the season to provide critical stop over habitat, especially in drought years (Hausheer 2018; D’Aloia et al. 2019). If challenges related to the uncertainty, practical logistics, and political feasibility of dynamic conservation approaches can be alleviated through the production of high quality climate and biological data at the appropriate scales as well as the development of suitably flexible policy instruments that generate widespread stakeholder support, coupled dynamic conservation areas and static preserves may be the best approach to protect biodiversity in the face of climate change (D’Aloia et al. 2019).

### Recent Federal-level Policy Updates

On July 26, 2022, the USFWS issued an advanced notice of proposed rulemaking (ANPR) seeking public comment on potential new guidance that will focus on “establishing objectives and standards for conservation banking,” (Wildlife and Fisheries: Compensatory Mitigation Mechanisms, 2022). The rule changes are proposed in response to part of the 2021 National Defense Authorization Act that “requires the Service to issue regulations of general applicability establishing objectives, measurable performance standards, and criteria for use for species conservation banking programs consistent with the ESA” (Kauffman 2022). The Service is particularly hoping to receive comments related to transparency, a characteristic that has been identified as a key issue within the US conservation banking program and market by many authors (e.g., Carreras Gamarra and Toombs 2017; Poudel, Zhang, and Simon 2018; T. B. White et al. 2021; Theis and Poesch 2022).

Recently proposed revisions to the ESA could facilitate the implementation of stepping-stone conservation banking in situations where land that is considered outside the “historical range” of a threatened or endangered species but now, under a changed climate regime, provides appropriate conditions could be established as a conservation bank and contribute to species recovery by translocating an “experimental population” to the area. A proposed rule issued by USFWS on June 7, 2022 would allow the previously prohibited practice of translocating populations of threatened or endangered species to locations outside of their historical range for conservation purposes. The Service specifically acknowledges that implementing conservation actions to support listed species outside the bounds of their historic range may be required more frequently “if the ability of the habitat to support one or more life history stages has been reduced due to threats, such as climate change or invasive species” (Endangered and Threatened Species: Designation of Experimental Populations, 2022).

Additionally, in March it was reported that the Biden Administration may be preparing to issue an ESA-specific Compensatory Mitigation Policy which may significantly impact the California conservation banking program (Barho and Marcus 2022). It is speculated that this potential policy would be similar to the ESA Compensatory Mitigation Policy (ESA-CMP) published in 2016 which represented “the first comprehensive treatment of compensatory mitigation under authority of the ESA” issued by USFWS (Endangered and Threatened Wildlife and Plants; Endangered Species Act Compensatory Mitigation Policy, 2016; Barho and Marcus 2022). This policy called for the implementation of landscape-scale strategic planning for compensatory mitigation, as well as the establishment of common standards for compensatory mitigation projects pursued under the authority of the ESA to better align with executive directives issued by then-President Obama that introduced a mitigation goal of accomplishing net gain of natural resource value and functions, or at a minimum no net loss. The 2016 ESA-CMP replaced the original USFWS guidance on establishing and managing conservation banks issued in 2003 (US Department of Interior Office of Policy Analysis 2016). However, in July 2018 the ESA-CMP was withdrawn, following the determination by the Trump Administration that “the Service does not have authority to require ‘net conservation gain’ under the ESA and that the ESA-CMP did not align with the Executive branch policy at the time (Endangered and Threatened Wildlife and Plants;

Endangered Species Act Compensatory Mitigation Policy, 2018). And so, at the federal level, the US conservation banking program is still directed by a nearly 20-year-old guidance document.

## Metrics and Accountability in Conservation Banking

As discussed previously in this paper, one of the key challenges within the US conservation banking market is transparency. In turn, the issue of transparency can be directly linked to metrics used for and accountability in relation to conservation banking. When employed in offsetting activities such as conservation banking, metrics are generally measures of biodiversity or other environmental characteristics used to evaluate the state of a given site and inform the quantification and assessment of the value of ecological functions and services supplied at compensation and impacted sites (Poudel, Zhang, and Simon 2019; Grimm 2021). Accountability in the context of conservation banking refers to whether or not commitments to endangered species conservation have been fulfilled through the establishment and operation of a conservation bank, but more generally the term is used to refer to the idea of willingness to accept responsibility for one's actions (Biermann and Gupta 2011; Barral 2022).

Metrics for conservation banking should ideally be developed through rational methods to reflect ecological equivalence, spatial and temporal dynamics, and various sources of uncertainty (Grimm 2021). However, multiple authors highlight how metrics currently in use for conservation banking in the US are poorly designed or oversimplified (thus not accurately representing ecological function in a detailed manner), non-standardized, and inconsistently applied; this shortcoming, combined with a more general lack of transparency surrounding conservation bank credit evaluation and transactions, precludes rigorous evaluation of the effect conservation banking has on species recovery (Grimm 2020; 2021; Barral 2022; Theis and Poesch 2022). For instance, Grimm (2021) evaluated metrics and quantification approaches employed for two northern California conservation banks, one of which – Dutchman Creek Conservation Bank – was also represented in this study. She found that even though habitat acreage conserved through credit transactions at these two banks exceeded the acreage impacted by development projects seeking offsets, suggesting at least on the surface a positive conservation outcome, there was no evidence of a connection between these transactions and the ESA policy goal of species recovery.

Metrics in conservation banking can be directly linked to accountability. Barral (2022) discussed how the degree of complexity of metrics chosen for conservation banking credit determination influences the strength of accountability such metrics allow, proposing that simple metrics, such as measures of presence/absence for a species within a given acre used to evaluate credits in most conservation banks, only approximate ecological condition allowing for low accountability while complex metric that incorporate detailed quantification of condition based on greater numbers of ecological indicators allow for strong accountability. This is because complex metrics require conservation bank practitioners and agency representatives to pay greater attention to details of management practices and outcomes whereas simple metrics filter out many elements of the ecological reality they are meant to assess (Barral 2022). Metrics are also related to accountability in its more general sense. The relational element of accountability, which refers to links between actors who are held accountable and those who have the right to hold them to account, relies on transparency (Biermann and Gupta 2011), a characteristic in which US conservation banking has been shown to be lacking (van Teeffelen et al. 2014; Carreras Gamarra and Toombs 2017; Grimm 2020; T. B. White et al. 2021; Theis and Poesch 2022). Conservation banking metrics contribute to some of this lack of transparency because metrics and associated evaluations of conservation value or ecological impact associated with credits are often “black boxed,” meaning “information about indicators and measurements remain confined within certification documents and files” (Barral 2022, 497). This does not provide the public with a way to easily assess for themselves whether conservation credit transactions are contributing to endangered species conservation, leaving



them to hope that wildlife agency representatives are appropriately representing public interests in their negotiations to conserve and protect public trust resources (endangered species) through the establishment of conservation banks and subsequent transactions of conservation credits. Though in theory RIBITS provides public access to conservation bank establishment and transaction records, the incompleteness of these records limits the public's ability to hold banking practitioners, developers purchasing credits, and agency representatives, accountable for meeting ESA requirements. For example, through my review of bank documents for this study, credit evaluation exhibits outlining how banks were assigned value in terms of the conservation credit currency were only available for six of the 14 banks considered.

Perhaps even more concerning in relation to accountability in conservation banking is the frequent descriptions within the literature which characterize the processes through which banks are assigned credits and subsequently bought and sold as “negotiations” and/or “proprietary information” (e.g., Mann and Absher 2014; Grimm 2020; Poudel, Zhang, and Simon 2018; Poudel and Pokharel 2021). Not only do negotiations result in the non-standard and inconsistent metrics currently used in conservation banking (Grimm 2020), but they are also depend closely on the relationships between individual bankers and wildlife agency personnel rather than on more democratic, participatory approaches to the quantification environmental value (Barral 2022). Barral (2022) illustrates how this can be problematic by reporting a comment made by a USFWS agent: “The more we know the banker, the more we are likely to trust his measures and not go and verify them” (500). If the determination of the conservation value for a given bank and subsequent transactions are further masked by unreported negotiations or redactions based on proprietaries, how can the public be sure that compensation for impacts to endangered species is sufficient or that there hasn't been industry capture of the conservation credit production process?

## Policy and Practice Recommendations

The findings presented in this study may be of interested to several stakeholder groups within the field of California conservation banking seeking to improve practices and policy, including current and potential conservation bank owners, consultants, and regulating agencies. Below I present a collection of recommendations for policy and practice based on my findings and review of the literature.

### Recommendations for Conservation Banking Practitioners

#### *Strengthen Commitment to Adaptive Management*

Adaptive management was frequently cited by survey respondents as one of the methods that is employed to address climate change impacts to conservation banks. However, many of the references to adaptive management within bank documentation, as with direct references to climate change, were formulaic in nature. Previous research has suggested that though adaptive management is cited as a way for conservation banks to deal with forces of uncertainty, it is unclear based on management plans if adaptive management is actually adhered to, or if it is simply stated as a sort of buzzword (Grimm 2020).

To strengthen commitment to adaptive management, California conservation bank sponsors, managers, and consultants should seek to include detailed descriptions of the adaptive management framework being applied within publicly available bank establishment and management documents. The Long-Term Management Plan for La Purisima Conservation Bank provides an example of how even a simple addition, with the succinct sentence of – “to achieve this [long-term adaptive management] the Plan establishes initial management objectives and activities for the Bank Site that are meant to be updated as monitoring and inspection data are gathered and analyzed” – can provide greater evidence that adaptive management will actually be implemented. Additionally, management reports should

specifically identify what actions are implemented each year as part of the adaptive management framework and should make clear what data sources were used to inform any changes in management. All efforts to expand and improve implementation of adaptive management practices should ideally be supported by the state and federal agencies that are signatories for conservation bank agreements.

### Recommendations for State and Federal Agencies

Understanding the motives and interests of conservation bank practitioners can help agencies adjust the design of the conservation banking mechanism to achieve more efficient habitat protection. Based on the findings from this study regarding motivations behind conservation bank establishment, as well as specific feedback from conservation banking practitioner survey respondents related to agency support in addressing climate change issues, I present several suggestions for potential changes to the California conservation banking program that may serve to improve efficiency and achieve better conservation outcomes.

#### *Provide Clarifications for Conservation Banking Document Elements Related to Climate Change*

The signatory agencies for California conservation banks should clarify whether climate change impacts may qualify as a force majeure event. Though the most recent BEI template developed by the Interagency Review Team (IRT) and available on the CDFW conservation banking program webpage does not include a force majeure clause, many previously approved banks have enabling instruments that do incorporate such a clause. The following definition of “force majeure” was included in the bank establishment documents of banks considered for this study:

*“... ‘Force Majeure’ shall mean war, insurrection, riot or other civil disorder, flood, earthquake, fire, disease, governmental restriction or failure by any governmental agency to issue any requisite permit or authority, or any injunction or other enforceable order of any court of competent jurisdiction, which has a material and detrimental impact on the Bank or the Bank Property and over which neither the Bank Sponsor nor the Property Owner has control; provided, however that (i) a riot or other civil disorder shall constitute an event of Force Majeure only if the event has broad regional impacts and is not endemic to the Bank Property and its immediate locale; (ii) a flood shall be considered an event of Force Majeure only if it is greater than a presently projected 100-year flood, where ‘flood’ refers to a runoff event; (iii) an earthquake shall constitute an event of Force Majeure only if the ground motion it generates at the Bank Property is greater than that presently projected from an earthquake with a return period of 475 years; (iv) disease shall constitute an event of Force Majeure only if such event has broad regional impact and is not endemic to the Bank Property and its immediate locale; and (v) governmental restriction or the failure by any governmental agency to issue any requisite permit or authority, or any injunction or other enforceable order of any court of competent jurisdiction shall not constitute an event of Force Majeure unless there is no other feasible means of Remedial Action...”*

There are several elements of this definition, such as floods and fires, that are predicted to increase in frequency and severity under climate change conditions. For example, the threshold of a “presently projected 100-year flood” for a bank established in the early 2000s may no longer be appropriate for future, or even now-present day events given the impacts of climate change on the frequency and severity of runoff events (Huang and Swain 2022). Will events of this level still qualify as

force majeure events even if they are “the new normal” in a changed climate? The agencies responsible for approving conservation banks in California should clarify whether previously defined levels of natural disasters still qualify as force majeure events and update banking agreements as necessary. More generally, agencies will need to clarify whether non-natural disaster climate change impacts such as shifts in species ranges, which are beyond the control of individual bank owners and managers, but are not necessarily unforeseen, should be treated as a force majeure event.

### *Develop Additional Support Resources*

The survey employed in this study included questions focused on the support provided to conservation bank by state and federal signatory agencies in relation to climate change. Two-thirds of respondents indicated that they felt they had the support of agencies in addressing potential issues of climate change impacting the achievement of perpetual conservation goals. Four of the one-third of respondents that indicated they did not feel they had agency support provided explanations for their answer. Half of these explanations made it clear that the negative answers were due to the fact that the subject of perpetual management goals being frustrated by climate change had yet to be brought up in conversations or meetings with agency representatives. The remaining two explanations provided more pointed critiques such as “*they [agencies] don’t have the resources to determine how climate change will affect species; [agencies are] more reactionary and not proactive enough,*” (Respondent 3) and “*[i]f agencies want banks to better consider and plan for climate change they need to offer financial incentives for bank sponsors to do so and/or change the regulations to better reflect climate change objectives*” (Respondent 18).

