ACTION ITEMS

ANNUAL AUDIT-2021-2022

TEMECULA ELSINORE ANZA MURRIETA RESOURCE CONSERVATION DISTRICT FINANCIAL STATEMENTS AND INDEPENDENT AUDITORS' REPORT For the Fiscal Year Ended June 30, 2022



For the Fiscal Year Ended June 30, 2022 Table of Contents

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INDEPENDENT AUDITORS' REPORT

Board of Directors Temecula Elsinore Anza Murrieta Resource Conservation District Temecula, California

Opinion

We have audited the accompanying financial statements of the governmental activities and the General fund of Temecula Elsinore Anza Murrieta Resource Conservation District, as of and for the fiscal year ended June 30, 2022, and the related notes to the financial statements, which collectively comprise the District's basic financial statements as listed in the table of contents.

In our opinion, the financial statements referred to above present fairly, in all material respects, the respective financial position of the governmental activities and the general fund of Temecula Elsinore Anza Murrieta Resource Conservation District, as of June 30, 2022, and the respective changes in financial position for the fiscal years then ended in accordance with accounting principles generally accepted in the United States of America.

Basis for Opinion

We conducted our audit in accordance with auditing standards generally accepted in the United States of America and the standards applicable to financial audits contained in *Government Auditing Standards*, issued by the Comptroller General of the United States. Our responsibilities under those standards are further described in the Auditor's Responsibilities for the Audit of the Financial Statements section of our report. We are required to be independent of the Temecula Elsinore Anza Murrieta Resource Conservation District and to meet our other ethical responsibilities in accordance with the relevant ethical requirements relating to our audit. We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our audit opinion.

Responsibilities of Management for the Financial Statements

Management is responsible for the preparation and fair presentation of the financial statements in accordance with accounting principles generally accepted in the United States of America, and for the design, implementation, and maintenance of internal control relevant to the preparation and fair presentation of financial statements that are free from material misstatement, whether due to fraud or error.

In preparing the financial statements, management is required to evaluate whether there are conditions or events, considered in the aggregate, that raise substantial doubt about the District's ability to continue as a going concern for twelve months beyond the financial statement date, including any currently known information that may raise substantial doubt shortly thereafter.

Auditor's Responsibilities for the Audit of the Financial Statements

Our objectives are to obtain reasonable assurance about whether the financial statements as a whole are free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes our opinion. Reasonable assurance is a high level of assurance but is not absolute assurance and therefore is not a guarantee that an audit conducted in accordance with generally accepted auditing standards and *Government Auditing Standards* will always detect a material misstatement when it exists. The risk of not detecting a material misstatement resulting from fraud is higher than for one resulting from error, as fraud may involve collusion, forgery, intentional omissions, misrepresentations, or the override of internal control. Misstatements are considered material if there is a substantial likelihood that, individually or in the aggregate, they would influence the judgment made by a reasonable user based on the financial statements.

In performing an audit in accordance with generally accepted auditing standards and *Government Auditing Standards*, we:

- Exercise professional judgment and maintain professional skepticism throughout the audit.
- Identify and assess the risks of material misstatement of the financial statements, whether due to fraud
 or error, and design and perform audit procedures responsive to those risks. Such procedures include
 examining, on a test basis, evidence regarding the amounts and disclosures in the financial statements.
- Obtain an understanding of internal control relevant to the audit in order to design audit procedures that
 are appropriate in the circumstances, but not for the purpose of expressing an opinion on the
 effectiveness of the District's internal control. Accordingly, no such opinion is expressed.
- Evaluate the appropriateness of accounting policies used and the reasonableness of significant accounting estimates made by management, as well as evaluate the overall presentation of the financial statements.
- Conclude whether, in our judgment, there are conditions or events, considered in the aggregate, that raise substantial doubt about the District's ability to continue as a going concern for a reasonable period of time.

We are required to communicate with those charged with governance regarding, among other matters, the planned scope and timing of the audit, significant audit findings, and certain internal control related matters that we identified during the audit.

Required Supplementary Information

Accounting principles generally accepted in the United States of America require that the budgetary comparison information be presented to supplement the basic financial statements. Such information, although not a part of the basic financial statements, is required by the Governmental Accounting Standards Board, who considers it to be an essential part of financial reporting for placing the basic financial statements in an appropriate operational, economic, or historical context. We have applied certain limited procedures to the required supplementary information in accordance with auditing standards generally accepted in the United States of America, which consisted of inquiries of management about the methods of preparing the information and comparing the information for consistency with management's responses to our inquiries, the basic financial statements, and other knowledge we obtained during our audit of the basic financial statements. We do not express an opinion or provide any assurance on the information because the limited procedures do not provide us with sufficient evidence to express an opinion or provide any assurance.

Prior-Year Comparative Information

The financial statements include partial prior-year comparative information. Such information does not include sufficient detail to constitute a presentation in accordance with accounting principles generally accepted in the United States of America. Accordingly, such information should be read in conjunction with the District's financial statements for the year ended June 30, 2021, from which such partial information was derived.

Other Reporting Required by Government Auditing Standards

In accordance with Government Auditing Standards, we have also issued a separate report dated September 15, 2022, on our consideration of the District's internal control over financial reporting and on our tests of its compliance with certain provisions of laws, regulations, contracts, and grant agreements and other matters. The purpose of that report is to describe the scope of our testing of internal control over financial reporting and compliance and the results of that testing, and not to provide an opinion on internal control over financial reporting or on compliance. That report is an integral part of an audit performed in accordance with Government Auditing Standards in considering the District's internal control over financial reporting and compliance.

Murrieta, California

Nigro & Nigro, PC

September 15, 2022

Management's Discussion and Analysis (Unaudited) For the Fiscal Year Ended June 30, 2022

This discussion and analysis of Temecula Elsinore Anza Murrieta Resource Conservation District's financial performance provides an overview of the District's financial activities for the fiscal year ended June 30, 2022. Please read it in conjunction with the District's financial statements, which immediately follow this section.

FINANCIAL HIGHLIGHTS

- The net position of the District increased by \$105,179, or 7.19% during the fiscal year.
- In 2022, total revenues were \$231,917 and total expenses were \$126,738.
- There were no additions to capital assets during the year, and there was no depreciation expense.

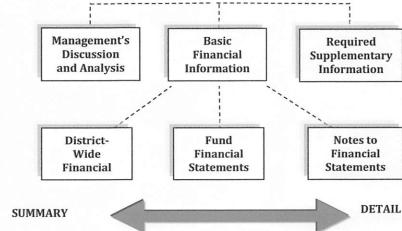
OVERVIEW OF THE FINANCIAL STATEMENTS

This annual report consists of three parts – management discussion and analysis (this section), the basic financial statements, and required supplementary information. The basic financial statements include two kinds of statements that present different views of the District:

- The first two statements are district-wide financial statements that provide both short-term and longterm information about the District's overall financial status.
- The remaining statements are fund financial statements that focus on individual parts of the District, reporting the District's operations in more detail than the district-wide statements.
 - The governmental funds statements tell how basic services were financed in the short term as well as what remains for future spending.

Figure A-1. Organization of Temecula Elsinore Anza Murrieta Resource Conservation District's Annual Financial Report

The financial statements also include notes that explain some of the information in the statements and provide more detailed data. Figure A-1 shows how the various parts of this annual report are arranged and related to one another.



Management's Discussion and Analysis (Unaudited) For the Fiscal Year Ended June 30, 2022

OVERVIEW OF THE FINANCIAL STATEMENTS (continued)

Figure A-2 summarizes the major features of the District's financial statements, including the portion of the District's activities they cover and the types of information they contain.

Figure A-2. Major Features of the District-Wide and Fund Financial Statements

Type of Statements	District-Wide	Governmental Funds
Scope	Entire district, except fiduciary activities	The activities of the district that are not proprietary or fiduciary
Required financial statements	 Statement of Net Position Statement of Activities 	 Balance Sheet Statement of Revenues, Expenditures & Changes in Fund Balances
Accounting basis and measurement focus	Accrual accounting and economic resources focus	Modified accrual accounting and current financial resources focus
Type of asset/liability information	All assets and liabilities, both financial and capital, short-term and long- term	Only assets expected to be used up and liabilities that come due during the year or soon thereafter; no capital assets included
Type of inflow/outflow information	All revenues and expenses during year, regardless of when cash is received or paid	Revenues for which cash is received during or soon after the end of the year; expenditures when goods or services have been received and payment is due during the year or soon thereafter

The remainder of this overview section of management's discussion and analysis highlights the structure and contents of each of the statements.

Management's Discussion and Analysis (Unaudited) For the Fiscal Year Ended June 30, 2022

OVERVIEW OF THE FINANCIAL STATEMENTS (continued)

District-Wide Statements

The district-wide statements report information about the District as a whole using accounting methods similar to those used by private-sector companies. The statement of net position includes all of the District's assets and liabilities. All of the current year's revenues and expenses are accounted for in the statement of activities regardless of when cash is received or paid.

The two district-wide statements report the District's net position and how it has changed. Net position – the difference between the District's assets, deferred outflows of resources, liabilities, and deferred inflows of resources – is one way to measure the District's financial health or position.

- Over time increases and decreases in the District's net position are an indicator of whether its financial
 position is improving or deteriorating.
- To assess the overall health of the District, you need to consider additional nonfinancial factors, such as the amount of building construction in the area, and the political climate affecting conservation.
- In the district-wide financial statements, the District's activities are categorized as Governmental
 Activities. Most of the District's basic services are included here, such as mitigation, public outreach and
 partnering with similar groups and agencies seeking to protect local watersheds.

Fund Financial Statements

The fund financial statements provide more detailed information about the District's most significant funds – not the District as a whole. Funds are accounting devices the District uses to keep track of specific sources of funding and spending on particular programs. Some funds are required by State law and by bond covenants.

The District has two funds, the General Fund and Permanent Fund.

Management's Discussion and Analysis (Unaudited) For the Fiscal Year Ended June 30, 2022

ORGANIZATION STRUCTURE

The District was formed in 1949 under Public Resource Code Section 9074-9801 of the State of California. The District's mission is to promote conservation practices of natural resources, opportunities for public education and participation, and a sustainable quality of life for communities within the District. The District's territory includes 505,000 acres, or approximately 789 square miles, extending south from Scott Road in Menifee to the San Diego County line, and from the east of Anza west to the Orange County line. It also includes the loop around the north of Lake Elsinore. The District accepts many forms of mitigation to allow projects to run smoothly through the permitting process and promote a healthy environment for the respective communities.

Board of Directors					
Rose Corona	President				
Randy Feeney	Vice President				
Newt Parkes	Secretary/Treasurer				
Teri Biancardi	Director				
Rick Neugebauer	Associate Director				

Management's Discussion and Analysis (Unaudited) For the Fiscal Year Ended June 30, 2022

FINANCIAL ANALYSIS OF THE DISTRICT AS A WHOLE

Table A-1

	Governmen	tal Activities	Variance Increase
	2022	2021	(Decrease)
ASSETS		· · · · · · · · · · · · · · · · · · ·	
Current assets	\$ 440,406	\$ 335,791	\$ 104,615
Restricted assets	388,414	388,271	143
Capital assets	747,750	747,750	-
Total assets	1,576,570	1,471,812	104,758
LIABILITIES			
Current liabilities	8,290	8,711	(421)
Total liabilities	8,290	8,711	(421)
NET POSITION			
Investment in capital assets	747,750	747,750	-
Restricted	388,414	388,271	143
Unrestricted	432,116	327,080	105,036
Total net position	\$ 1,568,280	\$ 1,463,101	\$ 105,179

Net Position. The District's combined net position was higher on June 30, 2022, than it was the year before – increasing to \$1.568 million. (See Table A-1).

Management's Discussion and Analysis (Unaudited) For the Fiscal Year Ended June 30, 2022

FINANCIAL ANALYSIS OF THE DISTRICT AS A WHOLE (continued)

Table A-2

	Government	Variance Increase	
	2022 2021		(Decrease)
REVENUES			
Program revenues:			
Cropswap	\$ 8,600	\$ 22,950	\$ (14,350)
SAWA stipends	19,038	17,450	1,588
RCFC pilot projects	183,253	157,715	25,538
Water audits	12,000	12,300	(300)
Grant revenue	1,225	-	1,225
Other revenue	7,511		7,511
Total program revenues	231,627	210,415	21,212
General revenues:			
Investment earnings	290_	2,297	(2,007)
Total general revenues	290	2,297	(2,007)
Total revenues	231,917	212,712	19,205
EXPENSES			
Program expenses	94,808	68,812	25,996
Administrative expenses	31,930	27,287	4,643
Total expenses	126,738	96,099	30,639
Change in net position	105,179	116,613	\$ (11,434)
NET POSITION			
Beginning of year	1,463,101	1,346,488	116,613
End of year	\$ 1,568,280	\$ 1,463,101	\$ 105,179

Changes in net position, governmental activities. The District's total revenues increased 10.08% to \$231,917 (See Table A-2). The increase is primarily due to the increase in RCFC pilot projects income in fiscal year 2022.

The total cost of all programs and services increased 31.88% to \$126,738. The increase is due to increased program costs for the RCFC pilot projects.

General Fund Budgetary Highlights

While the District's adopted final budget for the General Fund anticipated revenues would exceed expenditures by \$42,600 the actual results for the year show that revenues exceeded expenditures by \$104,899. Actual revenues were \$152,013 more than budgeted, but expenditures were \$89,741 more than planned.

Management's Discussion and Analysis (Unaudited) For the Fiscal Year Ended June 30, 2022

CAPITAL ASSETS

By the end of fiscal year 2022 the District had invested \$747,750 in capital assets. (More detailed information about capital assets can be found in Note 5 to the financial statements).

