

TERRACESCAPE Final Event

Athens - 30/06/2022

Recovery projects along trails and terraced areas: the Cinque Terre National Park experience

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www.parconazionale5terre.it

www.stonewalls4life.eu

Main topics

- General overview of Cinque terre morphological and land use features
- Terraced landscape in 5 terre: rise, decline and resumption
- Stonewallsforlife Project
- Trail maintenance crew «Manutentori» and path management

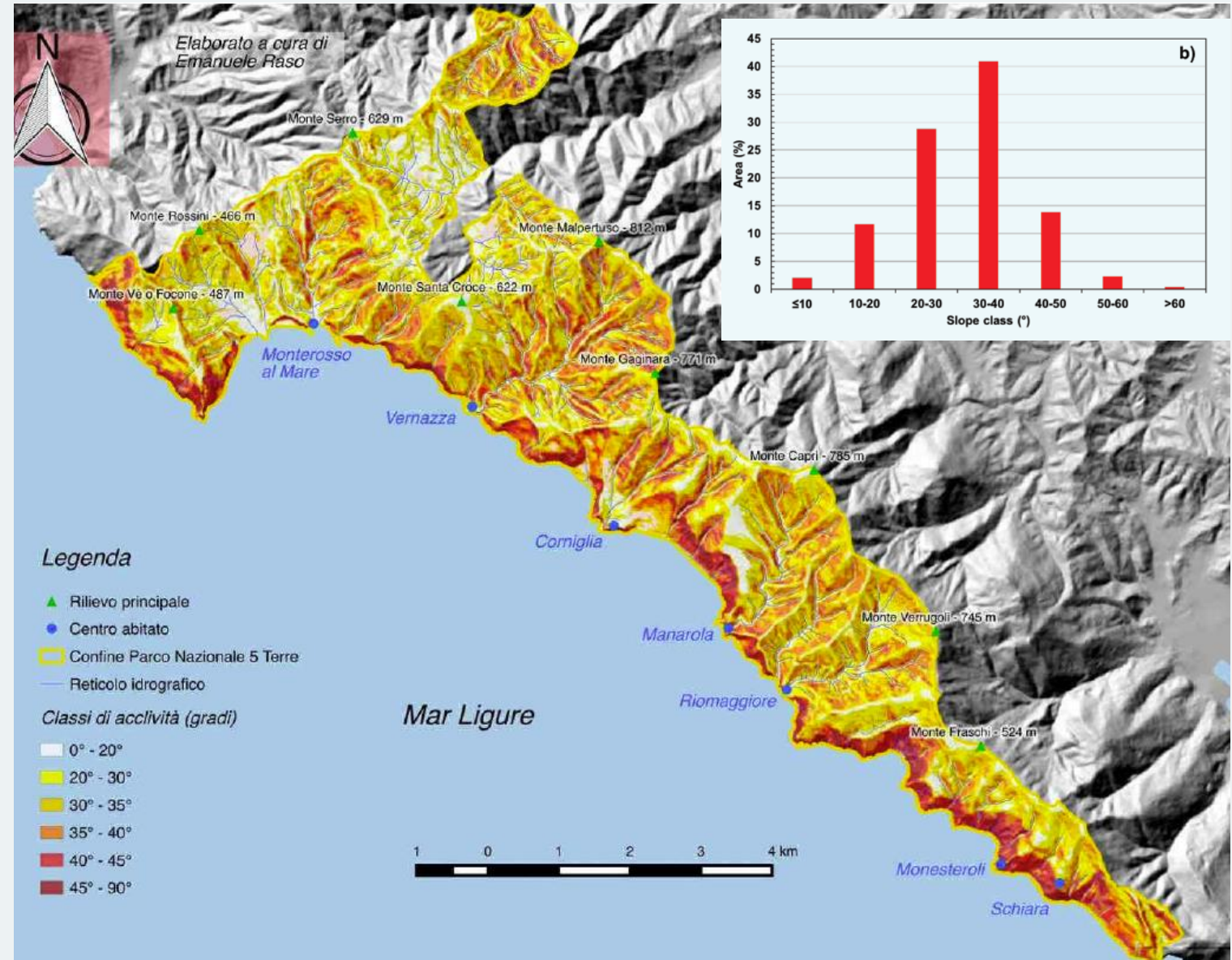


General overview of Cinque terre morphological and land use features

Slope chart

The Cinque Terre National Park has a few flat areas, and a concentration of areas characterized by slope gradients above 35° , especially along the coastal strip (up to 2-300 meters above sea level) and along the lateral valleys of the catchment areas ;