Based on the findings presented in this study, the state and federal agencies responsible for approving and overseeing conservation banks in California should endeavor to better support for conservation banking practitioners in the following ways:

- Expanding weather monitoring efforts to provide more robust regional weather data and forecasts.
- Developing and providing access to habitat models and climate models that can be combined to determine suitability of different areas under predicted climate change scenarios. This would require the commitment of sufficient funding and staff for necessary research and may be best accomplished if conducted in partnership with one of the extension offices associated with many of California’s public universities.
- Allowing for flexibility in the use of conservation bank endowment funds for adaptive management activities.

### *Investigate Feasibility of implementing a “Stepping-stone” Conservation Banking Approach or Developing a “Climate Banking” Program*

Signatory agencies for conservation banks in California should investigate whether proposed alternative banking approaches that seek to address the challenge of providing perpetual conservation for dynamic systems with static preserves, especially those approaches that explicitly incorporate climate change in their design. In line with responses from banking practitioners in previous studies who called for agency requirements to “catch up on climate change,” (Grimm 2020), some survey respondents in this study highlighted the desire for changes to conservation banking regulations that would allow for and incentivize “climate smart restoration.” This would place longevity of the California conservation banking program at the forefront and ensure that commitment to the specific endangered/threatened species values banks are established to protect are maintained. Two examples of dynamic conservation

approaches addressed in this paper are “stepping-stone” conservation banking (Kimbrell 2010) and climate banking (Whipps 2015). However, given the potentially more controversial nature of these approaches due to the continuing needs to acquire new land or access private land, agencies should make concerted efforts to increase opportunities for public participation in conservation bank planning with stakeholder groups outside of bank sponsors and owners.

### *Addressing Transparency and Accountability*

As other researchers have previously recommended, state and federal signatory agencies should work to improve the transparency of conservation banking programs by making efforts to provide greater public access to program and individual bank information. By increasing transparency, accountability within conservation banking programs will also be improved. Questions related to transparency and accountability in conservation banking and other compensatory mitigation programs are featured prominently in the recent ANPR issued by USFWS in July 2022. The Service is now reviewing public comments on general program characteristics as well as specific questions such as “how should the proposed rule incorporate monitoring, financial assurances, and publicly accessible mitigation data tracking systems to ensure a compensatory mitigation mechanism is meeting its performance standards?”

There are several specific ways agencies could improve conservation banking program transparency and accountability. Work towards improving public information access and transparency within the California conservation banking program could be kickstarted by developing a comprehensive database that includes both state and federally approved conservation banks to avoid duplicated tracking efforts as USFWS and CDFW currently appear to each track conservation banks separately. Agencies should also work to develop and employ standardized and more complex metrics to employ in conservation bank evaluation and monitoring. It will be important, however, to balance the rigor of new metrics with the potential for the data and analysis needs on the part of bank practitioners being too intensive and thus creating a barrier to market participation, slowing conservation banking program growth (Grimm 2021). One potential standard metric that is more complex than a simple acreage to credit evaluation used for many California banks and could be used to quantify the ecological value for proposed conservation banking sites in California has already been developed by D. A. Bunn, Moyle, and Johnson 2014).

And finally, agencies could look to improve transparency by considering the implementation of a blockchain enabled framework for tracking conservation credit transaction. Beyond the hype of cryptocurrencies and non-fungible tokens (NFTs), blockchain technology allows for the implementation of immutable registers that allow for safe and transparent data storage or “smart contracts” that rely on conditional functions determined by participating parties allowing for automatic approvals or commands (e.g., allowing the release of conservation credits for sale following submission of data indicating certain endangered species recovery outcomes have been met), thereby reducing potential for human error or delays attributed to bureaucracy (Villares 2021). Blockchain frameworks have already been applied to multiple natural resource management and environmental governance issues around the world, including an electronic permit verification system implemented by the Convention on International Trade in Environmental Species of Wild Fauna and Flora (CITES), the World Wildlife Fund’s “Bait to Plate” initiative targeting illegal fishing in Pacific tuna fisheries, and the IUCN’s smart contract platform, the Green List Standard Token, which is being used to implement the organization’s Green List program (Duberry 2019; “Blockchain Tuna Project” n.d.). If a conservation bank blockchain platform is developed

with explicit connections to platforms for other environmental credit markets (e.g., wetland mitigation credits or carbon credits), it would be a valuable tool to help avoid double-dipping.

## Conclusion

The goal of this study was to answer three questions related to the motivations underpinning conservation bank establishment and whether climate change is considered in bank management:

1. Is the establishment of California conservation banks primarily driven by financial or environmental motivations and interests?
2. Do California conservation banking practitioners view climate change as a threat to conservation banks?
3. Do conservation bank establishment documents and management plans currently address climate change?

I found that although financial motivational themes were reported at nearly twice the rate as environmentally focused motivational themes (Conservation/Natural Resources), examining only a financial vs environmental dichotomy masked much of the variability in motivational factors for bank establishment. Regulatory motivations were a factor I had not considered in the formulation of my research questions but were shown to be a common factor in the decisions to establish conservation banks in California. Moreover, many conservation banks were reported to have been established with primary motivations that fit within multiple motivational theme categories, indicating that viewing conservation bank establishment motivations as multifaceted is more appropriate. In the course of my investigation into motivations behind conservation bank establishment, I observed several themes related to the values embodied in and provided by California conservation banks. The sample of California conservation banks considered in this study provided multiple, “stacked” values – monetary and non-monetary, even without the stacking of credits sold in regulatory offset markets.

Climate change is a considerable threat to the operations and success of individual conservation banks and to the overall conservation banking framework in California. Landowners, bank sponsors, and wildlife agencies must come to terms with this threat and acknowledge that dynamic processes will bring about change at global, regional, and local scales that will impact static preserves, potentially creating a scenario where there is a mismatch between the environmental and economic values represented by conservation bank credits. This mismatch would result in ESA compensation occurring on paper only. Luckily, I have shown in this study that California conservation bank practitioners generally, but not universally recognize climate change as a threat to conservation banks in the present and future. Survey results indicated that interestingly, conservation bank practitioners did not agree as strongly that perpetual conservation goals will be impacted by climate change even though they reported relatively strong agreement that bank resources are at risk from climate change. Bank practitioner acknowledgement of climate change as a threat to conservation banks does not necessarily mean that the threat is considered in bank management practices and plans. I found that even though the term climate change is referenced fairly frequently in conservation bank establishment and management documents, many of these references are only formulaic at best and do not indicate that bank sponsors, managers, or signatory agencies have studied precisely how bank resources may be impacted or how such impacts may be remedied to continue providing effective compensatory mitigation.

I also sought to connect questions related to bank establishment motivations and the likelihood of climate change being considered in bank management practices. This study does provide evidence that banks established with conservation motivations are more likely to address climate change in

establishment and management documents or practices than those banks note established with the conservation theme as a primary motivation. This study was not able to test significance of this relationship due to sample size limitations. However, this knowledge may be useful in shaping future regulatory program updates to better tailor incentives and outreach.

There are several ways in which future research could improve and expand on the study presented above. First and foremost, study methods could be improved by obtaining a larger, more representative sample that would reflect the characteristics of banks from all of the key regional clusters of conservation banks in California and allow for statistical testing. Second, examination of all available California conservation bank establishment and monitoring documents, though likely a lengthy process, would provide a much more comprehensive view of how climate change is address in bank set up and management. Third, conducting interviews with study subjects rather than relying on surveys would likely provide a more detailed and nuanced perspective. And finally, expanding the scope to include agency representatives would result in an interesting opportunity to compare how the two sides of conservation banking view the issue of climate change as it relates to bank management and endangered species compensation practices.



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# Figures

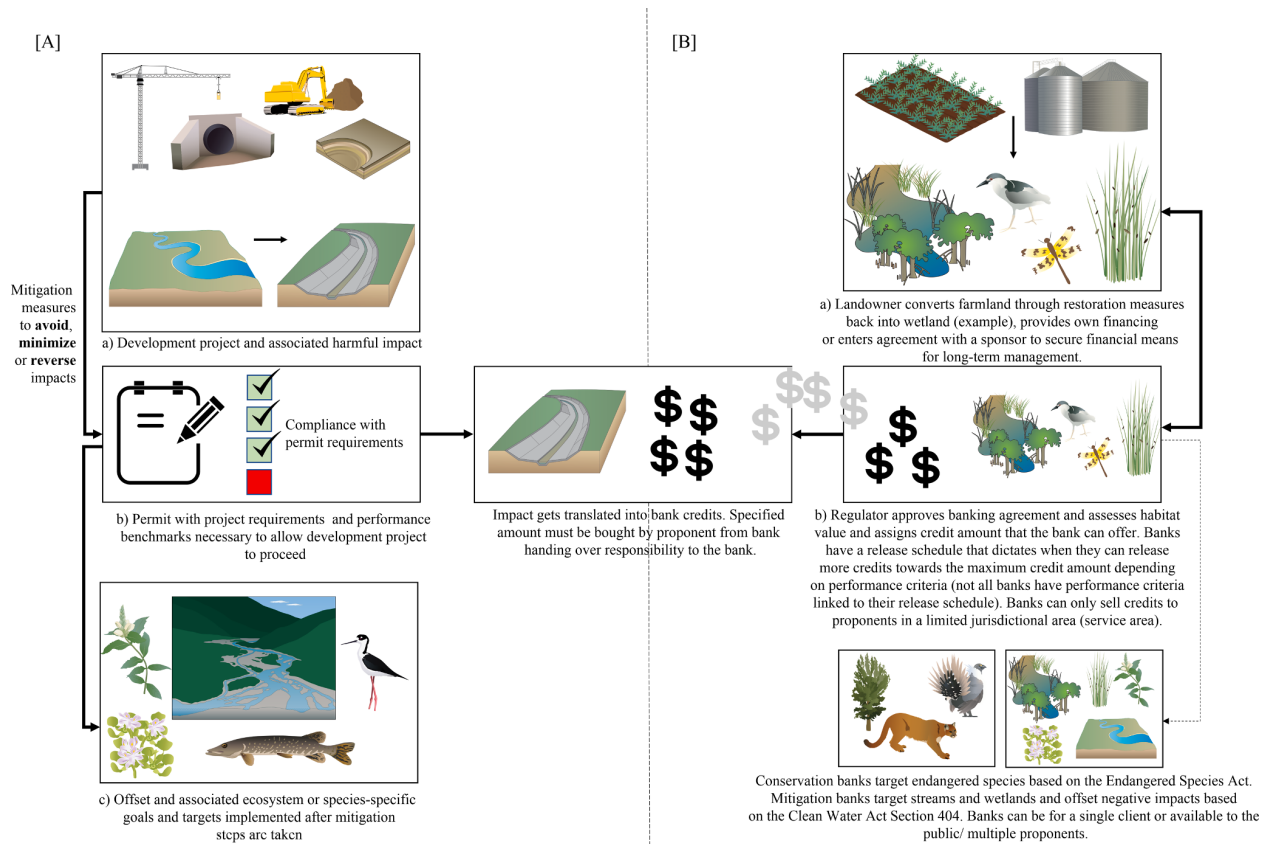


Figure 1: From Theis and Poesch (2022, 2). “Mitigation hierarchy outline, following the required steps (Avoidance, Minimization, Restoration & rehabilitation) before allowing for harmful impact to be compensated for through an equivalent or larger offset (A). (B) Banking principle and role of banking credits in the traditional offsetting scheme through translating losses into credit amounts and key bank components and the two main bank types (Conservation; Mitigation) in the United States (based on FWS, 2003; McKenney & Kiesecker, 2009; RIBITS, 2022; Vaissière & Levrel, 2015). (Digital symbols attribution Jane Thomas, Integration and Application Network; Dieter Tracey, Terrestrial Ecosystem Research Network Australia; Kim Kraeer, Lucy Van Essen-Fishman, Integration and Application Network; Tracey Saxby, Integration and Application Network; Jane Hawkey, Integration and Application Network; Sally Bell; Jason C. Fisher, University of California Los Angeles; Dieter Tracey, Marine Botany UQ; ([ian.umces.edu/media-library](http://ian.umces.edu/media-library))).”