FACTORS BEARING ON THE DISTRICT'S FUTURE

The District will continue to work with the communities of Lake Elsinore, Wildomar, Murrieta, Temecula, and Anza by providing education and mitigation services, protection of resources and the watershed through building stronger partnerships within the District's boundaries.

The District anticipates future revenue streams in partnership with the Santa Ana Watershed Association (SAWA), state grants and by accepting and monitoring new easements.

This and other factors were considered in preparing the Temecula Elsinore Anza Murrieta Resource Conservation District budget for the 2021-22 fiscal year.

CONTACTING THE DISTRICT'S FINANCIAL MANAGEMENT

This financial report is designed to provide our citizens, taxpayers, customers, and investors and creditors with a general overview of the District's finances and to demonstrate the District's accountability for the money it receives. If you have any questions about this report or need additional financial information, contact Rose Corona at Rose.Corona@teamrcd.org.

Statement of Net Position June 30, 2022

	Governmental Activities	
ASSETS		
Cash and cash equivalents (Note 2)	\$	399,237
Restricted - cash and cash equivalents (Note 2 and 6)		98,244
Restricted – investments (Note 2 and 6)		290,000
Restricted - accrued interest receivable (Note 6)		170
Accounts receivable (Note 3)		38,244
Prepaid Items		2,925
Capital assets – not being depreciated (Note 5)		747,750
Total assets		1,576,570
LIABILITIES		
Accounts payable and accrued expenses		8,290
Total liabilities		8,290
NET POSITION		
Investment in capital assets		747,750
Restricted for mitigation projects:		
Nonspendable (Note 6)		388,000
Expendable (Note 6)		414
Unrestricted		432,116
Total net position	\$	1,568,280

Statement of Activities For the Fiscal Year Ended June 30, 2022

	Governmental Activities	
EXPENSES		
Program expense	\$ 94,808	
Administrative	31,930	
Total program expenses	126,738	
PROGRAM REVENUES		
CropSwap income	8,600	
SAWA stipend income	19,038	
RCFC pilot projects	183,253	
Water audit income	12,000	
Grant revenue	1,225	
Other revenue	7,511	
Total program revenues	231,627	
Net program income	104,889	
GENERAL REVENUES		
Investment earnings	290	
Total general revenues	290	
Change in net position	105,179	
NET POSITION		
Beginning of year	1,463,101	
End of year	\$ 1,568,280	

Balance Sheet - Governmental Funds June 30, 2022

			ermanent Fund	Gov	Total ernmental Funds	
ASSETS						
Cash and cash equivalents	\$	399,237	\$	-	\$	399,237
Restricted – cash and cash equivalents		-		98,244		98,244
Restricted – investments		-		290,000		290,000
Restricted – accrued interest receivable		-		170		170
Accounts receivable		38,244		-		38,244
Prepaid Items		2,925				2,925
Total assets	\$_	440,406		388,414	\$	828,820
LIABILITIES						
Accounts payable	\$	8,290		<u> </u>		8,290
Total liabilities		8,290		-		8,290
FUND BALANCE (Note 7)						
Nonspendable		2,925		-		2,925
Restricted		-		388,414		388,414
Unassigned		429,191				429,191
Total fund balance		432,116		388,414	-	820,530
Total liabilities and fund balance	\$	440,406		388,414	\$	828,820

Reconciliation of the Governmental Funds Balance Sheet to the Statement of Net Position For the Fiscal Year Ended June 30, 2022

Total fund balances - governmental funds	\$ 820,530
Amounts reported for governmental activities in the statement of net position are different because:	
Capital assets used in governmental activities are not financial resources and therefore are not reported as assets in governmental funds. The cost of these	
assets is:	 747,750
Total net position - governmental activities	\$ 1,568,280

Statement of Revenues, Expenditures, and Changes in Fund Balance For the Fiscal Year Ended June 30, 2022

		General Fund	Pe	rmanent Fund	Gov	Total ernmental Funds
REVENUES	_	0.400				0.400
CropSwap income	\$	8,600	\$	-	\$	8,600
SAWA stipend income		19,038		-		19,038
RCFC pilot projects		183,253		-		183,253
Water audit income		12,000		-		12,000
Grant revenue		1,225		-		1,225
Other revenue		7,511		-		7,511
Investment earnings		10		280		290
Total revenues		231,637		280		231,917
EXPENDITURES						
Operational:						
CropSwap management		4,405		-		4,405
Water audit expenses		4,135		-		4,135
RCFC pilot projects		86,268		-		86,268
Administrative:						
Accounting and audit/review		2,000		-		2,000
Bookkeeping		3,219		-		3,219
Computer systems		270		-		270
Consulting		5,209		-		5,209
Insurance		2,651		-		2,651
Legal		9,743		-		9,743
Licenses and permits		4,088		-		4,088
Membership dues		1,697		-		1,697
Postage		304		-		304
Transcription		699		-		699
Website		2,050		-		2,050
Total expenditures		126,738		-		126,738
Excess of revenues over expenditures		104,899		280		105,179
OTHER FINANCING SOURCES(USES)						
Transfers in/(out) (Note 4)		147		(147)		
Change in fund balances		105,046		133		105,179
FUND BALANCE						
Beginning of year		327,080		388,271		715,351
End of year		432,126		388,404	\$	820,530

Reconciliation of the Governmental Funds Statement of Revenues, Expenditures, and Changes in Fund Balance to the Government-Wide Statement of Activities and Changes in Net Position For the Fiscal Year Ended June 30, 2022

There were no differences between the total net change in fund balances-governmental funds and the change in net position of governmental activities.

Notes to Financial Statements June 30, 2022

NOTE 1 – SIGNIFICANT ACCOUNTING POLICIES

Temecula Elsinore Anza Murrieta Resource Conservation District (the "District") accounts for its financial transactions in accordance with accounting principles generally accepted in the United States of America as prescribed by the Governmental Accounting Standards Board. The following is a summary of the more significant policies:

A. Reporting Entity

A reporting entity is comprised of the primary government, component units, and other organizations that are included to ensure the financial statements are not misleading. The primary government of the District consists of all funds, departments, and agencies that are not legally separate from the District. For Temecula Elsinore Anza Murrieta Resource Conservation District, this includes the General and Permanent Funds.

Component units are legally separate organizations for which the District is financially accountable. Component units may also include organizations that are fiscally dependent on the District, in that the District approves their budget, the issuance of their debt or the levying of their taxes. In addition, component units are other legally separate organizations for which the District is not financially accountable but the nature and significance of the organization's relationship with the District is such that exclusion would cause the District's financial statements to be misleading or incomplete.

The District has identified no organizations that are required to be reported as component units.

B. Basis of Presentation, Basis of Accounting

1. Basis of Presentation

Government-Wide Financial Statements

The statement of net position and the statement of activities display information about the primary government (the District). These statements include the financial activities of the overall government. Eliminations have been made to minimize the double-counting of internal activities. Governmental activities generally are financed through developer fees.

The statement of activities presents a comparison between direct expenses and program revenues for each function of the District's governmental activities. Direct expenses are those that are specifically associated with a program or function and, therefore, are clearly identifiable to a particular function. Program revenues include (a) fees, fines, and charges paid by the recipients of goods or services offered by the programs and (b) grants and contributions that are restricted to meeting the operational or capital requirements of a particular program. Revenues that are not classified as program revenues are presented as general revenues.

Fund Financial Statements

The fund financial statements provide information about the District's funds. The emphasis of fund financial statements is on major governmental funds, each displayed in a separate column.

Proprietary fund operating revenues, such as charges for services, result from exchange transactions associated with the principal activity of the fund. Exchange transactions are those in which each party receives and gives up essentially equal values. Nonoperating revenues, such as subsidies and investment earnings, result from nonexchange transactions or ancillary activities. The District does not operate any proprietary funds.

Notes to Financial Statements June 30, 2022

NOTE 1 - SIGNIFICANT ACCOUNTING POLICIES (continued)

B. Basis of Presentation, Basis of Accounting (continued)

1. Basis of Presentation (continued)

Governmental Funds

The District maintains the following major governmental funds:

General Fund: This fund is used to account for and report all financial resources not accounted for and reported in another fund.

Permanent Fund: This fund is used to account for principal and interest related to endowments paid to the District as part of easement agreements.

2. Measurement Focus, Basis of Accounting

Government-Wide Financial Statements

The government-wide financial statements are reported using the economic resources measurement focus and the accrual basis of accounting. Revenues are recorded when earned and expenses are recorded at the time liabilities are incurred, regardless of when the related cash flows take place.

Governmental Fund Financial Statements

Governmental funds are reported using the current financial resources measurement focus and the modified accrual basis of accounting. Under this method, revenues are recognized when measurable and available. Expenditures are recorded when the related fund liability is incurred. Capital asset acquisitions are reported as expenditures in governmental funds. Proceeds of general long-term debt and financing from capital leases are reported as other financing sources.

3. Revenues - Exchange and Non-Exchange Transactions

Revenue resulting from exchange transactions, in which each party gives and receives essentially equal value, is recorded on the accrual basis when the exchange takes place. On a modified accrual basis, revenue is recorded in the fiscal year in which the resources are measurable and become available. Available means that the resources will be collected within the current fiscal year. Generally, available is defined as collectible within 60 days.

Non-exchange transactions, in which the District receives value without directly giving equal value in return, include revenue from certain grants, entitlements, and donations is recognized in the fiscal year in which all eligibility requirements have been satisfied. Eligibility requirements include time and purpose requirements. On a modified accrual basis, revenue from non-exchange transactions must also be available before it can be recognized.

C. Budgetary Data

Annual budgets are adopted on a basis consistent with generally accepted accounting principles for all government funds. By state law, the District's governing board must adopt a tentative budget no later than July 1 and adopt a final budget no later than October 1. A public hearing must be conducted to receive comments prior to adoption.

Notes to Financial Statements June 30, 2022

NOTE 1 - SIGNIFICANT ACCOUNTING POLICIES (continued)

C. Budgetary Data (continued)

The District annually adopts a budget based on estimated revenues, estimated operation expenses, and capital expenditure requirements. The District's policy is to prepare its budgets on the modified accrual basis of accounting, which recognizes revenues when they are accrued, and expenses and capital assets are recorded as expenditures, and depreciation is not recorded.

D. Encumbrances

Encumbrance accounting is used in all budgeted funds to reserve portions of applicable appropriations for which commitments have been made. Encumbrances are recorded for purchase orders, contracts, and other commitments when they are written. Encumbrances are liquidated when the commitments are paid. All encumbrances are liquidated as of June 30.

E. Assets, Deferred Outflows of Resources, Liabilities, Deferred Inflows of Resources, and Net Position

1. Cash

The District's cash consists of cash on hand, demand deposits and short-term investments with original maturities of less than 90 days from the date of acquisition.

2. Investments

Investments consist of certificates of deposits with average maturity date of 90 days or more from the date of acquisition. Investments are reported at fair value except for short-term investments, which are reported at cost, which approximates fair value. Cash deposits are reported at carrying amount, which reasonably estimates fair value.

In accordance with fair value measurements, the District categorizes its assets and liabilities measured at fair value into a three-level hierarchy based on the priority of the inputs to the valuation technique used to determine fair value. The fair value hierarchy gives the highest priority to quoted prices in active markets for identical assets or liabilities (Level 1) and the lowest priority to unobservable inputs (Level 3). If the inputs used in the determination of the fair value measurement fall within different levels of the hierarchy, the categorization is based on the lowest level input that is significant to the fair value measurement.

Financial assets and liabilities recorded on the balance sheet are categorized based on the inputs to the valuation techniques as follows:

Level 1 – Inputs that reflect unadjusted quoted prices in active markets for identical investments, such as stocks, corporate and government bonds. The District has the ability to access the holding and quoted prices as of the measurement date.

Level 2 – Inputs, other than quoted prices, that are observable for the asset or liability either directly or indirectly, including inputs from markets that are not considered to be active.

Level 3 – Inputs that are unobservable. Unobservable inputs reflect the District's own assumptions about the factors market participants would use in pricing an investment, and is based on the best information available in the circumstances.

Notes to Financial Statements June 30, 2022

NOTE 1 – SIGNIFICANT ACCOUNTING POLICIES (continued)

E. Assets, Deferred Outflows of Resources, Liabilities, Deferred Inflows of Resources, and Net Position (continued)

3. Accounts Receivable

Accounts receivables represent amounts due to the District as of fiscal year end from conservation services rendered and interest.

4. Prepaids

Prepaid expenses arise when the District has paid for an expense, but the corresponding goods or services have not been received at the end of the fiscal year.

5. Capital Assets

The accounting and reporting treatment applied to the capital assets associated with a fund is determined by its measurement focus. Capital assets are reported in the government-wide statement of net assets, but are not reported in the fund financial statements.

Capital assets are capitalized at cost (or estimated historical cost) and updated for additions and retirements during the year. Donated fixed assets are recorded at their estimated fair market values as of the date received. The District does not currently define a threshold for capital assets. However, these assets are estimated to have an initial, individual cost of more than \$500 and an estimated useful life in excess of two years. Capital assets are depreciated during the expected life of the asset on the straight-line method. The District does not own any infrastructure as defined in GASB No. 34. Improvements are capitalized; the costs of normal maintenance and repairs that do not add to the value of the asset or materially extend an asset's life are not capitalized.

All reported capital assets, except for land and construction in progress, are depreciated. Improvements are depreciated over the remaining useful lives of the related capital assets. Depreciation is computed using the straight-line method.

As of June 30, 2022, the Organization has no depreciable assets.