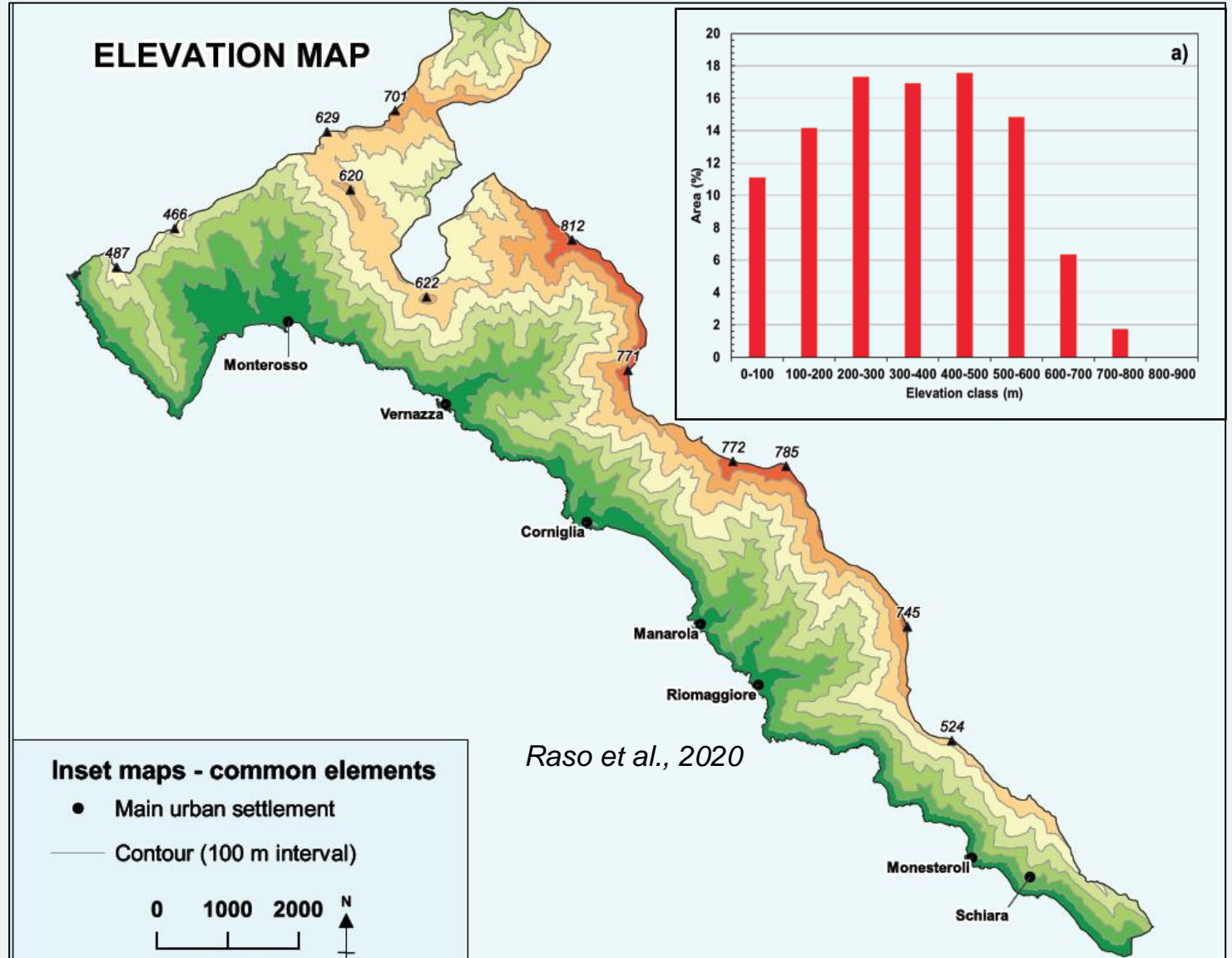
More than 40% of the PN5T territory shows a slope gradient comprised between 30 and 40 degrees