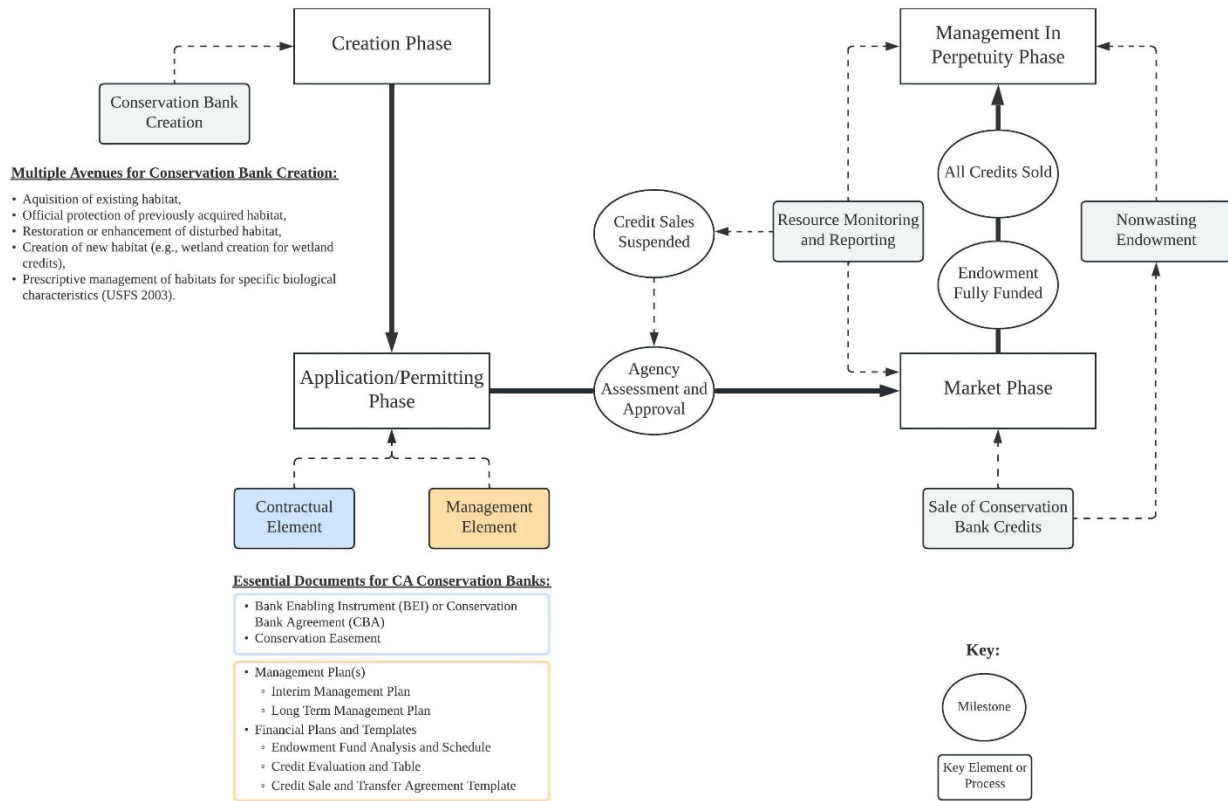
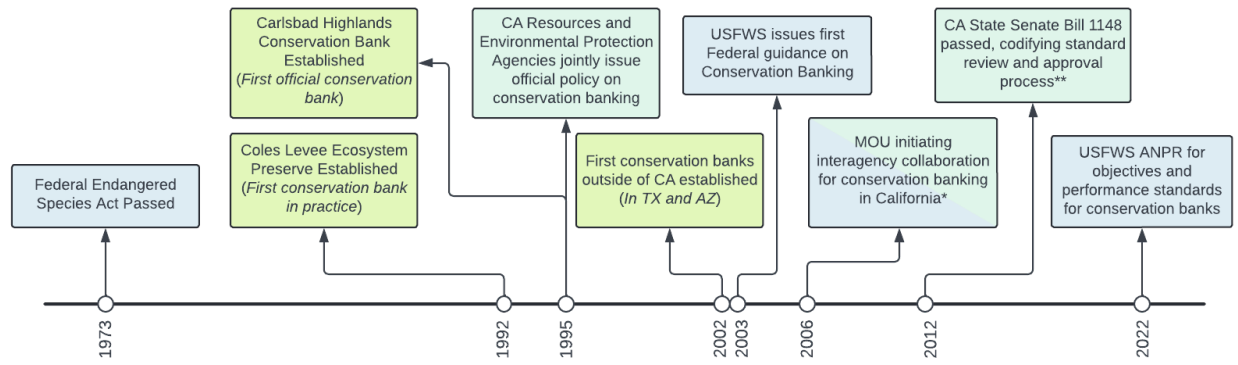


Figure 2: The "Life Cycle" of a Conservation Bank as conceptualized by the author (K. Molton) following extensive literature review. In the Creation Phase, landowners interested in establishing a conservation bank may reach out to consultants to conduct preliminary biological assessments or provide guidance on compiling the extensive collection of documentation required for submissions to state and/or federal agencies in the Application/Permitting Phase. The specific documents required in this second phase will vary from state to state and depend on the specific agencies involved in approving the bank (e.g., USACE would be needed for banks seeking to sell wetland habitat credits, but would not be required for banks seeking only to sell terrestrial habitat credits). The list of essential documents for CA conservation banks included in this diagram was adapted from CDFW 2019. Once banks reach the milestone of Agency Approval, they enter the Market Phase in which conservation bank credits can be purchased by entities seeking compensatory mitigation. There are two milestones to be met in between the Market Phase and Management In Perpetuity Phase: depositing enough funds from the sale of bank credits to fully fund the bank's endowment (the funding level that is considered "full" is determined during the Application/Permitting Phase), and the sale of all available conservation credits associated with a bank. When all bank credits have been sold, the bank enters the Management In Perpetuity Phase in which the Bank Sponsor and/or landowner is responsible for fulfilling the management objectives agreed to within the LTMP outlined in the Application/Permitting Phase. During the Market Phase and Management In Perpetuity Phase, sponsors are often responsible for conducting monitoring on conservation bank land and reporting findings to the appropriate state and/or federal agencies. If at any point during Market Phase the involved agencies find that the bank is not meeting management expectations, the bank may be suspended, meaning the sale of currently released credits and the release of additional credits may be halted.

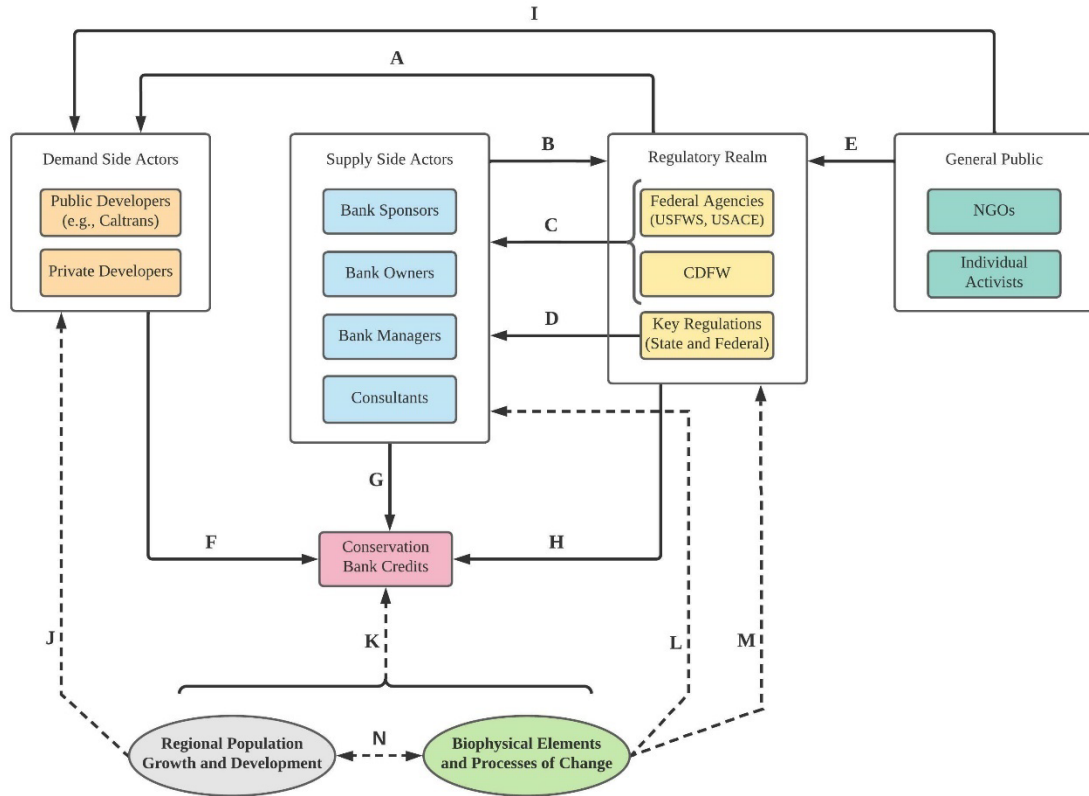


\* Signatory Agencies: CNRA, CDFW, USACE, USFWS, NMFS, US EPA, USDA NRCS, CA State Water Resources Control Board

\*\* Legislation became effective January 2013

Key: blue = federal policy development, green = key bank establishment, teal = state policy development

Figure 3: Timeline of key conservation banking events and policy developments. This diagram was created by the author (K. Molton).



**Pathways Key:**

- A** – Require and enforce mitigation.
- B** – Application fees generate revenue.
- C** – Support application process and perform oversight and monitoring.
- D** – Provide legitimacy for conservation banking arrangements.
- E** – Influence listing of species and/or habitat.
- F** – Purchase credits to offset impacts.
- G** – Sell to parties seeking compensatory mitigation.
- H** – Effective enforcement of mitigation requirements drives demand.
- I** – Exert economic power to hold accountable.

Figure 4: Diagram of Interactions Between Actors and Elements involved in the California Conservation Banking Market. Solid lines represent direct interaction, dotted lines represent indirect influences. The process of change of interested in this case study is specifically global climate change. This diagram was created by the author (K. Molton).

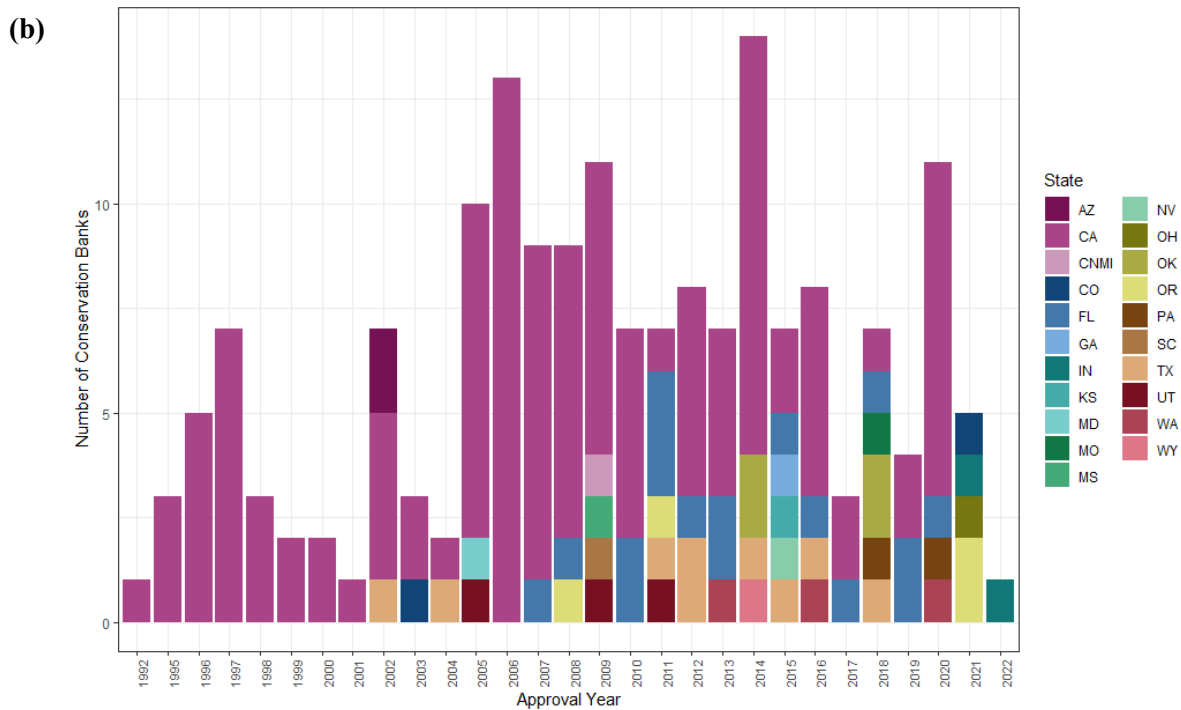
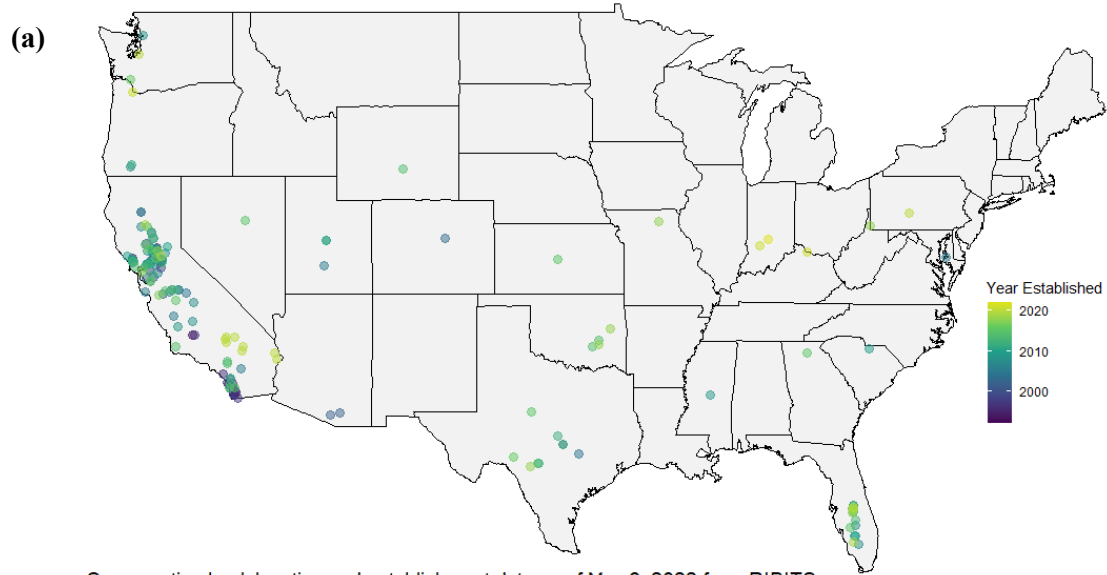