6. Unavailable Revenue

Unavailable revenue arises when potential revenue does not meet both the "measurable" and "available" criteria for recognition in the current period or when resources are received by the District prior to the incurrence of qualifying expenditures. In subsequent periods, when both revenue recognition criteria are met, or when the District has a legal claim to the resources, the liability for unavailable revenue is removed from the combined balance sheet and revenue is recognized.

Notes to Financial Statements June 30, 2022

NOTE 1 – SIGNIFICANT ACCOUNTING POLICIES (continued)

E. Assets, Deferred Outflows of Resources, Liabilities, Deferred Inflows of Resources, and Net Position (continued)

8. Fund Balance Reserves and Designations

Fund balance reporting for governmental funds is reported in classifications that comprise a hierarchy based primarily on the extent to which the District is bound to honor constraints on the specific purposes for which amounts in those funds can be spent. Some governments may not have policies or procedures that are comparable to those policies that underlie these fund balance classifications and therefore would not report amounts in all possible fund balance classifications.

Nonspendable: The nonspendable fund balance classification includes amounts that cannot be spent because they are either (a) not in spendable form or (b) legally or contractually required to be maintained intact. The "not in spendable form" criterion includes items that are not expected to be converted to cash, for example, revolving cash, inventories, and prepaid amounts.

Restricted: Fund balances should be reported as restricted when constraints placed on the use of resources are either (a) externally imposed by creditors (such as through debt covenants), grantors, contributors, or laws or regulations of other governments; or (b) imposed by law through constitutional provisions or enabling legislation.

Unassigned: Unassigned fund balance is the residual classification for the General Fund. This classification represents fund balance that has not been assigned to other funds and that has not been restricted, committed, or assigned to specific purposes within the General Fund.

9. Net Position

Net position is classified into three components: investment in capital assets; restricted; and unrestricted. These classifications are defined as follows:

- Investment in capital assets This component of net position consists of capital assets, including restricted capital assets, net of accumulated depreciation.
- Restricted This component of net position consists of constraints placed on net position use
 through external constraints imposed by creditors (such as through debt covenants), grantors,
 contributors, or laws or regulations of other governments or constraints imposed by law through
 constitutional provisions or enabling legislation.
- Unrestricted net position This component of net position consists of net position that does not meet the definition of "net investment in capital assets" or "restricted".

When both restricted and unrestricted resources are available for use, it is the District's policy to use restricted resources first, then unrestricted resources as they are needed.

Notes to Financial Statements June 30, 2022

NOTE 2 - CASH AND INVESTMENTS

Cash and investments at June 30, 2022, are reported on the statement of net position as follows:

Description		Balance
Cash and cash equivalents	\$	399,237
Restricted – cash and cash equivalents		98,244
Restricted – investments		290,000
Total cash and investments	\$	787,481

Cash and investments at June 30, 2022, consisted of the following:

Description		Balance		
Demand deposits with financial institutions	\$	497,481		
Certificates-of-deposit		290,000		
Total cash and investments	\$	787,481		

Demand Deposits

At June 30, 2022, the carrying amount of the District's demand deposits was \$497,481 and the financial institution balance was \$501,184. The net difference represents outstanding checks, deposits-in-transit and/or other reconciling items.

Custodial Credit Risk - Deposits

Custodial credit risk is the risk that in the event of a bank failure, the District's deposits may not be returned to it. The District does not have a policy for custodial credit risk for deposits. Cash balances held in banks are insured up to \$250,000 by the Federal Depository Insurance Corporation (FDIC) and are collateralized by the respective financial institutions. In addition, the California Government Code requires that a financial institution secure deposits made by State or local governmental units by pledging securities in an undivided collateral pool held by a depository regulated under State law (unless so waived by the governmental unit).

The market value of the pledged securities in the collateral pool must equal at least 110 percent of the total amount deposited by the public agencies. California law also allows financial institutions to secure public deposits by pledging first trust deed mortgage notes having a value of 150 percent of the secured public deposits and letters of credit issued by the Federal Home Loan Bank of San Francisco having a value of 105 percent of the secured deposits. Cash balances in banks as of June 30, 2022, are fully insured by the Federal Depository Insurance Corporation.

Cash and Investments

Cash and investments are reported at fair market value. The District considers certificates of deposit with a maturity date of 90 days or longer to be investments.

Authorized Investments

The investment policy adopted by the District is summarized as follows: "The District shall invest public funds in a manner which will safeguard principal, meet liquidity and achieve return on investments as referenced in government code section 53600.5." All investments of the District shall conform to the requirements of applicable law and policy, whichever is more restrictive.

Notes to Financial Statements June 30, 2022

NOTE 2 - CASH AND INVESTMENTS (continued)

Disclosures Relating to Interest Rate Risk

Interest rate risk is the risk that changes in market interest rates will adversely affect the fair value of an investment. Generally, the longer the maturity of an investment, the greater the sensitivity of its fair value to changes in market interest rates. One of the ways that the District manages its exposure to interest rate risk is by purchasing a combination of shorter term and longer-term investments and by timing cash flows from maturities so that a portion of the portfolio is maturing or coming close to maturity evenly over time as necessary to provide the cash flows and liquidity needed for operations.

Maturities and fair value of investments as of June 30, 2022, are as follows:

				<u>Maturity</u>		
Type of Investments	Measurement Input	Credit Rating	June 30, 2022 Fair Value	12 Months or Less		
Certificates-of-deposit	Level 2	N/A	\$ 290,000	\$ 290,000		
Total investments			\$ 290,000	\$ 290,000		

NOTE 3 - ACCOUNTS RECEIVABLE

Accounts receivable as of June 30, 2022, consisted of the following:

Customer		Balance		
Riverside County Flood Control and Water Conservation District		32,128		
Rancho California Water District		1,700		
Santa Ana Watershed Association		1,632		
Mission Resource Conservation District		1,559		
Department of Conservation		1,225		
Total accounts receivable		38,244		

NOTE 4 - INTERFUND TRANSFERS

The District transferred interest earnings of \$147 used for operations from the Permanent Fund to the General Fund during the fiscal year.

NOTE 5 - CAPITAL ASSETS AND DEPRECIATION

Capital assets activity for the year ended June 30, 2022, is shown below:

Comited accepts with along damage to be de-		Balance, July 1, 2021		Additions		Retirements		Balance, June 30, 2022	
Capital assets not being depreciated:									
Land	\$	475,000	\$	-	\$	-	\$	475,000	
Greer Ranch easement		110,000		•		-		110,000	
Adeline Farms/Benton Channel easement		162,750						162,750	
Total capital assets not being depreciated	\$	747,750	\$		\$			747,750	

Notes to Financial Statements lune 30, 2022

NOTE 5 - CAPITAL ASSETS AND DEPRECIATION (continued)

Easements:

A. Greer Ranch Community

In October of 2009, the District executed an agreement with Lennar Greer Ranch Venture, LLC, granting a conservation easement, in perpetuity, over property known as "Greer Ranch Community". The purpose of the Conservation Easement is to ensure the property will be preserved in a natural condition, in perpetuity, for gnatcatcher, vireo and other wildlife conservation, and to prevent, subject to the duties and rights retained by Grantor, any other use of the property that will impair or interfere with the conservation values of the property. The District is responsible for monitoring for compliance with this conservation easement and in-perpetuity, ongoing, long-term maintenance and management of the property.

B. Adeline Farms/Benton Channel

In 2007, the District executed an agreement with Shea Homes Limited Partnership granting a conservation easement over property known as "Adeline Farms". The purpose is to ensure the property will be retained in a natural condition and to prevent any use of the property that will impair or interfere with the conservation values of the property. In 2019, the easement name was changed to "Benton Channel".

NOTE 6 - CASH RESTRICTED FOR SPECIFIC PROGRAMS

The District accepted funds from a series of private development projects in the Murrieta and Temecula areas, which need offsite mitigation credit for permanent impacts to U.S. wildlife, open spaces, and watershed lands that is deemed appropriate and acceptable by the resource and regulatory agencies of \$98,000 as of June 30, 2022.

The District accepted endowment funds from Lennar Greer Ranch, LLC, a land developer, which will be used to maintain the Greer Ranch Conservation Easement associated with approximately 250 acres at Lennar's Greer Ranch residential community in the City of Murrieta, California in the amount of \$125,000.

The District accepted endowment funds from Shea Homes, a land developer, the income from which will be used, to maintain a conservation easement on the property marketed as the Benton Channel, in the vicinity of Washington Street and Benton Road, just west of Lake Skinner, in the French Valley area, in the amount of \$75,000.

The District accepted endowment funds from Pulte Homes, a land developer, the income from which will be used, to maintain a conservation easement on the property marketed as the Benton Channel, in the vicinity of Washington Street and Benton Road, just west of Lake Skinner, in the French Valley area, in the amount of \$90,000.

	Investment							
Description		Endowment		Earnings		Total		
Private development projects	\$	98,000	\$	244	\$	98,244		
Lennar Greer Ranch, LLC		125,000		73		125,073		
Shea Homes		75,000		44		75,044		
Pulte Homes		90,000		53		90,053		
Total restricted assets for specific programs	\$	388,000	. \$	414	\$	388,414		

Notes to Financial Statements

June 30, 2022

NOTE 7 - FUND BALANCES

The District's fund balances are designated as follows:

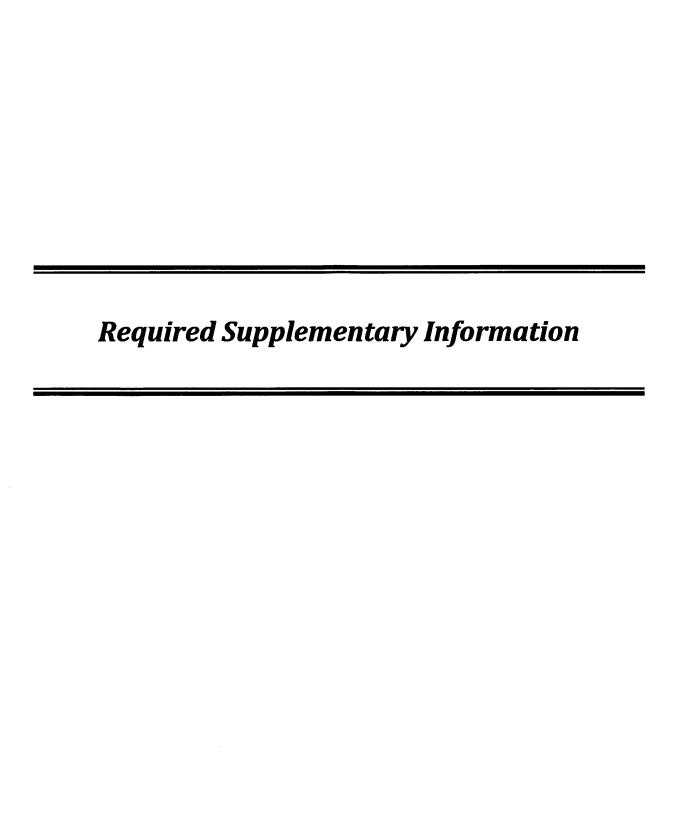
Description	General Fund	Permanent Fund	Total Governmental <u>Funds</u>	
Nonspendable:				
Prepaid items	\$ 2,925	\$ -	\$ 2,925	
Restricted:				
Nonexpendable endowments	-	388,000	388,000	
Expendable for mitigation projects	-	414	414	
Total restricted	-	388,414	388,414	
Unassigned	429,191		429,191	
Total fund balances	\$ 432,116	\$ 388,414	\$ 820,530	

NOTE 8 - RISK MANAGEMENT

The District is insured under a plan managed by the Special District Risk Management Authority for commercial general liability in the amount of \$2,500,000.

NOTE 9 – SUBSEQUENT EVENTS

The District has evaluated subsequent events through September 15, 2022, the date which the financial statements were available to be issued.



Budgetary Comparison Schedule - General Fund For the Fiscal Year Ended June 30, 2022

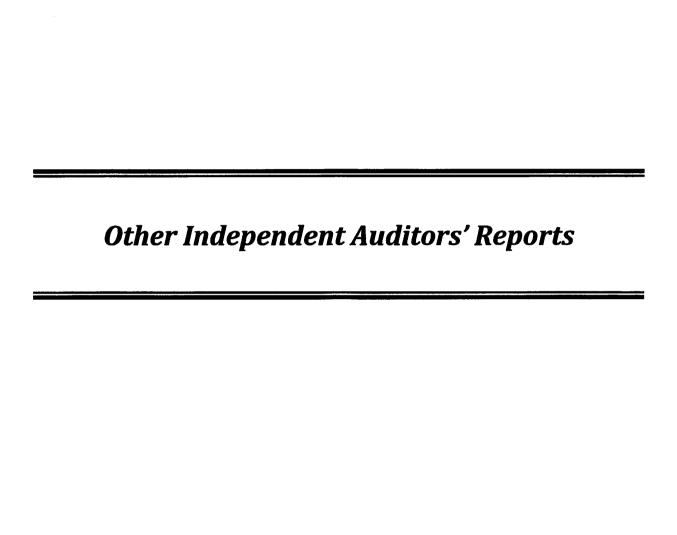
	Original and Final Budget		Actual		Variance	
REVENUES				-		
CropSwap income	\$	24,850	\$	8,600	\$	(16,250)
SAWA stipend income		22,090		19,038		(3,052)
RCFC pilot projects		22,890		183,253		160,363
Water audit income		9,650		12,000		2,350
Grant revenue		-		1,225		1,225
Other revenue		-		7,511		7,511
Investment earnings		144		10		(134)
Total revenues		79,624		231,637		152,013
EXPENDITURES						
Operational:						
CropSwap management		7,030		4,405		2,625
Water audit expenses		3,830		4,135		(305)
RCFC pilot projects		3,818		86,268		(82,450)
Administrative:						
Accounting and audit/review		5,110		2,000		3,110
Bookkeeping		-		3,219		(3,219)
Computer systems		359		270		89
Consulting		6,376		5,209		1,167
Insurance		2,651		2,651		-
Legal		5,174		9,743		(4,569)
Licenses and permits		-		4,088		(4,088)
Membership dues		876		1,697		(821)
Postage		-		304		(304)
Transcription		900		699		201
Website		900		2,050		(1,150)
Total expenditures		37,024		126,738		(89,714)
Excess of revenues over expenditures		42,600		104,899		62,299
OTHER FINANCING SOURCES(USES)						
Transfers in/(out)		<u>.</u>		147		147_
Change in fund balances	\$	42,600		105,046	<u>\$</u>	62,446
FUND BALANCE						
Beginning of year				327,080		
End of year			\$	432,126		
			$\dot{=}$			

Notes to the Required Supplementary Information For the Fiscal Year Ended June 30, 2022

NOTE 1 - PURPOSE OF SCHEDULES

Budgetary Comparison Schedule

This schedule is required by GASB Statement No. 34 as required supplementary information (RSI) for the General Fund and for each major special revenue fund that has a legally adopted annual budget. The budgetary comparison schedule presents both (a) the original and (b) the final appropriated budgets for the reporting period as well as (c) actual inflows, outflows, and balances, stated on the District's budgetary basis. A separate column to report the variance between the final budget and actual amounts is also presented, although not required.