Figure 5: (a) The number of conservation banks approved by federal agencies in each state with a conservation banking program from 1992 to 2022. Data obtained from RIBITS May 6, 2022. (b) Spatial distribution of US conservation banks approved by federal agencies

**RIBITS**  
Regulatory In-lieu Fee and Bank Information Tracking System

LOG IN [Home] [Printer] [Refresh] » Banks & Sites » Bank

« Collapse [Ledger] [Bank Contact Sheet] [Cyber Repository] [Annual Inspections] [Photo Gallery]

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Mitigation  
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USACE District  
 State  
 FWS Field Office  
 NOAA Fisheries Region

California

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**La Purisima Conservation Bank**

Chair: USFWS  
 USACE District: Los Angeles  
 FWS Field Office: Ventura  
 NOAA Fisheries Region: West Coast  
 State: California  
 County: Santa Barbara [CA]  
 Total Acres: 715.70  
 Status/Date: Approved 03/19/2014  
 Establishment Date: 03/19/2014  
 Type: Private Commercial  
 Website: [conserveland.com](http://conserveland.com)  
 On Public Lands: No

**Bank Credit Classifications**

**Species/Habitat**  
 • California Tiger Salamander (Santa Barbara DPS)  
**Group**  
 • Group: California tiger salamander - Western spadefoot load

**Contact Information**

**Bank Sponsor**  
 Rancho Purisima, LLC  
 c/o Conservation Land Group  
 90 Throckmorton Ave., Suite 18  
 Mill Valley, CA 94941  
 Email: [kevin@conserveland.com](mailto:kevin@conserveland.com)  
 Phone: (415) 331-3130

**Bank Sponsor POC**  
 Mr. Kevin Knowles  
 Conservation Land Group  
 90 Throckmorton Ave., Suite 18  
 Mill Valley, CA 94941  
 Email: [kevin@conserveland.com](mailto:kevin@conserveland.com)  
 Phone: (415) 331-3130  
 Fax: (415) 331-5130

**OpenLayers Map**

USACE Districts  
 States  
 FWS Field Offices  
 NOAA Fisheries Regions  
 Counties  
 HUC 8

Show  Service Area  
 Rank  Primary

**Credit Ledger Summary**

Last Transaction: Apr 20, 2022  
 \*\*\*ATTENTION\*\*\*  
 Credit reservations and pending transactions are NOT reflected in the Available Credits total. Potential purchasers MUST contact the Sponsor to verify credit availability.

Figure 6: Example of a bank summary page within RIBITS. Email contact information for conservation banking professionals was obtained from the Bank Sponsor and/or Bank Sponsor POC entries under the “Contact Information” section. Spatial location data were also downloaded for each bank. The link to a “Cyber Repository” for this example bank can be seen just below the webpage header.

## Mind Map of Inductive Coding Nodes

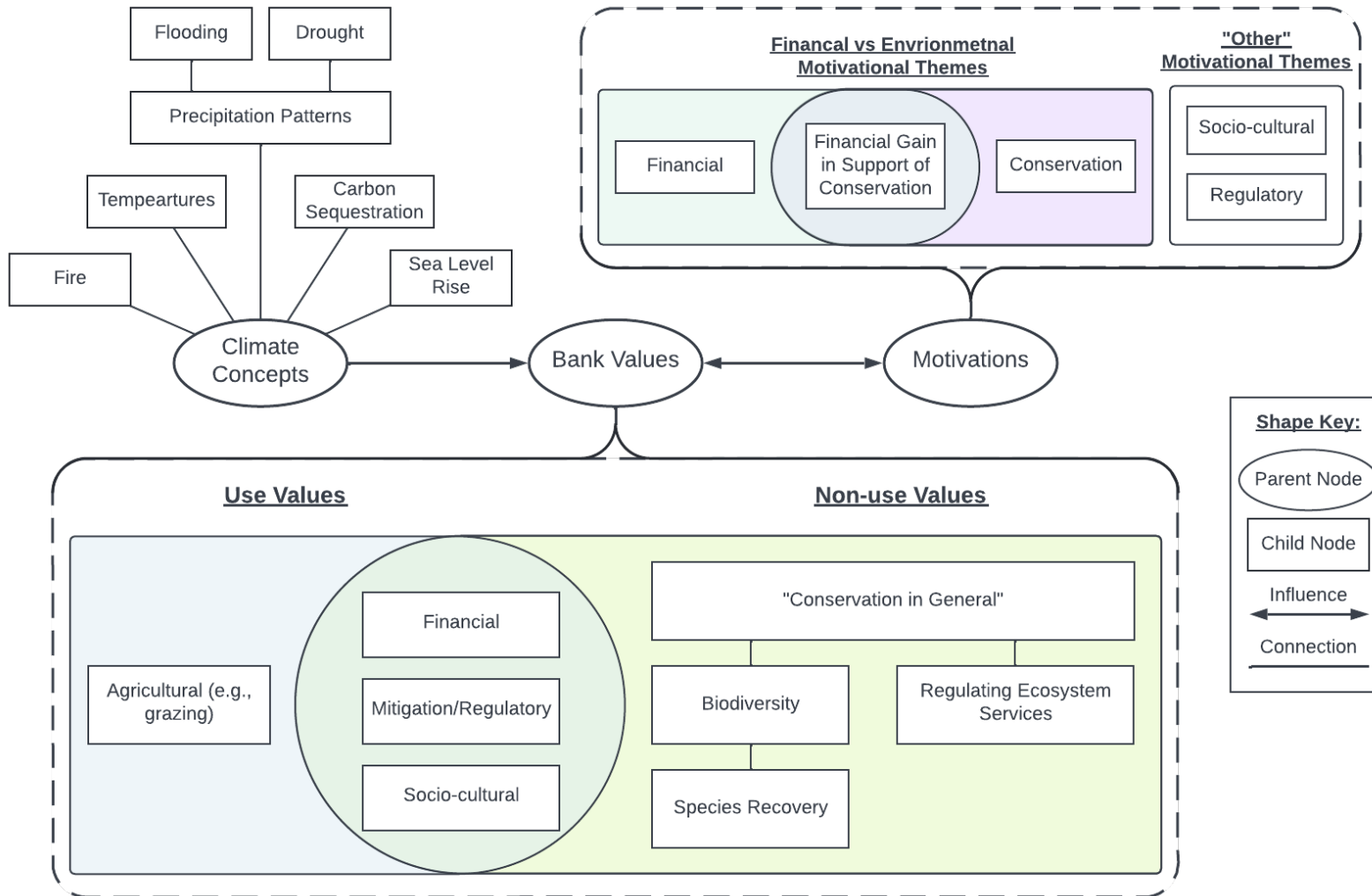


Figure 7: Conceptual map illustrating connections between groups of inductive coding nodes developed during qualitative analysis of conservation bank documents and study survey responses.

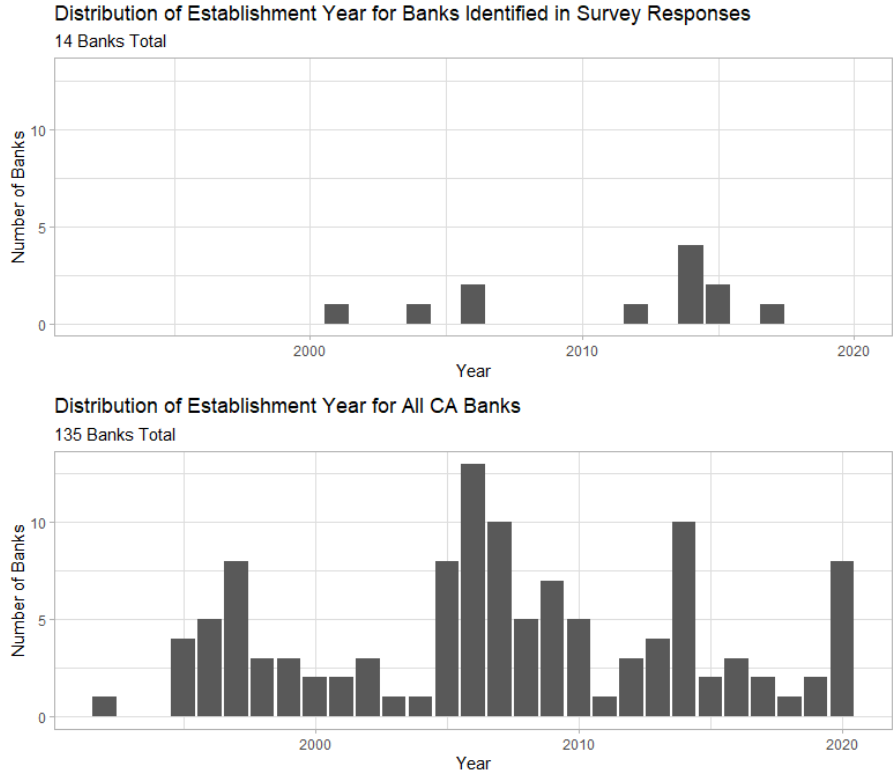


Figure 8: Comparison of establishment year distributions for all California conservation banks and the sample of banks identified by survey respondents that were considered in this study.

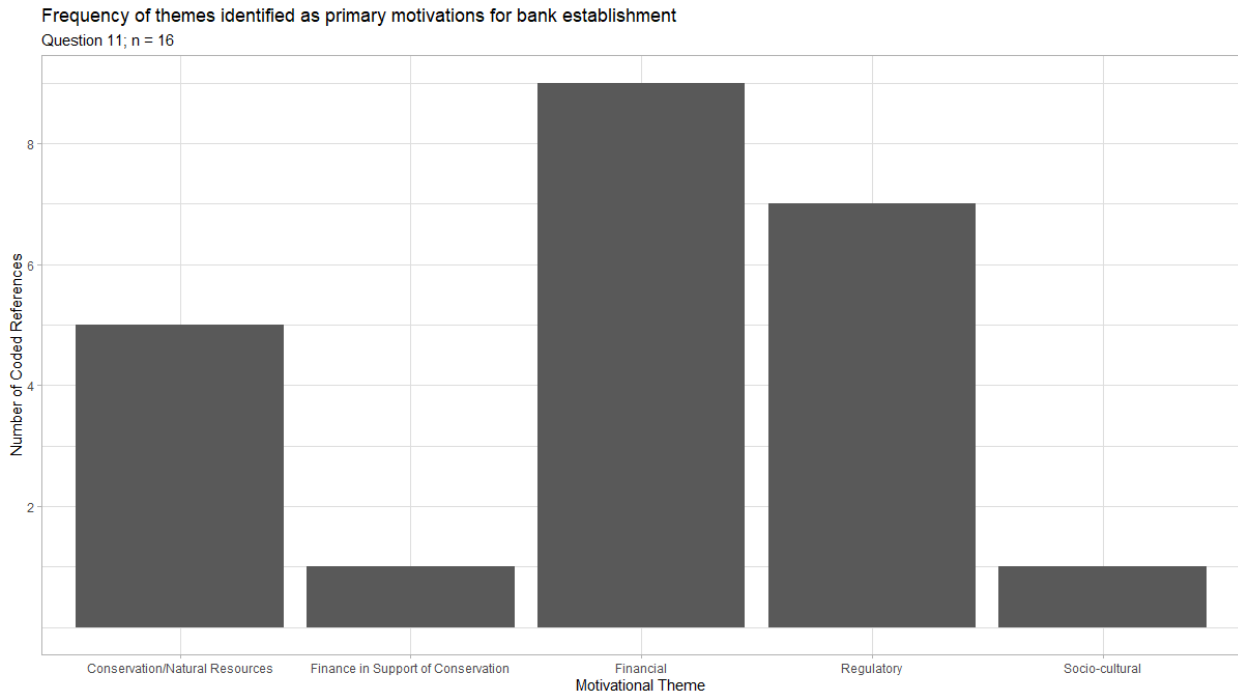


Figure 9: Frequency of motivational themes identified within survey respondents' answers to Question 11 – "Please briefly describe the primary motivations behind the decision to establish the conservation bank with which you are associated."



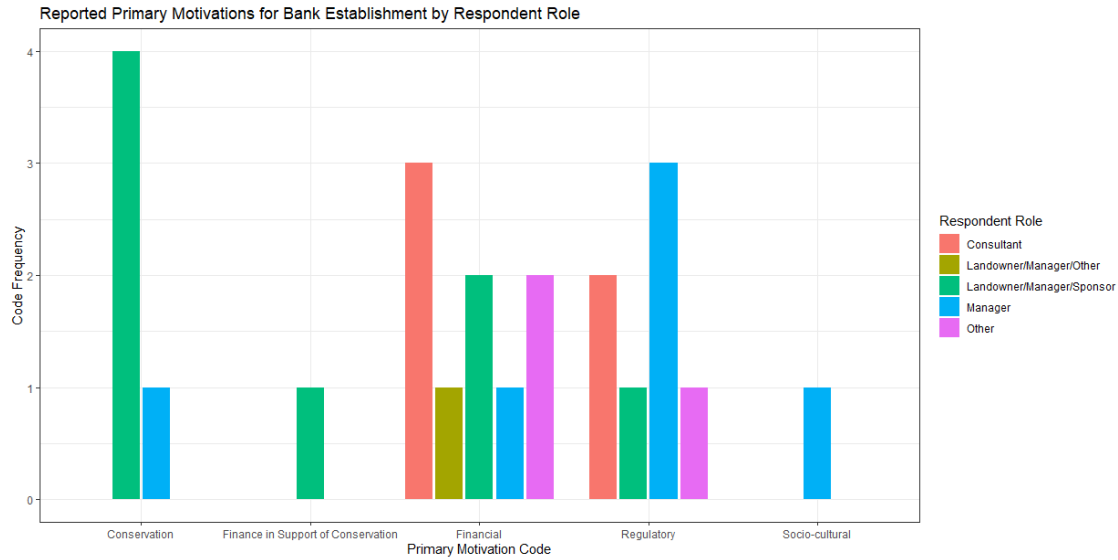


Figure 10: Distribution of motivational themes reported by survey respondents with different conservation banking roles. “Other” includes reported roles such as attorney and project manager. Note that “Consultant” was added as a post hoc role category following initial qualitative analysis.

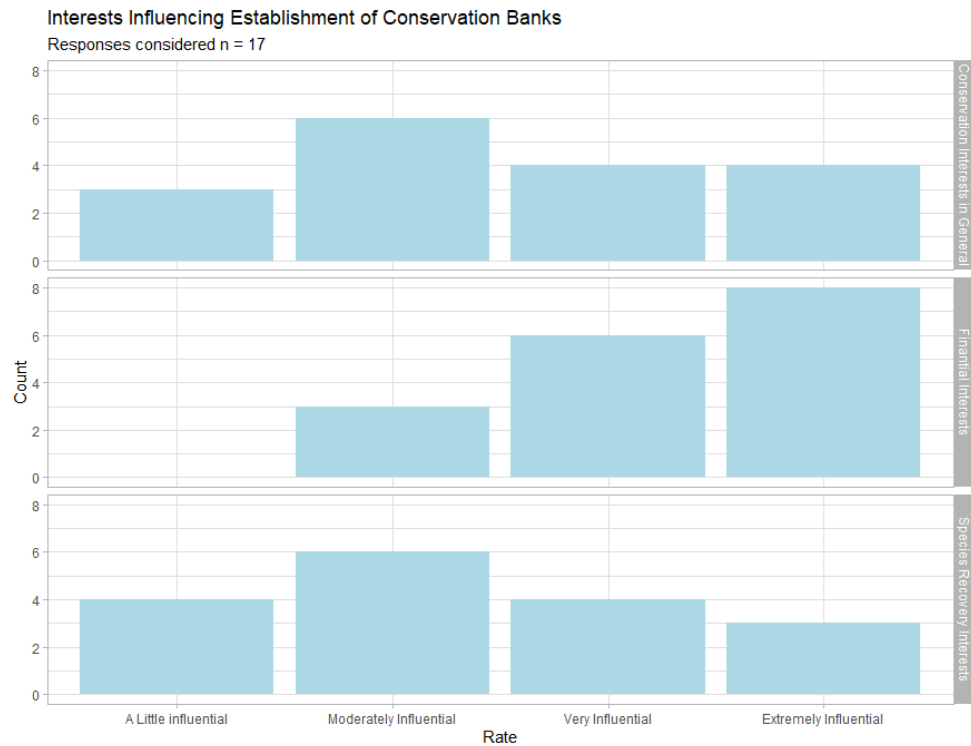


Figure 11: Summary of the reported influence ratings of interests that were believed to likely influence conservation bank establishment.

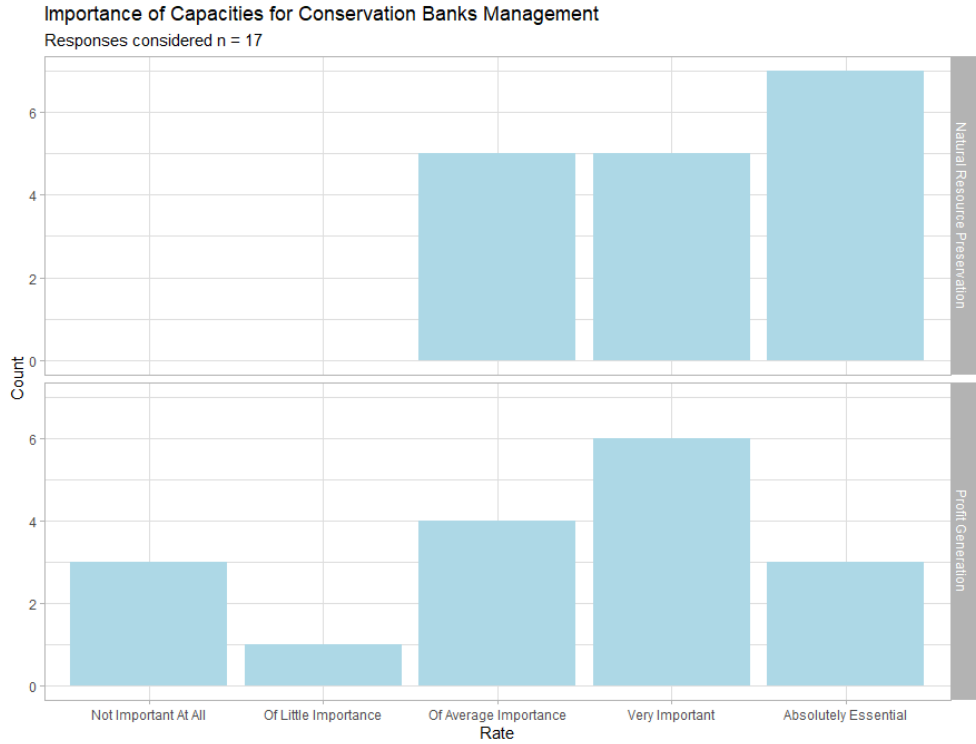


Figure 12: Summary of the reported importance ratings for natural resource preservation and profit generation capacities for the management of California conservation banks.

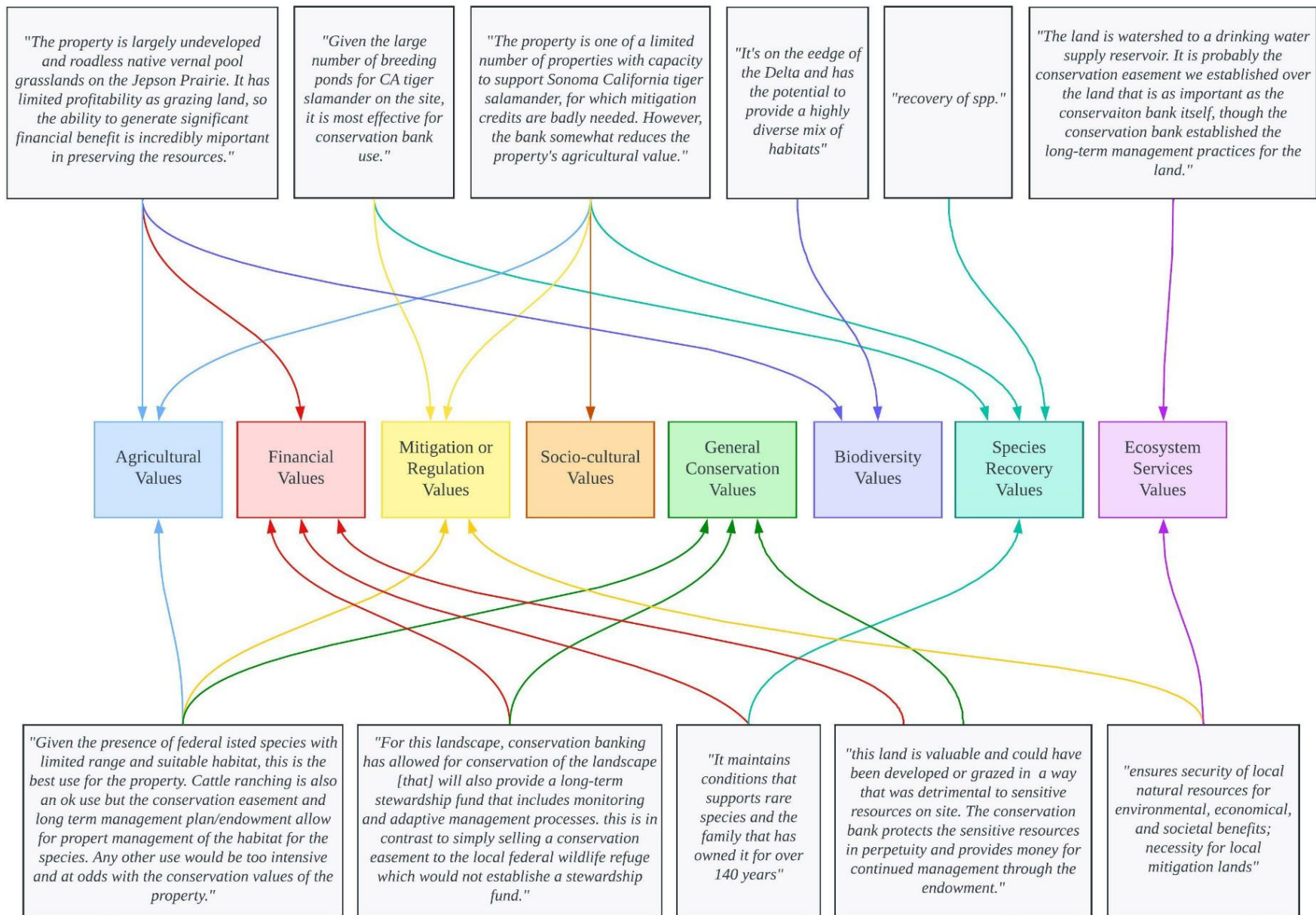


Figure 13: The eight themes for values embodied in and provided by the sample of California conservation banks considered in this study. Direct quotes from responses to Question 14.2 ("Please explain why you do or do not feel that managing this land as a conservation bank is the most effective use of the land") are connected to the themes identified with inductive coding.

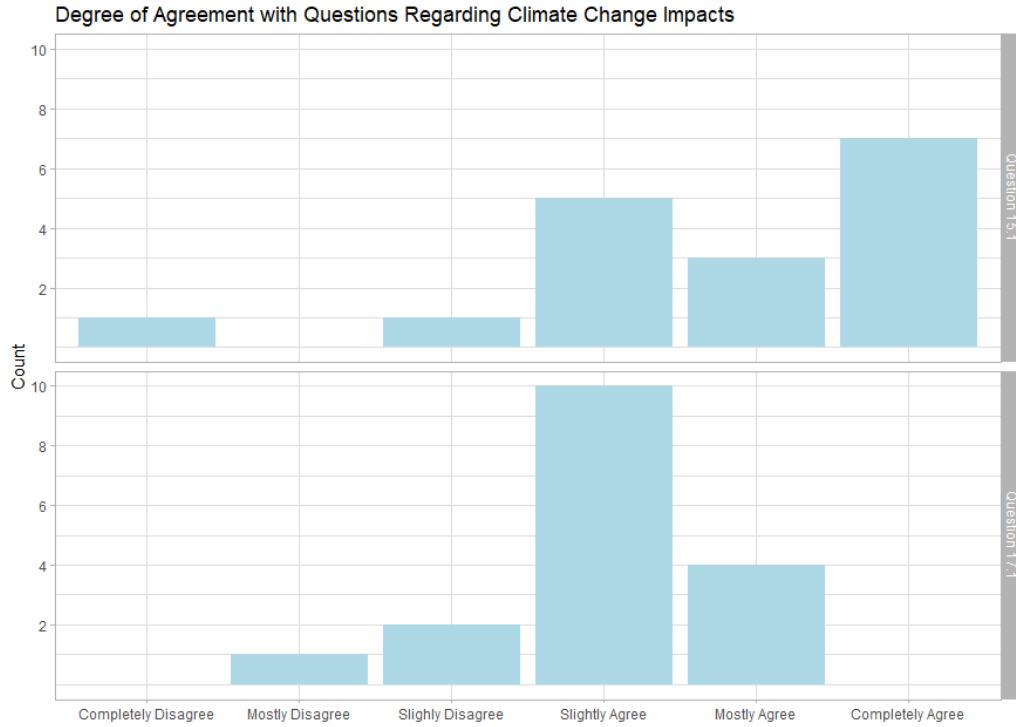


Figure 14: Distribution of responses indicating degree of agreement with Questions 15.1 (“Do you think the resources this conservation bank protects are at risk from climate change?”) and 17.1 (“Do you think that climate change will impact the ability of the conservation bank with which you are associated to meet the mandated goal of conserving resources in perpetuity?”).