INDEPENDENT AUDITORS' REPORT ON INTERNAL CONTROL OVER FINANCIAL REPORTING AND ON COMPLIANCE AND OTHER MATTERS BASED ON AN AUDIT OF FINANCIAL STATEMENTS PERFORMED IN ACCORDANCE WITH GOVERNMENT AUDITING STANDARDS

Board of Directors Temecula Elsinore Anza Murrieta Resource Conservation District Temecula, California

We have audited, in accordance with the auditing standards generally accepted in the United States of America and the standards applicable to financial audits contained in *Government Auditing Standards* issued by the Comptroller General of the United States, the financial statements of the governmental activities and the General fund of Temecula Elsinore Anza Murrieta Resource Conservation District (District) as of and for the year ended June 30, 2022, and the related notes to the financial statements, which collectively comprise the District's basic financial statements, and have issued our report thereon dated September 15, 2022.

Internal Control Over Financial Reporting

In planning and performing our audit of the financial statements, we considered the District's internal control over financial reporting (internal control) as a basis for designing audit procedures to determine the audit procedures that are appropriate in the circumstances for the purpose of expressing our opinions on the financial statements, but not for the purpose of expressing an opinion on the effectiveness of the District's internal control. Accordingly, we do not express an opinion on the effectiveness of the District's internal control.

A deficiency in internal control exists when the design or operation of a control does not allow management or employees, in the normal course of performing their assigned functions, to prevent, or detect and correct misstatements on a timely basis. A material weakness is a deficiency, or a combination of deficiencies, in internal control such that there is a reasonable possibility that a material misstatement of the District's financial statements will not be prevented, or detected and corrected on a timely basis. A significant deficiency is a deficiency, or a combination of deficiencies, in internal control that is less severe than a material weakness, yet important enough to merit attention by those charged with governance.

Our consideration of internal control was for the limited purpose described in the first paragraph of this section and was not designed to identify all deficiencies in internal control that might be material weaknesses or significant deficiencies. Given these limitations, during our audit we did not identify any deficiencies in internal control that we consider to be material weaknesses. However, material weaknesses may exist that have not been identified.

Compliance and Other Matters

As part of obtaining reasonable assurance about whether the District's financial statements are free of material misstatement, we performed tests of its compliance with certain provisions of laws, regulations, contracts, and grant agreements, noncompliance with which could have a direct and material effect on the financial statements. However, providing an opinion on compliance with those provisions was not an objective of our audit, and accordingly, we do not express such an opinion. The results of our tests disclosed no instances of noncompliance or other matters that are required to be reported under *Government Auditing Standards*.

Purpose of this Report

The purpose of this report is solely to describe the scope of our testing of internal control and compliance and the results of that testing, and not to provide an opinion on the effectiveness of the District's internal control or on compliance. This report is an integral part of an audit performed in accordance with *Government Auditing Standards* in considering the District's internal control and compliance. Accordingly, this communication is not suitable for any other purpose.

Murrieta, California September 15, 2022

Nigro & Nigro, PC

TEMECULA-ELSINORE-ANZA-MURRIETA RESOURCE CONSERVATION DISTRICT Report to the Board of Directors For the Fiscal Year Ended June 30, 2022



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Required Communications	2
Summary of Adjusting Journal Entries	4



Board of Directors
Temecula-Elsinore-Anza-Murrieta Resource Conservation District

We are pleased to present this report related to our audit of the financial statements of the Temecula-Elsinore-Anza-Murrieta Resource Conservation District (District) as of and for the year ended June 30, 2022. This report summarizes certain matters required by professional standards to be communicated to you in your oversight responsibility for the District's financial reporting process.

This report is intended solely for the information and use of the Board of Directors and management and is not intended to be, and should not be, used by anyone other than these specified parties. It will be our pleasure to respond to any questions you have about this report. We appreciate the opportunity to continue to be of service to the District.

Very truly yours,

Temecula, California

Murrieta, California September 15, 2022

Nigro & Nigro, PC

Required Communications

Required Communications For the Fiscal Year Ended June 30, 2022

Generally accepted auditing standards (AU-C 260, *The Auditor's Communication With Those Charged With Governance*) require the auditor to promote effective two-way communication between the auditor and those charged with governance. Consistent with this requirement, the following summarizes our responsibilities regarding the financial statement audit as well as observations arising from our audit that are significant and relevant to your responsibility to oversee the financial reporting process.

Area	Comments
Our Responsibilities with Regard to the Financial Statement Audit	Our responsibilities under auditing standards generally accepted in the United States of America have been described to you in our arrangement letter dated April 1, 2022. Our audit of the financial statements does not relieve management or those charged with governance of their responsibilities, which are also described in that letter.
Overview of the Planned Scope and Timing of the Financial Statement Audit	An audit includes examining, on a test basis, evidence supporting the amounts and disclosures in the financial statements; therefore, our audit involved judgment about the number of transactions and the account-type of areas tested. There were no changes to the planned scope and timing of our audit testwork.
Accounting Policies and Practices	Accounting Policies and Practices Under generally accepted accounting principles, in certain circumstances, management may select among alternative accounting practices. During our audit, no such circumstances were noted.
	Adoption of, or Change in, Significant Accounting Polies or Their Application Management has the ultimate responsibility for the appropriateness of the accounting policies used by the District. The District did not adopt any significant new accounting policies, nor have there been any changes in existing significant accounting policies during the current period.
	Significant or Unusual Transactions We did not identify any significant or unusual transactions or significant accounting policies in controversial or emerging areas for which there is a lack of authoritative guidance or consensus.
	Management's Judgments and Accounting Estimates Accounting estimates are an integral part of the preparation of financial statements and are based upon management's current judgement. No such significant accounting estimates were noted or estimate applications were changed from the previous year.
Audit Adjustments	Audit adjustments are summarized in the attached Summary of Adjusting Journal Entries .
Uncorrected Misstatements	We are not aware of any uncorrected misstatements other than misstatements that are clearly trivial.

Required Communications For the Fiscal Year Ended June 30, 2022

Area	Comments
Discussions With Management	We generally discuss a variety of matters, including the application of accounting principles and auditing standards, with management each year prior to retention as the District's auditor. However, these discussions occurred in the normal course of our professional relationship and our responses were not a condition to our retention.
Disagreements With Management	We encountered no disagreements with management over the application of significant accounting principles, the basis for management's judgments on any significant matters, the scope of the audit, or significant disclosures to be included in the financial statements.
Consultations With Other Accountants	We are not aware of any consultations management had with other accountants about accounting or auditing matters.
Significant Issues Discussed With Management	No significant issues arising from the audit were discussed or the subject of correspondence with management.
Significant Difficulties Encountered in Performing the Audit	No significant difficulties were encountered in performing our audit.
Required Supplementary Information	We applied certain limited procedures to the: 1. Management's Discussion and Analysis 2. Budget to Actual Comparison Which are required supplementary information (RSI) that supplements the basic financial statements. Our procedures consisted of inquiries of management regarding the methods of preparing the information and comparing the information for consistency with management's responses to our inquiries, the basic financial statements, and other knowledge we obtained during our audit of the basic financial statements. We did not audit the RSI and do not express an opinion or provide any assurance on the RSI.

This information is intended solely for the information and use of Board of Directors and management of the District and is not intended to be, and should not be, used by anyone other than these specified parties.



Summary of Adjusting Journal Entries For the Fiscal Year Ended June 30, 2022

No audit adjustments noted.

NEW BUSINESS

OLD BUSINESS

GUEST SPEAKER

SPEAKER-SCOTT MURRAY MISSION RCD FIRE MITIGATION CONCEPT AND GRANT



RAPID CARBON DRAWDON WHITE PAPER Make California Green Again

Executive Summary

Building on the success of three established demonstration sites, and for immediate action to combat climate change, protect biodiversity and build resilience, we propose an inclusive, multi-benefit nature-based land management solution to address Governor Newsom's 30 x 30 commitment. Engagement will be intentional and science-driven and include diverse communities and climate change experts.

The first iteration of our proposed Rapid Carbon Drawdown (RCD) program is to develop a CSU-led program using nature for enhanced carbon sequestration via a positive feedback loop between carbon, plants and soil. Starting with engagement and assessment of designated SoCal Edison sites, we will identify and map replacement of turf and traditionally landscaped sites with planting of drought tolerant natives and other species, including *Portulacaria afra*, an exceptional carbon sequesterer. These will be inter-planted with other drought tolerant plants and fruit bearing trees. Water reuse systems will be concurrently developed at the sites. Carbon sequestration research efforts currently being done by CSU Northridge will be extended across SoCal Edison sites.

Inherent to this program is development of viable career paths and workforce support; our program will diversify conservation to ensure equity driven approaches and develop community capacity. CSU students and other community members trained as trainers will work with California's Resource Conservation Districts (RCDs) to provide technical assistance for site development, implementation and training on SoCal Edison landscapes, particularly those serving disadvantaged communities. Vulnerable areas will be targeted across SoCal Edison coverage to provide connectivity and public health benefits. We will also build upon existing relationships to collaborate with local Tribal Nations to improve habitat connectivity and enhance areas that have cultural significance.

The proposed demonstration program will use established and proven best practices based on NRCS and California education standards to increase carbon drawdown, protect biodiversity and build resilience. We will leverage successful, localized community-based efforts with proven equitable engagement practices to develop community ownership and capacity for transformative multi-benefit solutions.

Purpose

This nature-based solutions program addresses Governor Newsom's 30 by 30 commitment directing state agencies to accelerate actions to combat climate change, protect biodiversity and build resilience through nature-based solutions. Our Team proposes to coordinate existing partnerships to quickly and effectively accelerate carbon drawdown via planting more efficient carbon sequestering, drought tolerant plants on state and municipal lands.

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California has less than eight years to protect six million acres of land that will require significant investment in conservation, community mobilization and strong accountability. Based on existing, successful demonstration sites, we propose to develop a turf and landscape replacement program for increased carbon sequestration and water conservation that can be implemented almost immediately, replicated anywhere in the state and provide communities with easily accomplished steps for climate change mitigation and a renewed hope for the future. Our approach to conservation is adaptive and across varied landscapes and regions and will:

- Protect against habitat loss in urban and urban-boundary areas
- Protect and create high-sequestering and persistent biodiverse habitat corridors
- Benefit underserved communities with urban greening, heat island mitigation and enhanced community involvement
- Partner with California Tribal Nations for cross-sharing ecosystem and conservation knowledge
- Track ecosystem carbon and biodiversity of planted areas to monitor carbon sequestration and biodiversity to better inform adaptation to climate change impacts.

Scope

Building on the success of three initial demonstration sites, and to act urgently to begin transition, we have proposed to first develop a California State University-wide program to use nature for enhanced carbon sequestration via a positive feedback loop between carbon, plants and soil. Initial sites will be on CSU campuses across the state and CSU students and facility staff will be trained for program support with site preparation, maintenance, and research activities. We will also engage and train local Resource Conservation Districts (RCDs) to work with student trainers and research staff to provide technical assistance at sites in their communities. The full program is projected to include University of California and local community college campuses and to branch out to state and municipal landscapes.

Program elements:

- Train student groups on horticulture and agriculture practices to propagate and plant *Portulacaria afra* and interplanted trees and native plants relative to their region
- Train student groups on water conservation and re-use strategies to develop water capture and re-routing systems to support planted areas
- Work with site facility and maintenance staff to ensure long-term care and maintenance of planted areas
- Train student groups on carbon sequestration research skills to assist researchers in determining and managing enhanced carbon sequestration
- Train RCD staff on program practices to implement the program at community and municipal sites in their Districts, and to collaborate with Tribal Nation partners

The program will be replicated to target areas for conservation that provide connectivity and public health benefits, with an equitable, community centered approach. Student trainers and RCD staff will provide educational outreach, technical assistance and resources for community collaboration to replicate landscape "tune-up" practices in disadvantaged neighborhoods. Urban landscapes and underutilized lands will be planted, water sources

identified and developed, and residents trained to ensure long-term maintenance and promote resilience, sustainability and community wellbeing.