### Primary Motivations for Bank Establishment and Climate Change References Within Bank Documentation

Number of survey responses considered = 15. Number of banks considered = 13

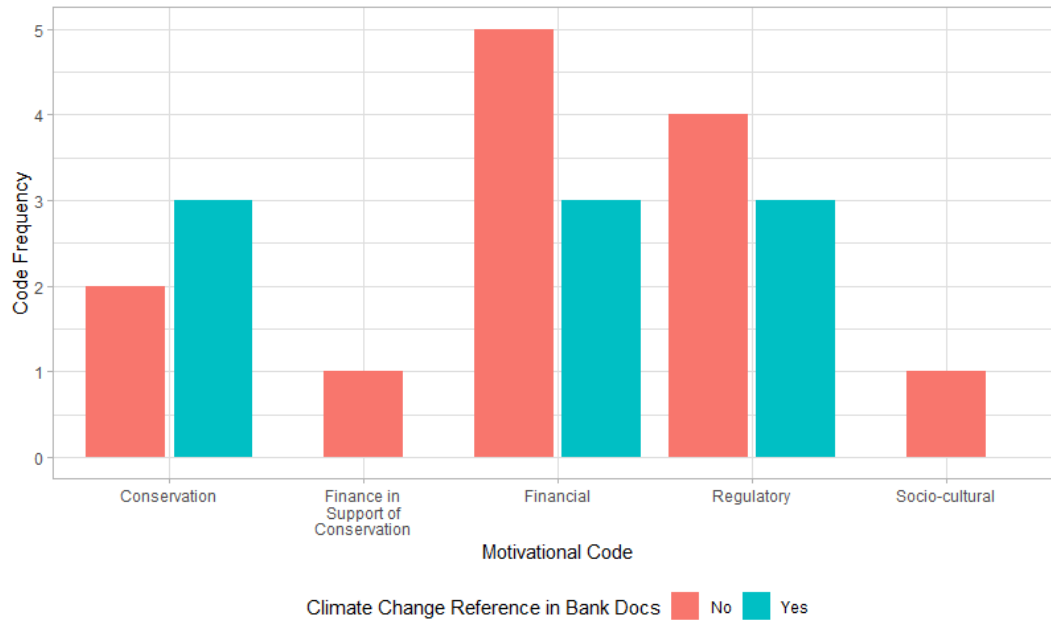


Figure 15: Overview of the frequency of reported primary motivation categories with whether or not climate change is referenced in bank documentation as a comparative factor.

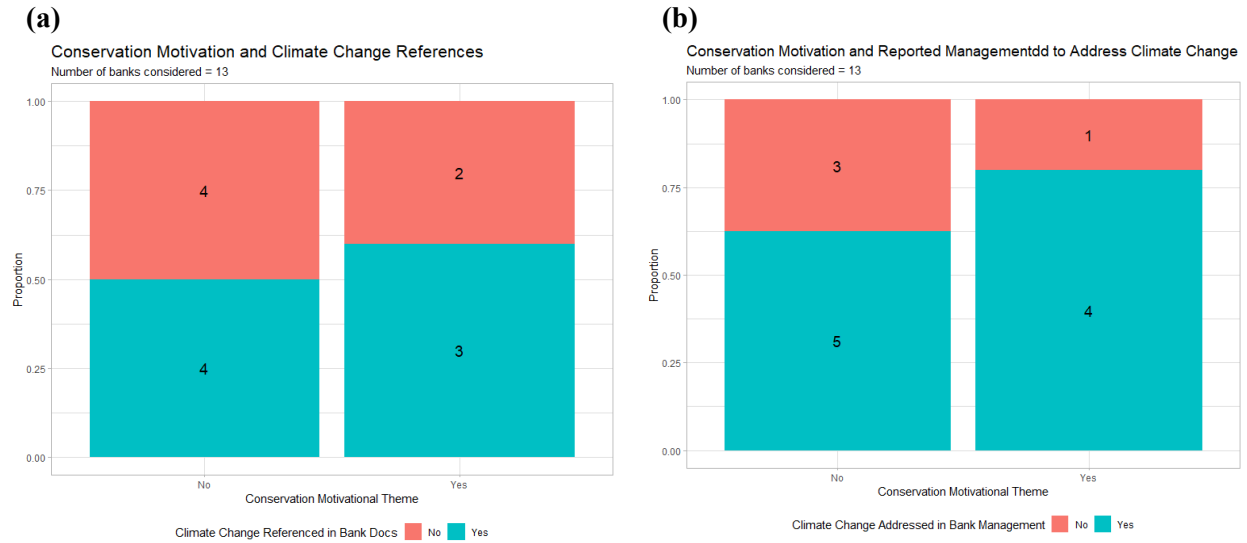
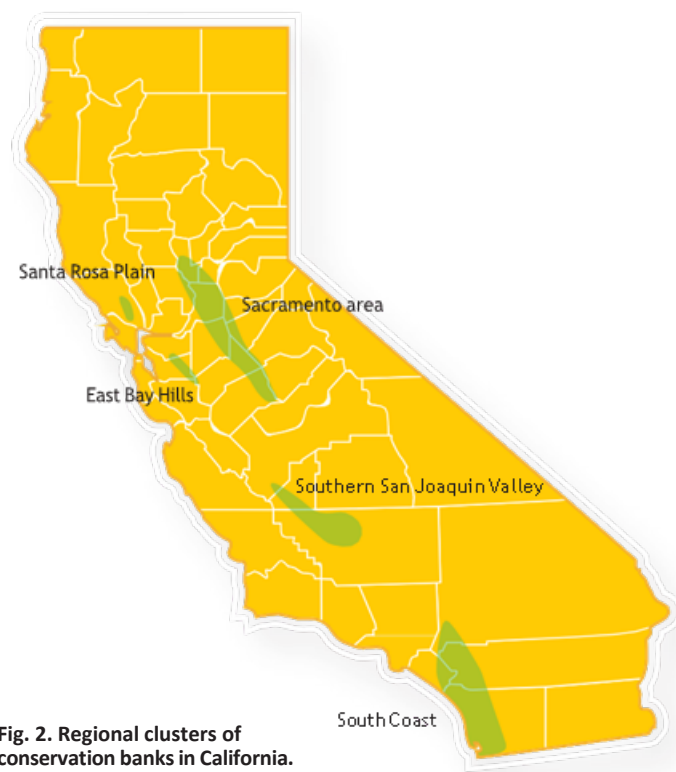
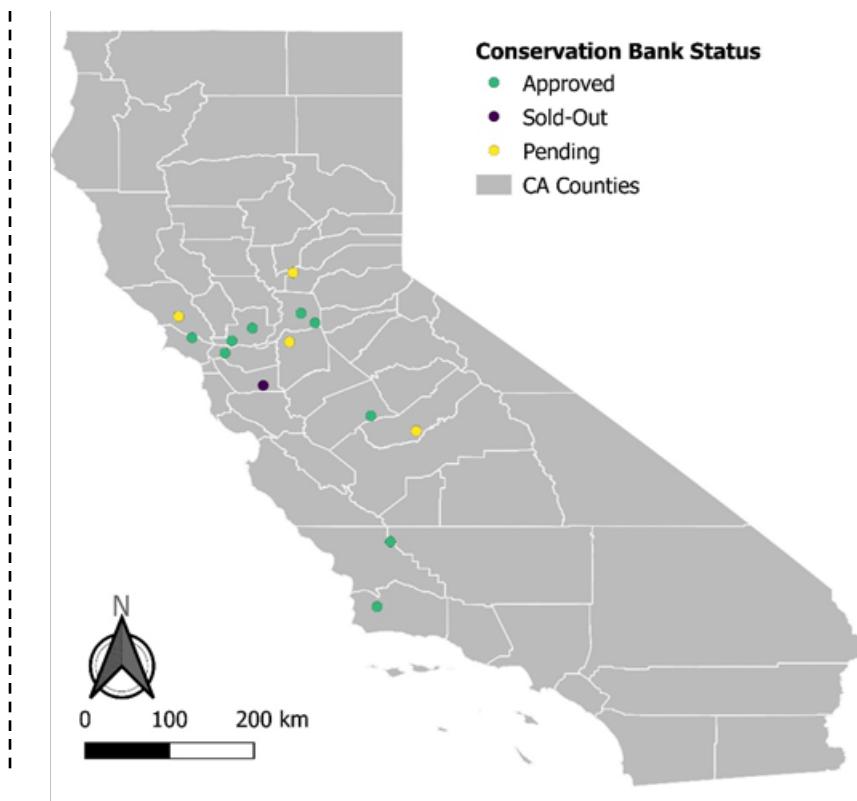


Figure 16: Comparison of proportions of banks that consider climate change among those were reported to have been established with conservation motivations versus those that were not based on two measures, (a) whether climate change is referenced in bank documentation, and (b) whether survey respondents associated with a given bank reported that the bank considers climate change in management practices.



**Fig. 2. Regional clusters of conservation banks in California. (Bunn, Lubell, and Johnson 2013)**



*Figure 17: Comparison of the spatial distribution of conservation banks considered in this study to the locations of primary regional clusters of California conservation banks observed by Bunn, Lubell, and Johnson (2013). Notice that due to the changes in survey methods, no banks from the South Coast region are represented in the sample of banks for this study.*

### Primary Motivations for Bank Establishment and Bank Type

Number of responses considered = 17. Number of banks considered = 16.

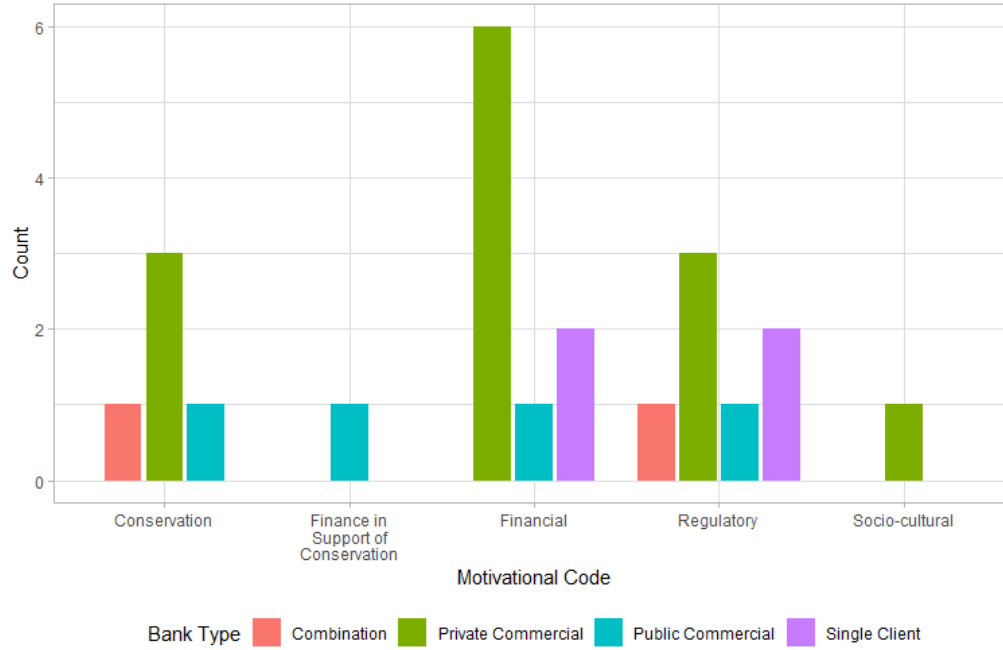


Figure 18: Distribution of reported primary motivations for bank establishment grouped by bank type.

### Comparison of Reported Management for Climate Change and Direct References to Climate Change Within Bank Documentation

Number of responses considered = 14. Number of Banks considered = 13

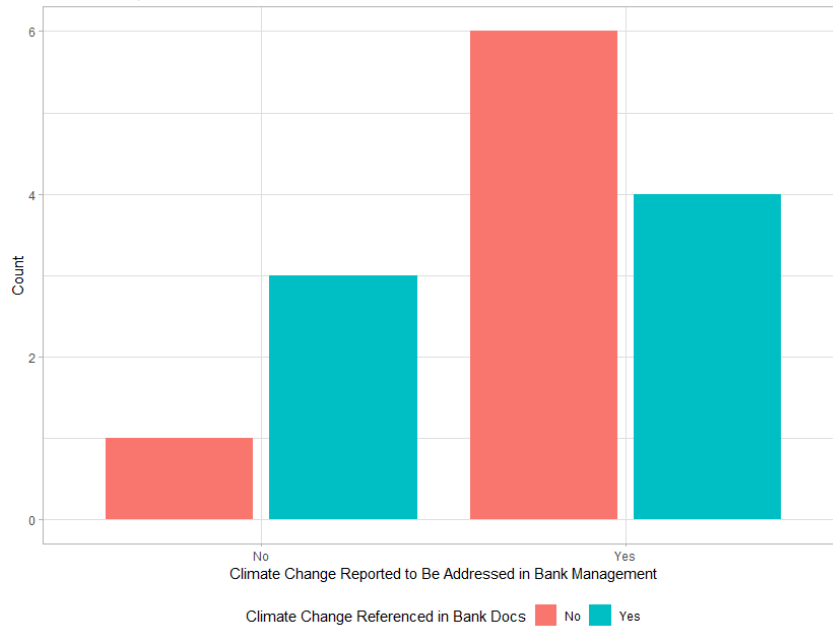


Figure 19: Comparison between the two measures of whether climate change is currently addressed in conservation bank management and establishment for this study. One measure, survey responses to Question 16.1 is indicated by the x-axis values and the other, whether climate change was directly referenced in bank documentation is indicated by the chart fill color.



## Tables

*Table 1: Summary of the ecological and economic factors influencing the conservation banking market in the US identified by Poudel, Zhang, and Simon (2018).*

<b>Ecological Factors</b>	<b>Economic Factors</b>
Habitat and/or species type	Land ownership
Area of land needed to develop a bank	Interest rates
	Land value
	Relative cost of development alternatives

Table 2: Combined overview of questions, response options, and conditional display flows for the two surveys distributed for this study. Also includes a summary of the number of responses received for each question.