The RCDs will collaborate with Tribal Nations in their Districts for cross-cultural knowledge exchange to improve habitat connectivity in areas vulnerable to climate change and degradation. Knowledge of indigenous conservation practices will then be communicated to the student trainers and academic researchers.

The fully developed landscape "tune up" program will include the following activities:

- Work with CalTrans to divert and harvest highway water runoff to swales, to provide water to linear plantations of *Portulacaria* by planting the strips along state highways and utilize the significant amount of underutilized state land for increased carbon sequestration
- Landscapes at state penitentiaries renovated to drought tolerant permaculture farms that use less water, provide efficient carbon sequestration and organic food production for site use
 - a. Nursery creation to grow plants to be used on site, for state lands and for highway planting
 - b. Job training for post-incarceration career enhancement

Background

Across the state there are:

- 23 CSU campuses with Sustainability Officers on all campuses and the NSF-funded Campus as a Living Lab program where students confront real-world sustainability problems and address the planet's environmental challenges.
- 10 UC campuses, with two agricultural and natural resource programs: Agricultural Experiment Stations that support basic and applied research at the Berkeley, Davis, and Riverside campuses, and Cooperative Extension which conducts applied research and provides outreach to stakeholders across the state.
- 95 Resource Conservation Districts work with state, federal, and local agencies and non-profit partners to assist local famers, residents and land managers make smart conservation and land management choices.
- 116 Community Colleges with additional campus centers and classrooms spread over a wide range of geography, from mountains to coasts, and rural regions to big cities. Each college offers a diverse array of educational programs, with specializations that reflect the unique character of the local region.

Since 2019, CSUN's Institute for Sustainability (IS) in partnership with Mission RCD and Murray Farms, Inc. has developed and provided tools, resources and training for CSUN community members to maximize the carbon sequestration of their landscape systems. MRCD's support includes technical assistance to the on-campus center to develop and deliver science based, region specific information and technologies to inspire actions to tune up the carbon sequestration performance for landscape, agriculture, orchard and rangeland properties. The implemented Rapid Carbon Drawdown development sites are described below.

California State College Northridge (CSUN)

For nearly a century, CSUN's on-campus five-acre orange grove has provided bountiful fruit for CSUN and the greater community—a legacy of San Fernando Valley's agricultural past as well as a beacon for the future of urban farming and community agroforestry. Building on these efforts and in full collaboration with PPM, this project seeks to create new educational and harvesting opportunities for students, faculty, staff, and neighbors, including an ongoing carbon tune up maintenance plan. The goal of managing this space is to create an innovative, hands-on outdoor classroom, provide faculty/student research opportunities on soil science, carbon farming, pollinators, and regenerative urban agriculture. In the coming years, these efforts will coalesce with events and programming at CSUN's renown Soraya Center and the campus's new conference center and hotel.

In collaboration with MRCD, the IS is working on the rapid improvement of CSUN's irrigated landscape systems that could eventually double the current carbon sequestration of the campus in order to meet CSUN's goal of carbon neutrality by 2040.

These projects focus on the following areas:

- Job training and career "recapture"
- Carbon drawdown optimization of current resources
- Energy economy conversion
- Participatory Action Research (PAR) initiatives that support drawdown efforts.

Additional demonstration sites are under development where turf and landscape plants will be replaced for enhanced carbon sequestration and water conservation research studies.

Whittier College

The Whittier College demonstration site is a ¼-acre orchard that includes a California native plant section, raised beds, an outdoor teaching area, greenhouse, composting, and 125 carbon sequestering coffee and avocado trees. The project began with solarization of the ¼-acre lawn to create the space for a carbon drawdown research program with planting of coffee and avocado trees. Faculty, students, and staff continue to undertake leaf and soil analysis to measure rates of carbon sequestration.

Chatsworth Manor

The Conservation Concierges Project at Chastworth Manor includes a substantial Cal Firefunded initiative to create, or update, a long-term fire hazard reduction plan involving communities in the Top Tier Fire Hazard Severity Zones, creating fire adapted communities to reduce fire risk, encouraging insights, and best-practice ideas for managing hazardous fuel. The project also includes a carbon drawdown landscape implemented and maintained by CSUN as a teaching, research, and community fire mitigation space.

California State College Northridge (CSUN) Citrus Grove

For nearly a century, CSUN's on-campus five-acre orange grove has provided bountiful fruit for CSUN and the greater community—a legacy of San Fernando Valley's agricultural past as well as a beacon for the future of urban farming and community agroforestry. Building on these efforts and in full collaboration with PPM, this project seeks to create new educational and harvesting opportunities for students, faculty, staff, and neighbors, including an ongoing

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carbon tune up maintenance plan. The goal of managing this space is to create an innovative, hands-on outdoor classroom, provide faculty/student research opportunities on soil science, carbon farming, pollinators, and regenerative urban agriculture. In the coming years, these efforts will coalesce with events and programming at CSUN's renown Soraya Center and the campus's new conference center and hotel.

Solution

This program will specifically utilize planting of *Portulacaria afra*, a South African native shrub and an exceptional carbon sequesterer, with the added benefit of being extremely drought tolerant and fire retardant. (see references at the end of this document). Also called elephant's food, elephant bush, spekboom, this quick growing plant thrives in warm, sunny climates, and tolerates both hot and arid conditions as well as high humidity and rainfall. It is frost tender but typically will survive unless severely damaged. There are several varieties of *Portulacaria* including mounding and trailing varieties. These easy-care landscape plants are readily propagated from cuttings and can be found as ornamentals in many California landscapes.

Research has shown *Portulacaria* to have significant carbon storing capabilities (see references), and according to South Africa's Spekboom Foundation, "Its capacity to offset harmful carbon emissions is 10 times more effective per hectare at carbon fixing than any tropical rainforest." The South African government plans to plant it so extensively that the thickets can be seen from space.

A succulent, *Portulacaria* stores water in its leaves in order to survive their native dry, hot regions, and avoids desiccation by opening their stomata (a plant's leaf cells that allow for respiration, taking in carbon dioxide and releasing oxygen) primarily at night. Succulents utilize "crassulacean acid metabolism" (CAM) where they convert CO2 to a four-carbon organic acid used during the day for photosynthesis.

South Africa's Spekboom Challenge launched in 2019 by Boplaas Family Vineyards in the Western Cape seeks to help fight climate change with citizens committing to plant ten plants each for a million spekboom plants by 2025.

Turf and Landscape Replacement

Starting with an assessment of CSU campuses, identify and map turf and traditionally landscaped areas. For turf replacement, use standard solarizing practices to replace turf by mowing, composting, mulching, then wet and cover. During the 2 months until replanting *Portulacaria* in solarized areas and while cuttings are propagating, design water reuse via runoff capture and other conservation strategies to provide new plantings a source of water. Interplant trees for long-term sequestration, wind breaks and additional habitat; trees can be fruit bearing to provide an additional source of produce to the community. Interplant with attractive and colorful California natives for drought tolerant, wildfire resistant, pollinator and small wildlife habitat.

For landscape zones, remove water thirsty plants and compost, mulch and plant *Portulacaria* plugs and seed beds with colorful California natives, while designing water reuse and runoff capture strategies. Interplant trees as zones allow for long-term sequestration and additional habitat.

The local RCDs will collaborate with the CSU Sustainability Officers, students and programs to undertake the replacement, replanting and determination and design of water strategies in their Districts. The RCDs will engage with and provide technical assistance to local DACs and municipal entities to implement similar landscape tune-up practices.

The CSUs, UCs, community colleges and municipal entities have established landscape and facility maintenance departments and staff. These staff will be provided training to ensure site maintenance and longevity of the new plantings. These entities landscape and maintenance budgets can be drawn on to support the new landscaping.

Training

Training programs will be quickly developed by CSUN IS and supported by MRCD to enlist CSU student and local RCD participation. Training will be based on existing course structures, will use Zoom and Google Classroom platforms, and include in-person, hands-on training at the demonstration sites and the new sites. As current partners on a USDA-funded agroecology training program, CSUN and MRCD will adopt a similar 10-week curriculum and training template along with internships and site-specific practicum phases.

Best Practices

The proposed demonstration program will use established and proven best practices based on NRCS standards, including:

- Planting and soil health practices for enhanced carbon sequestration
- Repurposing and capturing water and waste-water and runoff

Conservation practices, frequently called best management practices (BMPs) are tools used by conservationists and growers to improve soils, reduce soil, fertilizer and water runoff and protect water and air quality while achieving multiple positive environmental outcomes. A variety of BMPs exist and are primarily used to modify land management practices on croplands. NRCS has more than 100 best management practices that include planting trees, shrubs and other woody plants for carbon sequestration. In addition to sequestering carbon and increasing soil water holding capacity, these practices increase soil fertility and address water conservation and quality, groundwater management, erosion control, storm water reduction, watershed health and provide habitat for pollinators and other wildlife.

Benefits

In addition to addressing many of the 30 x 30 Advisory Panel recommendations as listed above under Purpose, benefits of this program seek to improve:

- Carbon drawdown
- Healthy soils
- Habitat for pollinators and other wildlife
- Education including TEK, LEK and student-led programming
- Career skills development
- Community development and PAR
- Heat island reduction
- Knowledge transfer of indigenous conservation practices.

Cost / Budget

Initial request of \$250K to support planning and capacity building for rapid implementation across the state.

Campuses, municipal properties and other sites will be engaged to provide in-kind funds from existing facilities budgets and staff to ensure long-term, stable maintenance and care for planted sites.

Grant funding will be identified for additional dedicated funding to target and prioritize community engagement.

Tasks

Program Management and Administration (MRCD Lead)

- Coordinate Partners
- RCDs
- Coordinate and Develop Additional Sites
 - o DACs
 - o UC Campuses
 - o Community College Campuses
 - o State government sites
 - o Municipal government sites
 - Water Districts
- Coordinate Training for Site Support and Maintenance

Principal Investigator and Education Director (CSUN IS Lead)

- CSU Liaison and Coordination
- Training Material Development
- Train Students for Program and Research Support
- CSU Site Development and Management
 - o Survey slopes, wetlands, public use
 - o Site replacement design
 - o Water reuse design
- Research on Sequestration
- Outreach
- DACs Support
 - o Community TEK/LEK collaborations

Agriculture Advisor (Murray Farms Lead)

- Project Design and Development
- Training Material Development
- Project Implementation
 - o Portulacaria propagation and care
 - o Interplanting design and care
- Research Support on Sequestration

Team

We bring together a diverse group to provide specialized trainings, technical assistance, wraparound services, entrepreneurial support, and employment opportunities for students and residents in underserved communities.

MRCD

Mission Resource Conservation District, in Fallbrook, California brings more than 75 years of experience advising and assisting private landowners, growers and public agencies in northern San Diego County to conserve natural resources on their lands. MRCD has an established network of RCDs in the state to leverage for quick project implementation.

Darcy Cook serves as the District Manager at MRCD and works with the Board of Directors to carry out the District's mission and responsibilities. Darcy identifies and manages fundraising opportunities, grant applications and collaboration strategies, develops and coordinates programs and outreach, supervises staff and oversees financial administration and the annual budget. Her current efforts are locally focused and support water conservation, healthy soils and climate smart programs, beginning farmer education and pollinator habitat corridors.

Darcy's previous project management experience includes consulting work for nonprofit, startup and small business clients in the environmental, marine, energy and international arenas with research, development and implementation of collaboration strategies, fundraising efforts and programming to help environmental and blue tech startups scale. Darcy has a master's degree in international environmental policy from the University of California, San Diego's Graduate School of Global Policy and Strategy. Her focus was on China and Mandarin Chinese, and she spent 3 months in Taiwan researching their nascent environmental regulatory and business sectors. Darcy is an Advisory Member of the Berry Good Food Foundation, where she supports their school garden program.

CSUN IS

Through a platform of education, research, programming, and community integration, the Institute of Sustainability seeks to address our local, regional, and global ecological challenges. IS's approach incorporates a broad range of knowledge systems including traditional ecological knowledge (TEK), local ecological knowledge (LEK), and western science to educate the CSUN community and the community it serves. IS's mission and staff are committed to advancing environmental and food justice. The IS is a leader in serving the Hispanic community as a Federally recognized "Hispanic Serving Institution (HSI)" and has a diverse set of skills available to support the proposed program.

Natale Zappia, Ph.D.

Natale Zappia is a professor of history and Director of the Institute for Sustainability at California State University, Northridge. His work explores the intersection of food systems, Indigenous political economies, and ecological transformations across California and the American West. His 2016 book, *Traders and Raiders: The Indigenous World of the Colorado Basin* (UNC Press), tells the early history the Lower Colorado River, a watershed that looms large over the modern urban landscapes of Los Angeles. Zappia was also the Associate Project Director of the Early California Cultural Atlas, a digital atlas mapping indigenous migration

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across California between 1769-1848, and co-creator of Open Gaarden, an urban gardening policy and agricultural history app. Before his academic career at CSUN and Whittier College, Zappia served as the Executive Director of the Garden School Foundation, an environmental non-profit based in South Los Angeles focusing on ecological literacy. He participates in several related public history and community-based outreach projects in LA, including the 2015-16 Project 51, a yearlong public humanities initiative connecting communities throughout Los Angeles to the region's 51-mile concrete river. He currently works with local tribal communities in Southern California on the Los Angeles Landscape History Mapping project.

Murray Farms

Murray Farms focuses on diversified, small farm production of a variety of vegetables, culinary herbs and fruits, selling to chefs and direct to consumers. Their Edge of Urban Farm in Vista is a high-density, permaculture research and production farm on 1.2 acres with 120 low-chill stone fruits, 148 avocado varieties, 100 coffee cultivars and 40 citrus trees planted with low water usage methods and is used for teaching, research and food events.

Scott A. Murray

Scott has been an organic farmer since 1974, working both in California and Mexico. Scott has been a student of agroecology since he studied at UC Santa Cruz in the early 1970's and has designed and implemented farms for a variety of clients in diverse locations from southern Mexico's tropical zone to the cold valleys of southern Oregon. Scott has supported educational projects over the past 20 years, ranging from the makeover of the Fallbrook California Ivy Continuation High School into an organic farm campus, to helping fund and develop a 20-acre organic farm on the 200-acre San Pasqual Academy Campus in Escondido California that supports 128 fostered high school students living on campus.

Scott has taught at the high school and college levels as an Associate Professor and served as an Elected California Conservation official for the last 28 years, currently serving in his 30th year as the President of the Board of Directors of Mission Resource Conservation District (MRCD) located in Fallbrook, and on the Board at MESA, located in Berkeley for the last 18 years. Scott conducts research with several college campuses in southern California to measure soil carbon drawdown and to demonstrate new high-density planting techniques combining avocado trees with coffee trees.

Scott co-developed continues to oversee and support research on the Whittier College Coffee and Avocado grove for Carbon Drawdown research in 2018; the CSUN campus innovative polyculture plantings of coffee and fruit trees in 2019; new test resurrection of the historic heirloom orange trees on campus, and development of a test plot with polyculture makeover beginning summer 2022; coffee and fruit tree polyculture planning and planting project 2020; and consultant on a CSUN team to a \$4.7 million CalFire fuel reduction and community safety grant awarded July 2022.

Podcast list:

- Urban Farm Podcast: based in Phoenix AZ
- High Density Avocado planting
- High Density Coffee Growing in Southern California

- Using Agricultural Crops to Maximize Carbon Drawdown
- Extreme Fruit Tree Planting

Action

Once funds have been committed, the Team will immediately:

- Reach out to colleagues at CSU sustainability institutes and programs to identify potential sites
- Training programs will be developed and student groups identified
- The RCDs in the CSU regions will be engaged and trained as a first wave
- Cuttings of *Portulacaria afra* are already being propagated, this will ramp up with the establishment of propagation infrastructure at the new sites

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CNRA, Natural and Working Lands Climate Smart Strategy, April 22, 2022 CNRA, Pathways to 30×30: Accelerating Conservation of California's Nature, April 22, 2022

Climate Advisory Panel Summary Document, <u>Expanding Climate Action Through Nature-Based Solutions</u>, June 2, 2021

Biodiversity Panel Summary Document, <u>Advancing 30 x 30 and Protecting Biodiversity</u>, July 27, 2021

Equity Advisory Panel Summary Document, <u>Using Nature-Based Solutions to Advance</u> Equity June 8, 2021

Topical Workshops

Workshop 1: Expanding Climate Action through Nature-Based Solutions

Workshop 2: Using Nature-Based Solutions to Advance Equity

Workshop 3: Advancing 30x30 and Protecting Biodiversity

Workshop 4: Advancing 30x30: Conservation of Lands

Workshop 5: Advancing 30x30: Conservation of Coastal Waters

Green spaces and heat mitigation https://climateadapt.ucsd.edu/can-green-spaces-mitigate-heat-related-hospitalizations/



OPEN ACCESS

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Data Availability Statement: All relevant data are within the manuscript and its <u>Supporting</u> information files.

RESEARCH ARTICLE

A biome-wide experiment to assess the effects of propagule size and treatment on the survival of *Portulacaria afra* (spekboom) truncheons planted to restore degraded subtropical thicket of South Africa

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Abstract

Insights from biome-wide experiments can improve efficacy of landscape-scale ecological restoration projects. Such insights enable implementers to set temporal and geographical benchmarks and to identify key drivers of success during the often decades-long restoration trajectory. Here we report on a biome-wide experiment aimed at informing the ecological restoration of thousands of hectares of degraded subtropical thicket dominated by the succulent shrub, Portulacaria afra (spekboom). Restoration using spekboom truncheons has the potential to sequester, for a semi-arid region, large amounts of ecosystem carbon, while regenerating a host of associated ecosystem services. This study evaluates, after about three years post-propagation, the effects of spekboom truncheon size and treatment on survivorship in 40 fence-enclosed (0.25 ha) plots located in target habitat across the entire spekboom thicket biome. In each plot, locally harvested spekboom truncheons, comprising eight size/treatment combinations, were planted in replicated rows of between 24 and 49 individuals, depending on treatment. The experiment assessed the role of truncheon size, spacing, application of rooting hormone and watering at planting on survivorship percentage as an indicator of restoration success. All eight combinations recorded extreme minimum survivorship values of zero, while the range of extreme maximum values was 70-100%. Larger truncheons (>22.5 mm diameter) had almost double the survivorship (ca. 45%) than smaller truncheons (< 15 mm) (ca. 25%). Planting large, untreated truncheons at 1 m intervals—as opposed to 2 m intervals recommended in the current restoration protocol resulted in no significant change in survivorship. The application of rooting hormone and water at planting had no significant effect on restoration success for both large and small truncheons. While our results do not provide an evidence base for changing the current spekboom planting protocol, we recommend research on the financial and economic costs and benefits of different propagation strategies in real-world contexts.

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Competing interests: The authors have declared that no competing interests exist.

Introduction

Many restoration projects implemented at the scale of landscapes seldom achieve their stated goals of restoring biodiversity and ecosystem services to pre-degradation levels [1-3]. Low restoration efficacy has been linked to a wide range of factors mostly acting in concert [4]. These include site factors such as variation in soil type or local climate, landscape context such as the proportion of landscape that is degraded, differences in degradation trajectories, and inadequate funding or political will to sustain interventions [5-9] Given the complexity of these factors, effective restoration practice typically requires planning at fine spatial scales [8, 10, 11], which combines expertise from a wide range of disciplines [12]. Also crucial is a commitment to routine monitoring and evaluation [13-15], which ideally should be expressed as a quantitative valuation of restoration outcomes [16] to evaluate efficiency and cost-benefits at certain stages along a commonly decades-long restoration trajectory [17-19]. In this regard, robust, biome-wide experiments—albeit costly and difficult to implement—may be critical for establishing benchmarks to evaluate efficiency and effectiveness over time and space, as well as to identify the main factors influencing the restoration process.

Payments for ecosystem services, including carbon sequestration, are potentially viable options to finance restoration action on a landscape-scale in many contexts [2, 20–24]. In some ecosystems, increasing carbon storage post restoration, both above- and belowground, is fundamental to achieving state transition and can be used as a proxy for restoration efficacy during the first decades of the restoration process [2, 17, 25–28]. Such opportunities are promising despite the uncertainty surrounding the global carbon price and the implementation of carbon taxation [29, 30]. In contexts where restoration outcomes have strong socio-economic imperatives, it is useful to measure effective restoration in terms of monetary costs and benefits [4, 31, 32]. Thus, cost-effectiveness, quantification of benefits and losses and related timescales are of prime concern [3, 33–36]. This is true in the context of this study, a developing country with high rates of poverty, where restoration initiatives must "earn their keep" [37].

Subtropical thicket dominated by *Portulacaria afra* (hereafter referred to as spekboom thicket)—a leaf succulent shrub to low tree—forms part of South Africa's Subtropical Thicket biome [38, 39]. Characterized as a dense, tangled mass of low trees (up to 5 m in height) and large shrubs—which are often spinescent, succulent, or both— spekboom thicket has been extensively degraded by injudicious land-use practices, particularly through over-browsing by domestic goats [40–43] (Fig 1). Approximately 45% of spekboom thicket (5,519 km² out of a total of 12,624 km²) had been altered in this manner by 2000 [44].

Spekboom can shift between C3 photosynthetic and Crassulacean Acid Metabolism (CAM) in response to increased water stress, longer photo periods and increased daytime temperatures [45–47]—thereby retaining productivity during drought periods. It is highly palatable and widely used as a fodder plant by mega-herbivores such as elephant (*Loxodonta africana*), buffalo (*Syncerus caffer*), black rhinoceros (*Diceros bicornis*) and greater kudu (*Tragelaphus strepciseros*), as well as domestic stock such as goats and cattle. It is regarded as the backbone of southeastern South Africa's highly lucrative angora mohair industry [48] and forms the foundation of the regions thriving wildlife and ecotourism economies [49].

Intact spekboom thicket stores carbon of about 200 t·ha⁻¹ (measured up to a soil depth of 50 mm)—a remarkable feature for a xeric ecosystem [50, 51]. Most of this carbon stock is associated with spekboom litter fall [52, 53] its dense canopy provides the relatively cool and dry conditions necessary for the accumulation of the high levels of soil carbon [54-56] and maintenance of biodiversity [49, 57]. Comparisons of degraded and intact sites reveal carbon losses of more than 80 t C·ha⁻¹ [50, 58]. These losses are evident from the decrease in aboveground biomass Fig 1, but also manifest as a massive reduction in soil organic carbon content [59, 60].

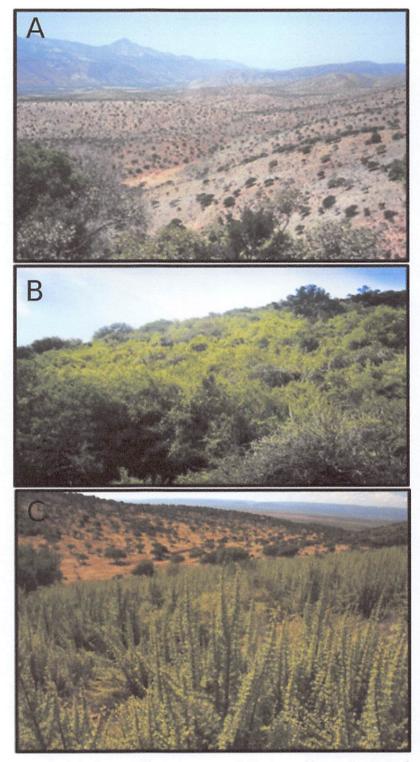


Fig 1. Degraded and intact spekboom sites compared with a 3-year old restoration site. A: a foothill landscape comprising livestock-degraded spekboom (*Portulacaria afra*) thicket where all spekboom has disappeared, leaving only woody canopy shrubs of *Pappea capensis* and *Euclea undulata* with a field layer of largely ephemeral plants. B: intact spekboom thicket (2-3 m tall) located in the same region as the top photo. Note the dense canopy of spekboom, scattered *P. capensis* trees on the skyline, and absence of bare ground (photos: RM Cowling). C: a thicket-wide plot

(TWP) located in target habitat and subject to low browsing intensity. Note the good establishment and growth of spekboom truncheons approximately three years after planting (photo: ML van der Vyver).

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Under current environmental conditions, degraded spekboom thicket does not regenerate spontaneously to its intact state [40, 41, 54, 55]. However, planting spekboom truncheons does restore populations of this species [17, 52], sequester relatively large amounts of carbon [17, 52, 61] and—after 30–50 years—facilitate the restoration of other members of intact spekboom thicket, including long-lived trees and shrubs [17]. Indeed, after this period of restoration, the restored state resembles the intact state in terms of biodiversity, vegetation structure and ecosystem services. However, the transition from degraded to intact states requires the replenishment of above- and belowground carbon, which is achieved using the ecosystem engineering properties of spekboom [17]. Stands under restoration older than five years are scarce, and studies quantifying appropriate reference sites in terms of biodiversity, ecosystem services, structure and function are few. Research on established (5-50 year) stands under restoration report annual total carbon sequestration rates of between 1.4 and 4.5 t C ha⁻¹ yr⁻¹ [17, 52, 62]. These data were derived from restoration stands which were informally established by landowners and hence, lack information on implementation techniques such as truncheon size, planting depth, planting season and truncheon spacing.

To inform best-practice for the biome-wide restoration of spekboom thicket, the Subtropical Thicket Restoration Project (STRP)—a community of scientists, government officials and implementers [50]—established in 2007 a thicket-wide plot (TWP) experiment, comprising 300 plots (Fig 1), over the entire range of spekboom thicket. A major goal of the TWP experiment was to evaluate different truncheon planting techniques to identify the most efficient and effective protocols for maximising annual carbon sequestration rates throughout the restoration trajectory. Using 173 of the thicket-wide plots described above, Van der Vyver et al. [63] applied a rule-based learning ensemble to identify the physiographic and management-related factors that best predict restoration efficacy. Browsing impacts and the misidentification of target habitat (i.e. location of plot in non-spekboom thicket vegetation) emerged as the two most important predictors, negatively affecting both survivorship and carbon sequestration. However, this study was restricted to only one of the treatments applied to the spekboom truncheons—representative of the current restoration protocol used by the STRP—namely planting large (22.5 mm diameter) truncheons every two meters with no applications of root hormone or water at planting (Treatment 2 in Table 1).

Understanding the effects of different truncheon planting methods is of great importance to the STRP. For example, while planting larger truncheons may positively influence restoration efficacy, efficiency may be compromised relative to planting smaller truncheons which, because of their abundance in source sites and requirement for shallower holes, are likely less costly to harvest and to plant. Similarly, while watering at planting may increase survivorship, the effort and costs of getting water to remote restoration sites may well outweigh this benefit. In this paper, we focus on the effectiveness in terms of truncheon survivorship, or the benefit side, of different planting methods, and refer to costs only indirectly and qualitatively. Here, we assess combinations of eight treatment/size combinations (hereafter treatments) to explore the role of truncheon size (measured as stem diameter), spacing of truncheons, application of rooting hormone and application of water at planting on truncheon survivorship, approximately 3.5 years after planting. For this analysis, we selected the subset of plots (n = 40) that were in target habitat (spekboom thicket) and exposed to low browsing intensity—factors that promote restoration success of spekboom [63]. While the post-restoration period is sufficiently long to accommodate the post-planting mortality peak, it is too short to provide a useful

Table 1. Treatments applied to truncheons of spekboom (Portulacaria afra) planted in 40 plots (0.25 ha) located across the extent of spekboom thicket vegetation	ion
(see Fig 2).	