Question	Response Options	Conditional Display	# seen (# responses)
1	What is your Role in Conservation Banking	Landowner Manager Bank Sponsor Other	None 19 (19)
2	How many conservation banks within California [or San Diego County] do you own or perform work for?	1, 2, 3, 4, 5, more than 5	None 19 (19)
3	If you own or perform work for more than one conservation bank, please consider and respond in relation to just one for the rest of the questions in this survey: What is the name of this conservation bank	Short text box answer	Not included for San Diego County respondents 17 (16)
4	What type of bank is this conservation bank?	Public Commercial Private commercial Private Nonprofit Combination Public/Private Single Client	None 19 (19)
5	When was this conservation bank established?	Short text box answer	None 19 (19)
6	How many acres are currently managed in this conservation bank	Short text box answer	None 17 (17)
7	Please list the specie(s)/habitat(s) for which your conservation bank provides credits	Short text box answer	None 17 (17)
8	Under what statues does this conservation bank provide compensatory mitigation?	Federal ESA California ESA Other	None 17 (17)
9	How many bank credits have been sold from this conservation bank?	Short text box answer	None 17 (17)
10	To what type of development entities does the conservation bank with which you are associated sell credits?	Private Firms Public Agencies Other	None 17 (17)
11	Please briefly describe the primary motivations behind the decision to establish the conservation bank with which you are associated.	Short text box answer	None 17 (16)
12.1	Please Consider the following interests and rate how influential they were in the decision to establish the conservation bank with which you are associated: 12.1.1 – Financial Interests 12.1.2 – Conservation Interests in General 12.1.3 – Prospect of contributing to the recover of a specific threatened or endangered species	0 – Not influential at all 1 – A little influential 2 – Moderately influential 3 – Very influential 4 – Extremely influential	None 17 (17)
12.2	What other (if any) interests influenced the decision to establish this conservation bank?	Short text box answer	None 17 (5)
13.1	Please consider the following capacities of the conservation bank with which you are associated and rate how important they are to the management of the bank on a scale of 0 (not at all important) to 4 (absolutely essential): 13.1.1 – Profit generation capacity 13.1.2 – Natural resource preservation capacity	0 – Not important at all 1 – Of little importance 2 – Of average importance 3 – Very important 4 – Absolutely essential	None 17 (17)
13.2	What other (if any) capacities is the conservation bank with which you are associated managed to maintain?	Short text box answer	None 17 (9)
14.1	Do you feel that managing this land as a conservation bank is the most effective use of the land?	Completely agree Mostly agree Slightly agree Slightly disagree Mostly disagree Completely disagree	None 17 (17)

Question		Response Options	Conditional Display	# seen (# responses)
14.2	Please explain why you do or do not feel that managing this land as a conservation bank is the most effective use of the land:	Short text box answer	None	17 (11)
15.1	Do you think the resources this conservation bank protects are at risk from climate change?	Completely agree Mostly agree Slightly agree Slightly disagree Mostly disagree Completely disagree	None	17 (17)
15.2	Please explain why you do or do not think resources within this conservation bank are at risk from climate change:	Short text box answer	None	17 (13)
16.1	Does the management plan for this conservation bank include provisions for adaptations in management practices to address potential climate change impacts?	Yes No	None	17 (17)
16.2a	Please briefly explain some of the climate change-related management adaptations your bank has considered. Are any of these adaptations already in place?	Short text box answer	Only shown if "Yes" selected for 16.1	12 (11)
16.2b	Would you consider including voluntary provisions for adaptive management to address potential impacts to this conservation bank that are due to climate change?	Short text box answer	Only shown if "No" selected for 16.1	5 (5)
17.1	Do you think that climate change will impact the ability of the conservation bank with which you are associated to meet the mandated goal of conserving resources in perpetuity?	Completely agree Mostly agree Slightly agree Slightly disagree Mostly disagree Completely disagree	None	17 (17)
17.2	What are some specific climate change-related factors that you believe will make meeting the mandated goal of conserving resources in perpetuity difficult?	Short text box answer	Only shown in an "agree" option selected for 17.1	13 (13)
18	If, in the future, changes to the climate cause the conservation bank with which you are associated to fail at meeting conservation objectives, what options are in place for potential restoration of ecosystem functions or habitat characteristics which underlie the value of the bank credits? Please explain:	Short text box answer	None	16 (16)
19.1	Do you feel that you have the support of state and/or federal agencies in addressing potential issues related to climate change in terms of managing this conservation bank to ensure mandated conservation goals are met in the future?	Yes No	None	16 (15)
19.2	Please explain how state and/or federal agencies do or do not support you in addressing potential issues related to climate change in relation to managing the conservation bank with which you are associated:	Short text box answer	None	16 (12)
20	What forms of additional support from state and/or federal agencies would be helpful for addressing potential climate change-related issues facing this conservation bank?	Short text box answer	None	16 (11)

Table 3: Overview of key characteristics for 14 conservation banks identified by survey respondents. The information presented is a combination of data from survey responses and information available from RIBITS. A \* in the heading of a column indicates that information was obtained from RIBITS.

Group Credits represent areas of the bank where suitable habitat for multiple species overlaps, meaning these credits can be used to compensate for impacts to any of the included species in the group. When credits are used to compensate for one species in that group, the number of available credits is debited for all species in the group.

Abbreviations for species/habitat types as recorded in RIBITS are as follows: Alameda Whipsnake (AWS), Burrowing Owl (BUOW), Callippe Silverspot Butterfly (CSB), Swainson's Hawk (SWHA), CTS (California Tiger Salamander), Conservancy Fairy Shrimp (CFS), San Joaquin Kit Fox (SJKF), Vernal Pool Fairy Shrimp (VPFS), Vernal Pool Tadpole Shrimp (VPTS), Western Spadefoot Toad (WSFT), San Joaquin Orcutt Grass (SJOG), Sacramento Orcutt Grass (ORVI) California Red-legged Frog (CFLR), Open Water (OW), Annual Grassland (AG), Bogg's Lake Hedge Hyssop (GRHE), Dwarf Downingia (DOPU), Legenera limosa (LELI), Lobb's Aquatic Butercup (RALO), Tricolored Blackbird (TRBL)

Bank Name ( <i>abbreviation</i> )	County*	Year Established	Size in acres ( <i>exact*</i> )	Status*	Bank Type	Regulatory Authorities	Bank Credit Classifications*
Bryte Ranch Conservation Bank ( <i>BRCB</i> )	Sacramento	2002	546 (573.00)	Approved	Private Commercial	<ul style="list-style-type: none"> <li>• Federal ESA</li> <li>• CA ESA</li> </ul>	<u>Species/Habitat</u> <ul style="list-style-type: none"> <li>• BUOW</li> <li>• SWHA</li> <li>• VPFS – preservation</li> <li>• VPTS – preservation</li> </ul> <u>Group</u> <ul style="list-style-type: none"> <li>• SWHA and BUOW</li> <li>• VPFS and VPTS w/ Multiplier</li> <li>• VPFS and VPTS w/out Multiplier</li> </ul>
Dutchman Creek Conservation Bank ( <i>DCCB</i> )	Merced	2014	500 / 501.23	Approved	Private Commercial	<ul style="list-style-type: none"> <li>• Federal ESA</li> <li>• CA ESA</li> </ul>	<u>Species/Habitat</u> <ul style="list-style-type: none"> <li>• BUOW</li> <li>• SWHA</li> <li>• CTS – Central DPS – aquatic</li> <li>• CTS – Central DPS – upland</li> <li>• WSFT (state only)</li> <li>• SJKF</li> <li>• VPFS – preservation</li> <li>• VPTS – preservation</li> <li>• CFS – preservation</li> </ul> <u>Group</u> <ul style="list-style-type: none"> <li>• Federal – CTS/ VPFS/VPTS</li> <li>• Federal – CTS/VPFS/VPTS/CFS</li> <li>• CTS/WSFT(State)/VPTS/VPFS</li> <li>• CTS/WSFT(State)/VPFS/VPTS/COFS</li> <li>• CTS-upland/SJKF/SWHA/BUOW</li> </ul>
Fenston Mitigation Bank ( <i>FMB</i> )	Madera	Pending	1,200 / na	Pending	Public Commercial	<ul style="list-style-type: none"> <li>• Federal ESA</li> <li>• CA ESA</li> <li>• CWA Section 404</li> </ul>	Information not yet available

<b>Bank Name (abbreviation)</b>	<b>County*</b>	<b>Year Established</b>	<b>Size in acres (exact*)</b>	<b>Status*</b>	<b>Bank Type</b>	<b>Regulatory Authorities</b>	<b>Bank Credit Classifications*</b>
Kelly Farm Mitigation Bank (KFMB)	Sonoma	Pending	99 / 100	Pending	Single-Client	<ul style="list-style-type: none"> <li>• Federal ESA</li> <li>• CA ESA</li> <li>• CWA</li> </ul>	Information not yet available
La Purisima Conservation Bank (LPCB)	Santa Barbara	2014	853 / 715.7	Approved	Private Commercial	<ul style="list-style-type: none"> <li>• Federal ESA</li> <li>• CA ESA</li> </ul>	<u>Species/Habitat</u> <ul style="list-style-type: none"> <li>• CTS – Santa Barbara DPS</li> </ul> <u>Group</u> <ul style="list-style-type: none"> <li>• CTS and WSFT</li> </ul>
Muzzy Ranch Conservation Bank (MRCB)	Solano	2013	1288 / 1391	Approved	Private Commercial	<ul style="list-style-type: none"> <li>• Federal ESA</li> <li>• CA ESA</li> <li>• CEQA</li> <li>• CA Lake and Streambed Alteration Agreement</li> </ul>	<u>Species/Habitat</u> <ul style="list-style-type: none"> <li>• Stream Preservation</li> <li>• VPFS - preservation</li> </ul> <u>Group</u> <ul style="list-style-type: none"> <li>• COFS/VPTS</li> <li>• COFS/VPTS/CTS</li> <li>• COFS/VPTS/CTS/SJOG</li> <li>• COFS/VPTS/VPFS</li> <li>• CTS/SWHA/BUOW</li> </ul>
North Bay Highlands Conservation Bank (NBHCB)	Marin	2014	450 / 449.80	Approved	Private Commercial	<ul style="list-style-type: none"> <li>• Federal ESA</li> </ul>	<u>Species/Habitat</u> <ul style="list-style-type: none"> <li>• CRLF</li> </ul>
Ohlone Preserve Conservation Bank (OPCB)	Alameda	2005	640 / 640	Sold Out	Private Commercial	<ul style="list-style-type: none"> <li>• Federal ESA</li> <li>• CA ESA</li> </ul>	<u>Species/Habitat</u> <ul style="list-style-type: none"> <li>• AWS</li> <li>• CTS – Central DPS – aquatic</li> <li>• CTS – Central DPS – upland</li> <li>• CRLF</li> </ul> <u>Group</u> <ul style="list-style-type: none"> <li>• CRLF and AWS</li> <li>• CRLF and CTS – aquatic</li> <li>• CRLF and CTS – upland</li> <li>• CRLF/AWS/CTS – upland</li> </ul>
Oursan Ridge Conservation Bank (ORCB)	Contra Costa	2017	400 / 429	Approved	Public Commercial	<ul style="list-style-type: none"> <li>• Federal ESA</li> <li>• CA ESA</li> </ul>	<u>Species/Habitat</u> <ul style="list-style-type: none"> <li>• CRLF</li> </ul> <u>Group</u> <ul style="list-style-type: none"> <li>• CRLF and AWS</li> </ul>
Palo Prieto Conservation Bank (PPCB)	San Luis Obispo	2009	“around 5,000” / 5,086	Approved	Private Commercial	<ul style="list-style-type: none"> <li>• Federal ESA</li> <li>• CA ESA</li> <li>• CEQA</li> </ul>	<u>Species/Habitat</u> <ul style="list-style-type: none"> <li>• SJKF</li> </ul>

<b>Bank Name (abbreviation)</b>	<b>County*</b>	<b>Year Established</b>	<b>Size in acres (exact*)</b>	<b>Status*</b>	<b>Bank Type</b>	<b>Regulatory Authorities</b>	<b>Bank Credit Classifications*</b>
Ridge Top Ranch Wildlife Conservation Bank (RTRWCB)	Solano	2014	750 / 745	Approved	Private Commercial	<ul style="list-style-type: none"> <li>• Federal ESA</li> <li>• CEQA</li> </ul>	<u>Species/Habitat</u> <ul style="list-style-type: none"> <li>• CRLF</li> </ul> <u>Group</u> <ul style="list-style-type: none"> <li>• CRLF/CSB</li> </ul>
Shin Kee Mitigation Bank (SKMB)	San Joaquin	Pending	144 / 82.78	Pending	Private Commercial	<ul style="list-style-type: none"> <li>• Federal ESA</li> <li>• CWA Section 404</li> <li>• CWA Section 10</li> </ul>	Information not yet available
SMUD Nature Preserve Mitigation Bank (SMUDMB)	Sacramento	2014	1,132 / 1,132	Approved	Single- Client	<ul style="list-style-type: none"> <li>• Federal ESA</li> <li>• CA ESA</li> <li>• Also CWA Section 404 (but not reported in survey)</li> </ul>	<u>Species/Habitat</u> <ul style="list-style-type: none"> <li>• AG</li> <li>• GRHE</li> <li>• CTS – Central DPS – aquatic</li> <li>• CTS – Central DPS – upland</li> <li>• DOPU</li> <li>• LELI</li> <li>• RALO</li> <li>• ORVI</li> <li>• TRBL</li> <li>• VPFS – establishment</li> <li>• VPFS – preservation</li> <li>• VPTS – establishment</li> <li>• VPTS – preservation</li> </ul> <p>Also available are many group credit designations comprised of various combinations of the above listed species/habitat credits.</p>
Wild Flower Mitigation Bank (WFMB)	Placer	Pending	Not answered / 267	Pending	Not answered	Not answered	Information not yet available

Table 4: Comparison of the counts/percentages of banks with each RIBITS status for sampled conservation banks and the total population of conservation banks in California.