Treatment	Mean no. (range) of alive truncheons per plot	Stem diameter (mm)	Planting depth (mm)	Additional treatment
1	85.8 (165-5)	30	30	None
2	78.8 (145-5)	22.5	30	None
3	30.3 (70-1)	22.5	30	2-m spacing
4	75.2 (132-5)	22.5	30	Rooting hormone
5	78.3 (150-11)	22.5	30	Water at planting
6	22.9 (56-0)	15	15	None
7	26.6 (67-3)	10	10	None
8	29.3 (87-0)	10	10	Water at planting

Notes: Other than Treatment 3, all truncheons were planted at 1 m intervals.

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assessment of patterns of carbon sequestration in relation to truncheon treatment; this will be undertaken shortly, now that the experiment has run for more than a decade.

Study area

The study area comprises the global distribution of spekboom thicket, delimited by the Fish River drainage in the east and the Gouritz River drainage in the west (Fig 2) [39]. This region is highly heterogeneous in terms of topography, climate, geology and soils and is home to eight biomes which interdigitate in complex ways [39, 64]. Spekboom thicket is often, but not exclusively, associated with relatively deep, shale-derived and mostly rocky soils on sloping ground [39]. Annual rainfall is bimodally distributed, with peaks in spring and autumn. In the west, more rain falls in the cooler months while the east may experience appreciable summer

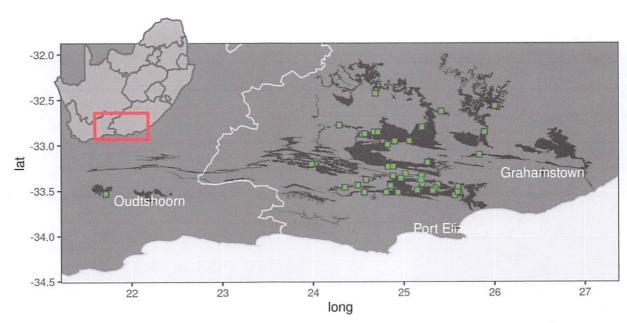


Fig 2. Map of the study region showing the extent of the spekboom thicket vegetation (dark shading) and location of the 40 experimental plots used in this study (green squares).

https://doi.org/10.1371/journal.pone.0250256.g002

5/17

rain. Mean annual precipitation ranges from 250 mm in the western, inland regions to 550 mm in the eastern, coastal regions [48]. Localised flash-floods and prolonged droughts are not uncommon. Summers are very hot with temperatures often exceeding 40°C; winters are mild, but the nights may be cold and frost occurs regularly in bottomlands because of cold-air pooling [65–69]. Spekboom thicket eschews frost-exposed terrain [67, 68]. The geology is dominated by rocks associated with the Cape Supergroup (quartzitic sandstones, shales), Karoo Supergroup (mudstones, shales) and Uitenhage Group (mudstones, conglomerates). Other than Cape sandstones, which yield infertile sands, other geologies yield mainly moderately fertile and relatively clay-rich soils [64, 70, 71].

Materials and methods

Experimental plots

Our study used 40 of 300 0.25 ha plots established throughout the spekboom thicket biome between March 2008 and October 2009 by unskilled teams contracted and trained by the national Department of Environmental Affairs' Working for Woodlands programme via its implementing agent, the Gamtoos Irrigation Board (for more details, see van der Vyver et al. subm.). Managers and contracted teams were given training to enable them to harvest spekboom cuttings of suitable dimensions from nearby intact stands and plant these in multiple rows, according to different treatments within a fenced herbivore exclosure of 0.25 ha (50 x 50 m) (Fig 1). Fencing comprised a 1.2 m high wire-mesh stabilised by steel droppers and wooden posts at the corners. Two strands of wire were added to increase the height to circa 1.4 m to prevent access by domestic stock and potentially deter (but not eliminate) entry by the large, indigenous browser, the greater kudu (*Tragelaphus strepsiceros*).

In each plot, the eight treatments were replicated by 2–4 rows, comprising 49 truncheons (27 truncheons per row in Treatment 3 where truncheons were planted at two-meter intervals) (Table 1). Treatment 3, comprising truncheons of 22.5 mm diameter, planted at 30 mm depth with no additional treatment, is the current planting protocol for landscape-scale restoration projects implemented by the STRP. Other treatments were distinguished according to stem diameter of truncheons and the application of extraneous treatments, namely the root hormone 4-Indole-3-Butyric Acid (IBA) and water (200 ml) at planting. We did not vary planting depth systematically. Given the widespread stoniness of spekboom soils, the excavation of planting holes is time-consuming and expensive. Thus, we applied planting depths commensurate with maintaining the truncheon in an upright position in the face of wind, rain and browsing. These depths are 30 mm for larger truncheons and 10–15 mm for smaller ones (Table 1).

Treatment rows were assigned randomly. This design created problems for data collection as treatments in many plots could not be identified, owing to poor database management. Thus, only 162 plots were retrieved where all treatments could be identified and sampled. Of these, we focused here on the 40 plots that were in the correct target habitat (spekboom thicket and associated ecotones that were identified in the field by an expert thicket ecologist) and subject to a moderate or low browsing intensity. This was done because these were the explanatory variables identified in rule-based, predictive models as having the strongest positive effects on both survivorship and carbon sequestration of one of the treatments (Treatment 3 in Table 1) [63].

Data collection

The response variable for this experiment was survivorship percentage of planted truncheons. Data were collected by a scientific services company (Conservation Support Services) between

Table 2. Combinations of treatments for assessing impacts of a specific treatment on the survivorship of spekboom (*Portulacaria afra*) truncheons (see <u>Table 1</u> for description of treatments).

Target treatment Description		Treatment combinations1	Planting depth (mm)		
Stem diameter	30, 22.5, 15 & 10 mm diameter	1,2,6,7	1 & 2 = 30 6 & 7 = 15		
Spacing	1 or 2 m 22.5 mm diameter	2,3	30		
Rooting hormone	Yes or no 22.5 mm diameter	2,4	30		
Water at planting	Yes or no 22.5 & 10 mm diameter	2,5 & 7,8	30 & 10		

June 2012 and January 2013, some 33–57 months (3–5 years) after planting, depending on when a particular plot was planted. Thus, all plots were at least about three years post-planting at the time the survivorship data were collected, by which time mortality rates would have stabilised. Survivorship of planted truncheons per treatment was quantified by counting all alive, dead and missing truncheons in all planted rows in each plot.

Experimental design and statistical analysis

We combined different treatments (Table 2) to test hypotheses on the effects on survivorship of stem diameter, spacing of truncheons, application of rooting hormone and addition of water at planting. Survivorship was predicted to be positively related to stem diameter, since greater reserves in the succulent stems of larger truncheons would confer greater resistance to bouts of prolonged water stress post-planting [72, 73]. We also expected that the denser 1 m spacing would—owing to intraspecific competitive effects typical of many semi-arid communities [74, 75]—reduce survivorship, thereby reducing the benefits for carbon sequestration of their higher density. Finally, we posited that the application of rooting hormone and water at planting would improve survivorship [63, 76], specifically for smaller truncheons with fewer reserves. Survivorship data were normally distributed for all analyses. Hence, we used parametric statistics to test hypotheses (one-way ANOVA and Welch two sample t-tests). We used base R [77] to implement all statistical analyses, while graphics were created with the tidyverse [78] and ggplot2 [79] packages.

Results

We recorded significant variation in survivorship across all treatments for (F = 12.97; P < 0.0001) (S1 Fig). All treatments recorded extreme minimum survivorship values of < 5%, while extreme maximum values of > 90% survival were observed in three treatments, including one using small truncheons. Treatment 1 (30 mm diameter truncheons with no additional treatment) (Table 1) recorded highest mean survivorship (44%) whereas lowest mean survivorship (24%) was recorded for Treatment 6 (15 mm diameter truncheons with no additional treatment).

Survivorship was significantly influenced by truncheon size (F = 11.96; P< 0.0001). As we predicted, larger truncheons (> 22.5 mm diameter) had significantly higher (almost two-fold) survivorship (ca. 45%) than smaller truncheons (< 15 mm diameter) (ca 25%) (Fig 3). However, differences between the two larger diameters (Treatments 1 and 2, see Table 1) were not significant, nor were differences between the two smaller diameters (Treatments 6 and 7). This implies that a truncheon diameter of 22.5 mm is a likely low-size threshold for maximizing survivorship of spekboom truncheons in restoration projects. When compared to the STRP restoration protocol of planting truncheons of 22.5 mm diameter at 2 m intervals (Treatment 3 in Table 1), decreasing the planting interval to 1 m (Treatment 2) had no effect (t = -0.017; P = 0.99) on survivorship (Fig 4).

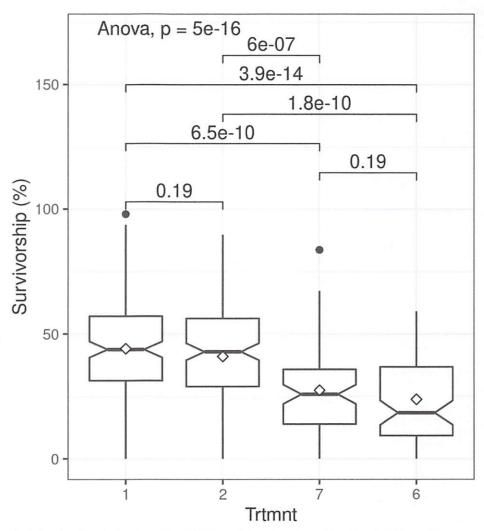


Fig 3. Boxplots showing the effect of stem diameter of planted spekboom (*Portulacaria afra*) truncheons on percentage survivorship for different stem diameters (Trtmnt) (1 = 30 mm, 2 = 22.5 mm, 6 = 15 mm and 7 = 10 mm; see Tables 1 and 2 for details). Within-box horizontal lines depict median values and the diamonds depict mean values. The paired comparisons above the boxes are P values for t-tests.

Applying rooting hormones to truncheons of 22.5 mm diameter had no significant effect on survivorship (t = 0.99; P = 0.32) (Fig 5) nor did the application of 200 ml of water prior to planting of truncheons with diameters of 10 mm (t = -1.19; P = 0.24) and 22.5 mm (t = 0.26; P = 0.079) (Fig 6).

Discussion

Our study shows that over the duration of the experiment, survivorship was maximised by planting large (22.5 and 30 mm diameter) truncheons, irrespective of the application of additional treatments. Treatments using larger truncheons recorded a survivorship of ca. 45%, almost twice as high as those using smaller truncheons. Extreme upper values of > 90% survivorship that we recorded for three treatments (two large-truncheon and one small-truncheon treatments) represent a high level of success for perennial plant restoration in semi-arid

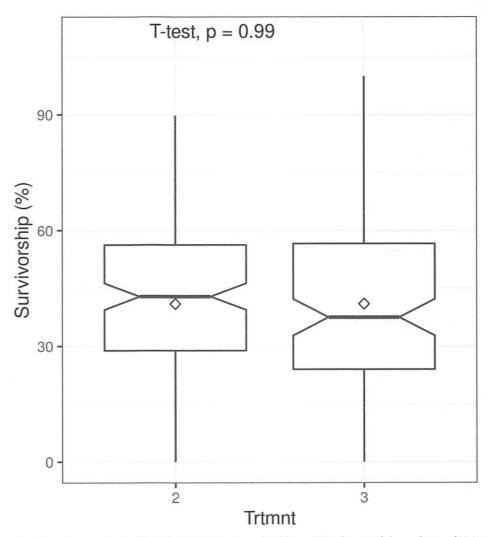


Fig 4. Boxplots showing the effect of spacing at planting of spekboom (*Portulacaria afra*) truncheons of 22.5 mm diameter on survivorship (Trtmnt 2 = 1-m spacing, Trtmnt 3 = 2-m spacing; see Tables $\underline{1}$ and $\underline{2}$ for details). Within-box horizontal lines depict median values and the diamonds depict mean values.

environments, where poor performance is the norm [80–84]. In their review of 54 restoration experiments across a range of ecosystems, [83] showed that nursery-grown seedlings used in restoration projects had a mean survivorship of 62% whereas survivorship of seedlings emerging from in situ sowing of seeds was only 18%. In a semi-arid setting comparable to the context of this study, survivorship of the best performing 3-month old seedlings of three shrubs barely reached 31%, even after added moisture [80]. Indeed, planting cuttings instead of transplanting containerised rooted seedlings grown in a nursery, is generally less successful in terms of survivorship [85]. When carrying out such planting activities, it is important to note that the defining characteristic for survivorship of planted propagules is root to shoot ratio. Sufficiently developed root systems of transplanted seedlings or even bareroot seedlings confer better drought tolerance [86, 87] than stem cuttings with no roots. In this respect, the survivorship values we recorded in this study for large truncheons are remarkably high, especially when

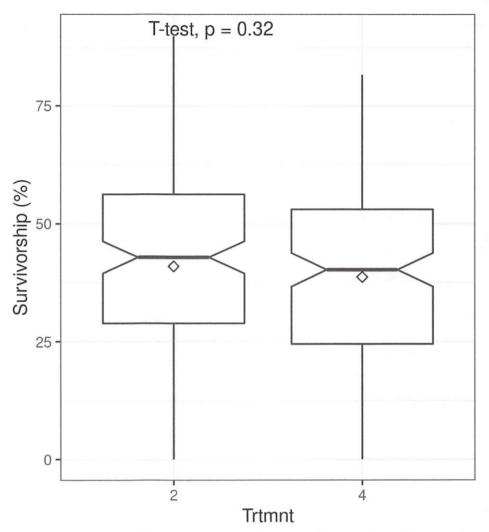


Fig 5. Boxplots showing the effect on survivorship of root hormone application at planting (Trtmnt 2 = no hormone, Trtmnt 4 = hormone application; see Tables $\underline{1}$ and $\underline{2}$ for details) of spekboom (*Portulacaria afra*) truncheons of 22.5 mm diameter planted at 1 m intervals. Within-box horizontal lines depict median values and the diamonds depict mean values.

taking into consideration the reduced implementation costs of planting truncheons directly into the restoration site [17].

Treatment effects

It is not surprising that, in a stem-succulent plant such as spekboom, larger truncheons performed better in restoration experiments than smaller truncheons. The larger the truncheon, the greater the amount of internally stored resources to weather droughts and tolerate exposure to inclement weather and browsing— as has been shown in other revegetation contexts [73, 88–90]. However, restoration using smaller truncheons is likely less costly in terms of truncheon harvesting, transport and planting, than using larger truncheons. Using smaller truncheons will also reduce the impacts of harvesting on intact sites used as a source of truncheons. Research is urgently required on the economic and ecological costs and benefits of

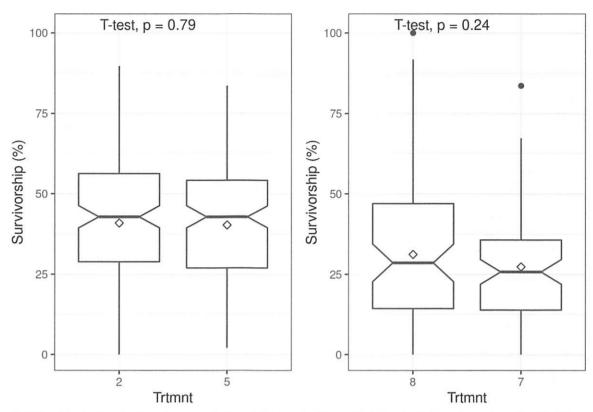


Fig 6. Boxplots showing the effect of water application at planting of spekboom (*Portulacaria afra*) truncheons on survivorship. The top panel is for 22.5 mm diameter truncheons and bottom panel is for 10 mm diameter truncheons, all planted at 1 m intervals. Treatments (Trtmnt) 5 and 8 had water application whereas treatments 2 and 7 had none (see Tables 1 and 2 for details). Within-box horizontal lines depict median values and the diamonds depict mean values.

planting different sized truncheons. We do not know the ecophysiological details of this truncheon size effect, another topic requiring further research. The almost two-fold higher survivorship of 22.5 mm versus 15 mm diameter truncheons is intriguing. The similar survivorship of truncheons of 30 mm and 22.5 mm diameter is also of interest. The practical implication of this is that the STRP protocol for selecting truncheon size can remain unchanged until rigorous cost-benefit analyses of using different truncheon sizes have been undertaken.

Doubling the planting density of large (22.5 mm diameter) truncheons relative to the STRP protocol showed no negative impacts on survivorship. This suggests that the likely increased (below-ground) competition among more densely planted truncheons does not affect survivorship. Planting truncheons less densely will also reduce the impact on intact sites used as a harvesting source of truncheons for restoration. However, planting at wider intervals may increase the time taken for spekboom canopy closure and the positive feedbacks this has for improving soil organic matter, reducing runoff and evaporation, enhancing soil water holding capacity facilitating biodiversity return [17, 55, 91]. Based on these data, we see no reason to change the STRP planting guidelines of 2 m spacing for 22.5 mm diameter truncheons. Although the experiment did not assess the potential impacts of planting density of smaller truncheons, we suspect that the lower carbon sequestration of planting these at 2 m intervals would outweigh the economic and ecological benefits of using smaller truncheons.

We found no positive effects of applying either rooting hormone or water-at-planting on survivorship, irrespective of truncheon diameter. This is surprising given the results from other studies that recorded positive effects on restoration efficacy of applying these treatments [17, 92–94]. We would have expected, at least for the smaller (10 mm diameter) truncheons, that water-at-planting would have positively influenced survivorship [94]. Since rooting of cuttings of 17 succulent species takes between 21 and 53 days, depending on temperature [95], improved survivorship could be achieved by applying additional moisture three to four weeks after planting by which time most spekboom truncheons may have rooted. However, van der Vyver et al. [63] found only a weak, positive effect of the amount of rain falling post-planting on the survivorship of truncheons planted according to the STRP protocol.

An improved protocol for restoring spekboom thicket

The array of treatments used in this study falls short of what is required to comprehensively inform an improved protocol for spekboom restoration. More research is required on extraneous treatments for maximizing survivorship, and spacing patterns for maximizing rates of canopy closure, with the concomitant increases in ecosystem service delivery, including the restoration of pre-degradation biodiversity [17]. Nonetheless, overall the STRP protocol of planting untreated, 22.5 mm diameter truncheons at 2 m intervals produced survivorship rates equivalent to the best among the other treatments. We see no reason to change this protocol until rigorous cost-benefit analyses have been undertaken for other treatments. Given the likely reduced costs, planting smaller truncheons shows great promise; we urgently recommend cost-benefit research using small truncheons for spekboom restoration.

Supporting information

S1 Fig. Box plots showing results for survivorship for all treatments (see Tables 1 and 2 for details). Within-box horizontal lines depict median values and the diamonds depict mean values. (TIF)

S1 Data. (CSV)

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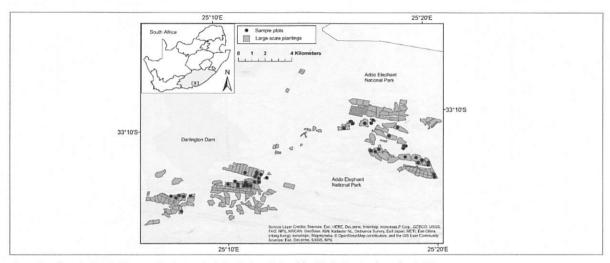


Figure 1: Sample plots and large-scale plantings in Addo Elephant National Park in the Eastern Cape, South Africa.

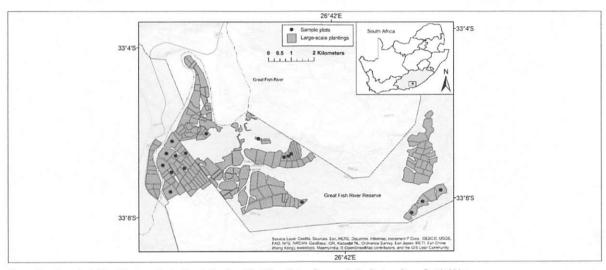


Figure 2: Sample plots and large-scale plantings in the Great Fish River Nature Reserve in the Eastern Cape, South Africa.

Table 1: Spekboom cutting survivorship (%) for different (a) sites, (b) geology types and (c) aspects

		а					
Site		п	Mean	Median		s.d.	
Addo Elephant National Park	4	17	31	28		24	
Great Fish River Nature Reserve	1	7	20	16		15	
Combined	6	64	28	24		23	
		b					
Site		Dwyka			Ecca		
	n	Mean	s.d.	п	Mean	s.d	
Addo Elephant National Park	29	35	28	18	25	14	

Site	Flat			North-facing			West-facing		
	п	Mean	s.d.	n	Mean	s.d.	п	Mean	s.d.
Addo Elephant National Park	19	24	20	28	36	25	-	-	-
Great Fish River Nature Reserve	7	18	16	7	25	15	3	13	6
Combined	26	22	19	35	34	24	-	-	-

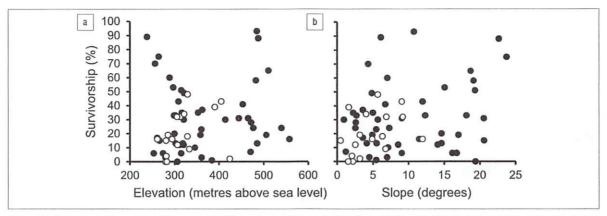


Figure 3: Spekboom cutting survivorship in relation to (a) elevation and (b) slope in Addo Elephant National Park (solid circles) and Great Fish River Nature Reserve (open circles).

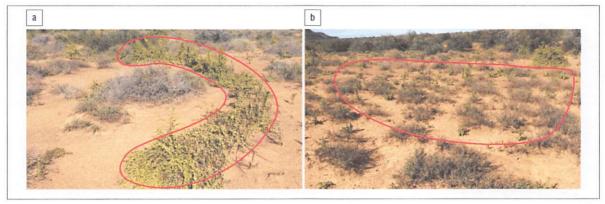


Figure 4: Comparison of spekboom growth after ~5 years after planting at Camdeboo National Park: (a) in dense clusters in a trench and (b) as single cuttings.

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Survivorship of spekboom (*Portulacaria afra*) planted within the Subtropical Thicket Restoration Programme

Through the Subtropical Thicket Restoration Programme (STRP), about 21.5 million cuttings of spekboom (Portulacaria afra) were planted over the period 2004–2016 in the Addo Elephant National Park, Great Fish River Nature Reserve and the Baviaanskloof Nature Reserve. This planting includes a large experiment of 330 quarter-hectare plots in which 14 different planting treatments were used.¹ These experimental plots, known as the 'thicket-wide plots', comprised 200 000 cuttings, with the remaining 21.3 million cuttings planted out in what were called the 'large-scale plantings'. Some of the large-scale plantings were replanted with cuttings — a procedure referred to as blanking. The positioning and number of cuttings used in each blanking operation was not recorded and consequently the surviving cuttings in any particular landscape within the large-scale plantings cannot be aged accurately. Notwithstanding the limitation of many sites in the large-scale plantings made up of cuttings planted in different years, we saw value in monitoring survivorship of cuttings in random plots within the large-scale plantings, simply to determine the likely outcomes of the South African government's investment in planting 21.5 million cuttings over the past 12 years.

In June and November 2015 we collected survivorship data in large-scale plantings from 47 plots in Addo Elephant National Park and 17 plots in Great Fish River Nature Reserve (Figures 1 and 2). We used the STRP database hosted by the Gamtoos Irrigation Board in Patensie (Eastern Cape) to identify appropriate areas for sampling across a range of topography and geology. At each plot (20 m by 20 m) we counted all living cuttings and estimated survivorship using the assumption that each plot had originally contained 100 cuttings. This assumption was based on the standard STRP planting protocol of planting cuttings 2 m apart, i.e. 2500 cuttings per hectare. It should be noted, however, that depending on the rockiness of a particular landscape, the distance between cuttings – and consequently the original number of cuttings in each of our study plots – would have varied.

The data show that survivorship in the large-scale plantings is extremely variable, ranging from 0 to 93%, with a mean of 28% across all 64 plots sampled (Table 1a). Geographical reasons for this variation were not evident in our data set (Table 1b,c; Figure 3). A generalised linear model showed, for example, that geology, aspect, elevation and slope were not related to survivorship.

To better inform planting protocols of future restoration efforts, we suggest that future studies examine the effects of inter alia soil temperature, soil water content and quality of planting operations on cutting survivorship. Importantly, the future monitoring of large-scale plantings should be undertaken in such a way that the effects of blanking can easily be taken into account in analyses of cutting survivorship. Lastly, permanent monitoring plots should be established in some of the large-scale plantings immediately after planting to ensure that accurate baseline data on the number of cuttings planted in a particular plot are captured.

A new planting protocol (Figure 4) that has proved successful in Carndeboo National Park is the planting of cuttings in bunches in trenches or micro-basins (Taplin B 2016, personal communication, May 5). This protocol ostensibly results in rainwater harvesting in the depressions which increases the rate of growth of cuttings relative to individual cuttings planted outside of depressions. If the dense clusters of spekboom cuttings ultimately form vigorous patches of mature plants that expand outwards in all directions — as is evident in some photographic records (Hoffman T 2016, personal communication, June 22) and old restoration sites² — the number of micro-basins excavated per hectare could be reduced to 25 to 50, as opposed to the current protocol of 2500 holes per hectare.

The average survivorship of 28% of the 21.3 million cuttings planted to date by the STRP means that the likely current legacy of the programme is ~6 million surviving spekboom cuttings. Based on results from old restoration sites^{2,3}, many of these cuttings will in time form large spekboom clumps which will — where herbivore stocking densities are appropriate — continue to expand for decades to come. The end result will consequently be a new matrix in which other species of thicket plants can establish.⁴ Assuming that 5 million of the 6 million surviving plants will over the rest of the 21st century grow to establish thicket patches of ~4 m in diameter, based on a conservative 25-mm cutward spread per annum (i.e. a 50-mm increase in diameter of the thicket patch per annum), ~7000 ha of thicket will have been restored by 2100 through an investment totalling ~ZAR100 million. Given the considerable benefits of restored compared with degraded thicket in terms of soil quality^{3,5}, infiltration of rainwater⁶, carbon sequestration⁷ and herbivore carrying capacity⁸, this investment by the South African public is likely to be deemed worthwhile by future generations. To reach such a conclusion, however, a comprehensive analysis of the costs and benefits in terms of public goods (e.g. contribution to baseflow in rivers) and private goods (e.g. tourism and wildlife) over the ensuing decades would be required. Such an analysis would ideally track the change in value of the restored thicket through time and would assist government as well as the private sector to take informed decisions on investments in the upscaling of thicket restoration.

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