<b>RIBITS Status</b>	<b>Survey Banks</b>	<b>All CA Banks</b>
Approved	9 (64.3%)	94 (67.6%)
Pending	4 (28.6%)	18 (12.9%)
Sold-Out	1 (7.1%)	23 (16.5%)
Suspended	0	2 (1.4%)
Withdrawn	0	2 (1.4%)

Table 5: Summary of California conservation bank documentation reviewed for this study. Documents were designated as either bank establishment documents, such as conservation bank agreements, long term management plans, or conservation easements, or monitoring documents, including annual reports and conservation easement monitoring reports.

<b>Bank</b>	<b>Number of Documents Reviewed</b>		
	<b>Bank Establishment</b>	<b>Monitoring</b>	<b>Total</b>
BRCB	5	7	12
DCCB	13	17	30
FMB	1		1
KFMB	1		1
LPCB	5	10	15
MRCB	7		7
NBHCB	5	6	11
OPCB	12		12
ORCB	6	3	9
PPCB	8	4	12
RTRWCB	13	6	19
SKMB	1		1
SMUDMB	20	8	28
WFMB	1		28
<i>Total:</i>	98	61	159



Table 6: Overview of responses to survey question 11 organized by motivational theme. Quotes are attributed to the associated respondent with unique identifiers.

<b>Financial</b>	<b>Regulatory</b>	<b>Conservation/Natural Resources</b>	<b>Socio-cultural</b>	<b>Finance in Support of Conservation</b>
“Financial” (1, 9)	“Development demand” (2)	“great habitat resources” (3)	“Protect rangeland in perpetuity for preservation of family ranching operation” (10)	“A conservation bank is expected to generate revenue that we will use to purchase watershed land this is currently privately held...” (8)
“Established for long term investment purposes” (4)	“...resource concentration would have made building projects on the property difficult” (3)	“...As the manager the interests were for the conservation and recovery” (14)		
“I am not responsible for this decision, the following are guesses at others’ motivations: saving city funds.” (11)	“The property was required for a small amount of mitigation and the landowner decided to devote the remainder to a bank” (5)	“... Managing land to preserve endangered species habitat was already part of our mission and values” (8)		
“...financial interests for landowner and bank sponsor” (12)	“urgent need for conservation banking locations in service region, high rate of regional development...” (12)	“Conservation of a relicual Central Valley habitat block” (16)		
“cheaper for City to manage own [bank] than buy credits.” (13)	“...In addition, credits are becoming scarce” (13)	“Preserve habitat...” (19)		
“For the owners the primary motive was financial.” (14)	“highest and best land use given property value and presence of endangered species/Critical Habitat” (17)			
“My client chose to establish the bank for profit.” (18)				
“...monetize existing property without selling” (19)				

Table 7: Summary of the definitions of conservation value included in the conservation easements for each currently approved bank in the study sample of California conservation banks. \*Palo Prieto Conservation Bank (PPCB) was established in phases and crosses county lines, so has five conservation easements associated with it. Each conservation easement deed includes the same description of conservation values.

Conservation Bank	Conservation Values as Described in Conservation Easements
BRCB	“The Property possesses wildlife and habitat values (collectively, “conservation values”) of great importance to the Grantee, the people of the State of California ... The Property possesses significant ecological and habitat values that benefit endangered, threatened, and other rare species. These species and their habitats are of aesthetic, ecological, educational, historical, recreational, and scientific value to the people of California and the people of the United States. These values include vernal pools and other seasonal wetlands that provide habitat for the endangered vernal pool tadpole shrimp ( <i>Lepidurus packardii</i> ) and the threatened vernal pool fairy shrimp ( <i>Branchinecta lynchi</i> )...”
DCCB	“The Bank Property will provide high quality natural habitat for Conservancy fairy shrimp ( <i>Branchinecta conservatio</i> ), vernal pool fairy shrimp ( <i>Branchinecta lynchi</i> ), vernal pool tadpole shrimp ( <i>Lepidurus packardii</i> ), California tiger salamander ( <i>Ambystoma californiense</i> ), San Joaquin kit fox ( <i>Vulpes macrotis mutica</i> ), Swainson’s hawk ( <i>Butea swainsoni</i> ) and Western Spadefoot ( <i>Spea hammondi</i> ) and contains native breeding, non-breeding, foraging, and dispersal habitats for these species and preserved jurisdictional waters of the United States. Individually and collectively, these wildlife and habitat values comprise the ‘Conservation Values’ of the Bank Property.”
LPCB	“The Bank Property will provide high quality natural, restored and/or enhanced habitat for California tiger salamander (CTS) ( <i>Ambystoma californiense</i> ), western spadefoot (WSF) ( <i>Spea hammondi</i> ), California red-legged frog (CRF) ( <i>Rana draytonii</i> ), and other special-status species and contain various habitats supporting these species including man-made stock ponds and a mosaic of grassland, coastal scrub, oak woodland and riparian woodland habitats. Individually and collectively, these wildlife and habitat values comprise the “Conservation Values” of the Bank Property.”
MRCB	“The Bank Property will provide high quality natural, restored and/or enhanced habitat for vernal pool tadpole shrimp ( <i>Lepidurus packardii</i> ), vernal pool fairy shrimp ( <i>Branchinecta lynchi</i> ), conservancy fairy shrimp ( <i>Branchinecta conservatio</i> ), delta green ground beetle ( <i>Elaphrus viridis</i> ), California tiger salamander ( <i>Ambystoma californiense</i> ), Ricksecker's water scavenger beetle ( <i>Hydrochara rickseckeri</i> ), burrowing owl ( <i>Athene cunicularia</i> ), northern harrier ( <i>Circus cyaneus</i> ), white-tailed kite ( <i>Elanus leucurus</i> ), ferruginous hawk ( <i>Buteo regalis</i> ), San Joaquin Valley orcutt grass ( <i>Orcuttia inaequalis</i> ), Baker's navarretia ( <i>Navarretia leucocephala ssp. bakeri</i> ), dwarf downingia ( <i>Downingia pusilla</i> ), alkali milk.vetch ( <i>Astragalus tener var. tener</i> ), and Swainson's hawk ( <i>Buteo swainsonii</i> ) and contain 327.3 acres of vernal pools, several large playa pools totaling 38.1 acres, 4.3 acres of stream, and 839.5 acres of associated uplands. Individually and collectively, these wildlife and habitat values comprise the "Conservation Values" of the Bank Property.”
NBHCB	“The Bank Property possesses wildlife and habitat values of great importance to Grantee, the people of the State of California and the people of the United States. The Bank Property will provide high quality natural habitat for California Red-legged Frog. Individually and collectively, these wildlife and habitat values comprise the "Conservation Values" of the Bank Property”

Conservation Bank	Conservation Values as Described in Conservation Easements
OPCB	“The Property possesses wildlife and habitat values (collectively, “conservation values”) of great importance to the Grantee and the people of the State of California ... The Property provides significant ecological and habitat values that benefit endangered, threatened, and other rare species. These species and their habitats are of aesthetic, ecological, educational, historical, recreational, and scientific value to Grantee, the people of California, and the people of the United States. These Conservation Values include habitats for the threatened California red-legged frog ( <i>Rana aurora draytoniz</i> ) and the threatened Alameda whipsnake ( <i>Masticophis lateralis ez,ryxanthus</i> )”
ORCB	“The Bank Property possesses wildlife and habitat values of great importance to Grantee, the people of the State of California and the people of the United States. The Bank Property will provide high quality natural, restored and/or enhanced habitat for the California red-legged frog and Alameda whipsnake and contain breeding, non-breeding and dispersal habitats. Individually and collectively, these wildlife and habitat values comprise the "Conservation Values" of the Bank Property.”
PPCB*	“The Property possess wildlife and habitat values, including but not limited to habitat values for the San Joaquin kit fox ( <i>Vulpes macrotis mutica</i> ), of great importance to Grantee and the people of the State of California (collectively, “Conservation Values”), which Grantor and Grantee desire to conserve and protect.”
RTRWCB	“The Bank Property will provide high quality natural, restored and/or enhanced habitat for the California red-legged frog ( <i>Rana draytonii</i> ) and the callippe silverspot butterfly ( <i>Speyeria callippe callippe</i> ) and contains breeding ponds, non-breeding aquatic habitat, and upland dispersal habitat for the California red-legged frog, and the host plant johnny jump-up, native nectar plants including California buckeye, and grasslands, hilltops, and ridges essential for the callippe silverspot butterfly. Individually and collectively, these wildlife and habitat values comprise the "Conservation Values" of the Bank Property.”
SMUDCB	“The Bank Property will provide high quality natural, restored, established, enhanced, and/or preserved habitat for vernal pool fairy shrimp ( <i>Branchinecta lynchi</i> ), vernal pool tadpole shrimp ( <i>Lepidurus packardi</i> ), California tiger salamander ( <i>Ambystoma californiense</i> ), in addition to tricolored blackbird ( <i>Agelaius tricolor</i> ) and five plan species Boggs Lake hedge-hyssop ( <i>Gratiola heterosepala</i> ), legener ( <i>Legenera limosa</i> ), Sacramento Orcutt grass ( <i>Orcutt viscida</i> ), Lobb’s aquatic buttercup ( <i>Ranunculus lobbii</i> ), and dwarf downingia ( <i>Downingia pusilla</i> ). The Bank Property also contains vernal pool, vernal swale, seasonal wetland, seasonal swale, Juncus wetland, intermittent drainage, open water, annual grassland, and restored, established, enhanced and/or preserved jurisdictional waters of the United States. Individually and collectively, these wildlife and habitat values comprise the “Conservation Values” of the Bank Property.”

Table 8

Frequency of Direct References to Climate Change in CA Conservation Bank Documents			
<b>Bank</b>	<b>Bank Establishment</b>	<b>Monitoring</b>	<b>Total</b>
DCCB	1 (1 document)	2 (1 document)	3
LPCB	6 (2 documents)		6
MRCB	2 (2 documents)		2
NBHCB	1 (1 document)		1
RTRWCB	2 (1 document)		2
SMUDMB	1 (1 document)	3 (3 documents)	4
WFMB	1 (1 document)		1
<i>Total</i>	<i>14</i>	<i>5</i>	<i>19</i>

Table 9: Summary of language included in all references to the term climate change within reviewed bank documentation organized by type of reference: formulaic or descriptive.

Formulaic References	Descriptive References
<p>“Adaptive management includes those activities necessary to address the effects of climate change, fire, flood, or other natural events, force majeure, etc”</p> <p>(DCCB Long-term Management Plan; LPCB Exhibit D Management &amp; Operations Documents; NBHCB Exhibit D-4 Interim and Long-term Management Plan)</p>	<p>“The surveys conducted for this monitoring year have demonstrated that the pools are capable of supporting CTS larval development, even with low precipitation and unusual rainfall patterns which could become more common with the threat of climate change” (DCCB 2015 Monitoring Report)</p>
<p>“Adaptive management includes those activities necessary to address the effects of climate change, fire, flood, or other natural events, force majeure, changes in knowledge, etc.” (Muzzy Ranch Exhibit D-4 Interim Management Plan &amp; Exhibit D-5 Long-term Management Plan)</p>	<p>“...these surveys have demonstrated that the pools are capable of supporting CTS larval development, even during a year with low precipitation and unusual rainfall patterns, which could become more common in the region as the effects of climate change become more apparent.” (DCCB 2015 Monitoring Report)</p>
<p>“Adaptive management includes those activities necessary to address the effects of climate change, fire, flood, or other natural unforeseen events or conditions that may arise.” (SMUD 2019, 2020, and 2021 Monitoring Reports &amp; Exhibit D-5 Long-term Management Plan)</p>	<p>“The maintenance of the ponds as suitable habitat for these species will require an adaptive approach. Hydrologic monitoring data from the ponds will be critical in the face of climate change and should drive pond maintenance and management activities.” (LPCB Exhibit D Management &amp; Operations Documents)</p>
<p>“Adaptive management will be evaluated and performed to the extent that sufficient endowment funds are available and will include activities to address the effects of climate change.” (RTR Exhibit D-4 Long-term Management Plan)</p>	<p>“As discussed below, in the section on climate change impacts, temperatures are expected to increase by 2 to 5°F by 2050 and by 4 to 9°F by 2100...” (LPCB Exhibit H – Biological Resources Survey)</p>
	<p>“The California Natural Resources Agency (2009) has identified several changes in the climate that are currently occurring in California. These are increased average temperature, more extreme hot days and fewer colder nights, seasonal shifts and lengthening of growing seasons, and shifts in precipitation patterns. The consequences of these changes include, among others, more frequent and intense wildfires.” (LPCB Exhibit H – Biological Resources Survey)</p>