General overview of Cinque terre morphological and land use features

Elevation map

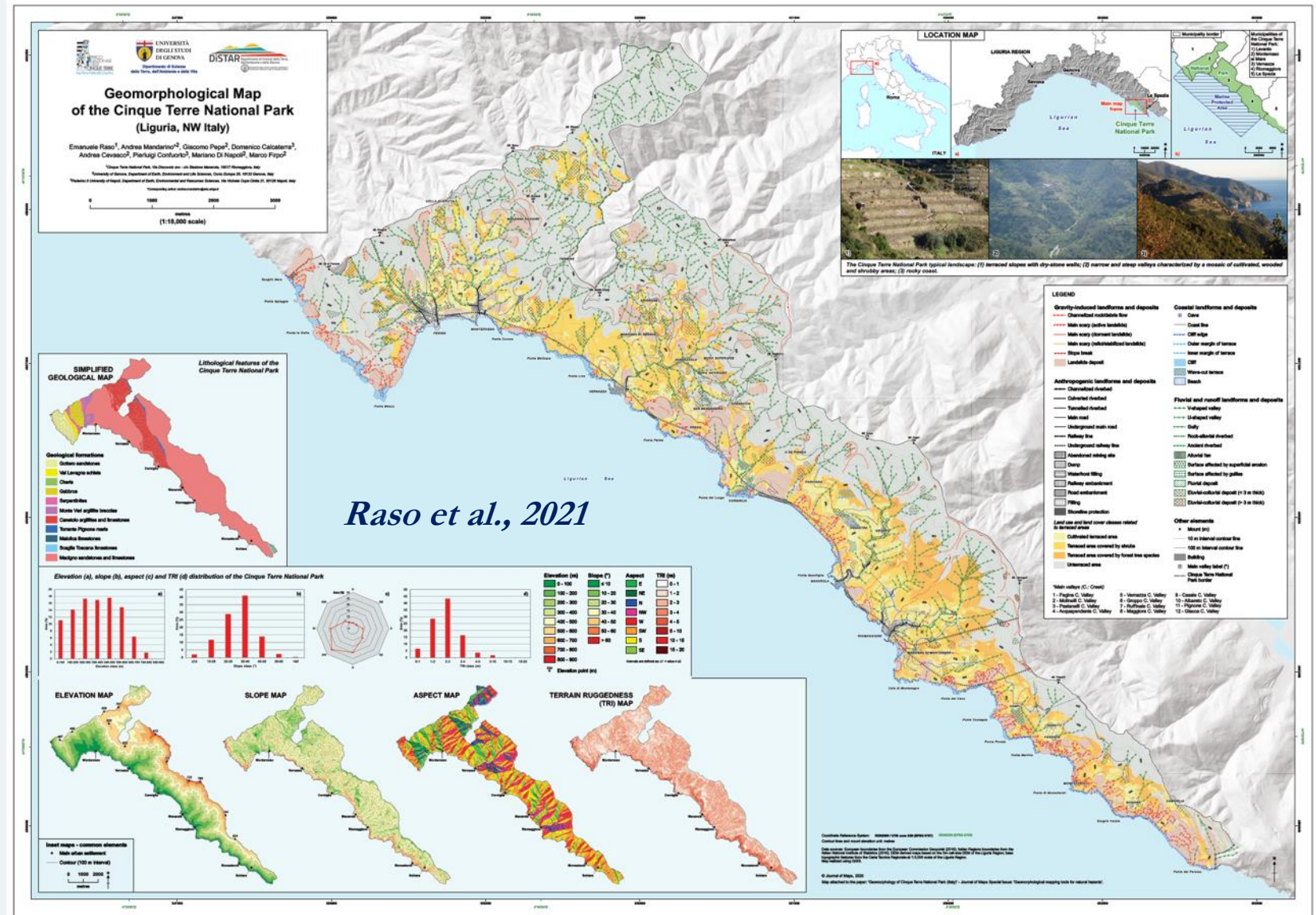
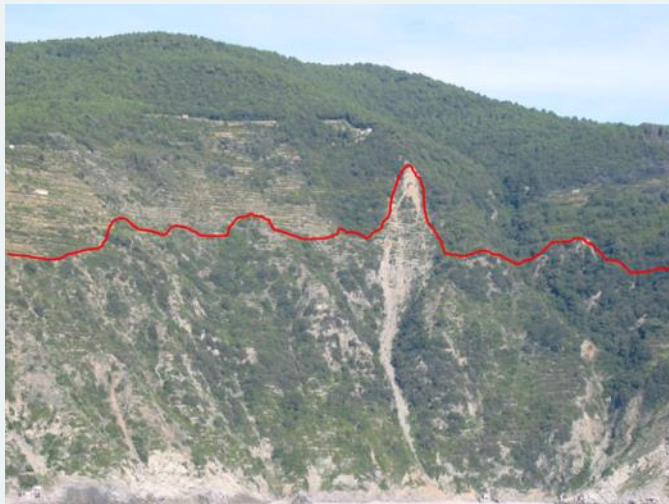
- Over 75% of the CTNP territory is characterized by altitudes exceeding 200 meters;
- The maximum heights are detected along the ridge separating Tyrrhenian watersheds from the inner land: they range from 812 meters of Monte Malpertuso (behind Vernazza) to 785 meters of Monte Le Croci (above Manarola);
- The short distance between the ridge and the coast line, combined with non-negligible altitude values, is a **determining factor for rainfall intensity rates**, especially during the transition between the summer and autumn seasons;



General overview of Cinque terre morphological and land use features

Geomorphological map of the Cinque Terre National Park (2020)

- Over **459 landslides** (area > than 25 m²) have been recorded
- Presence of a **erosional coastal scarp edge** above the coastline
- Fluvial landforms: majority of **V-shaped valleys**, bedrock-confined channels.
- Anthropogenic forms: **man-made terraces** delimited by dry stone walls, road and railway embankments



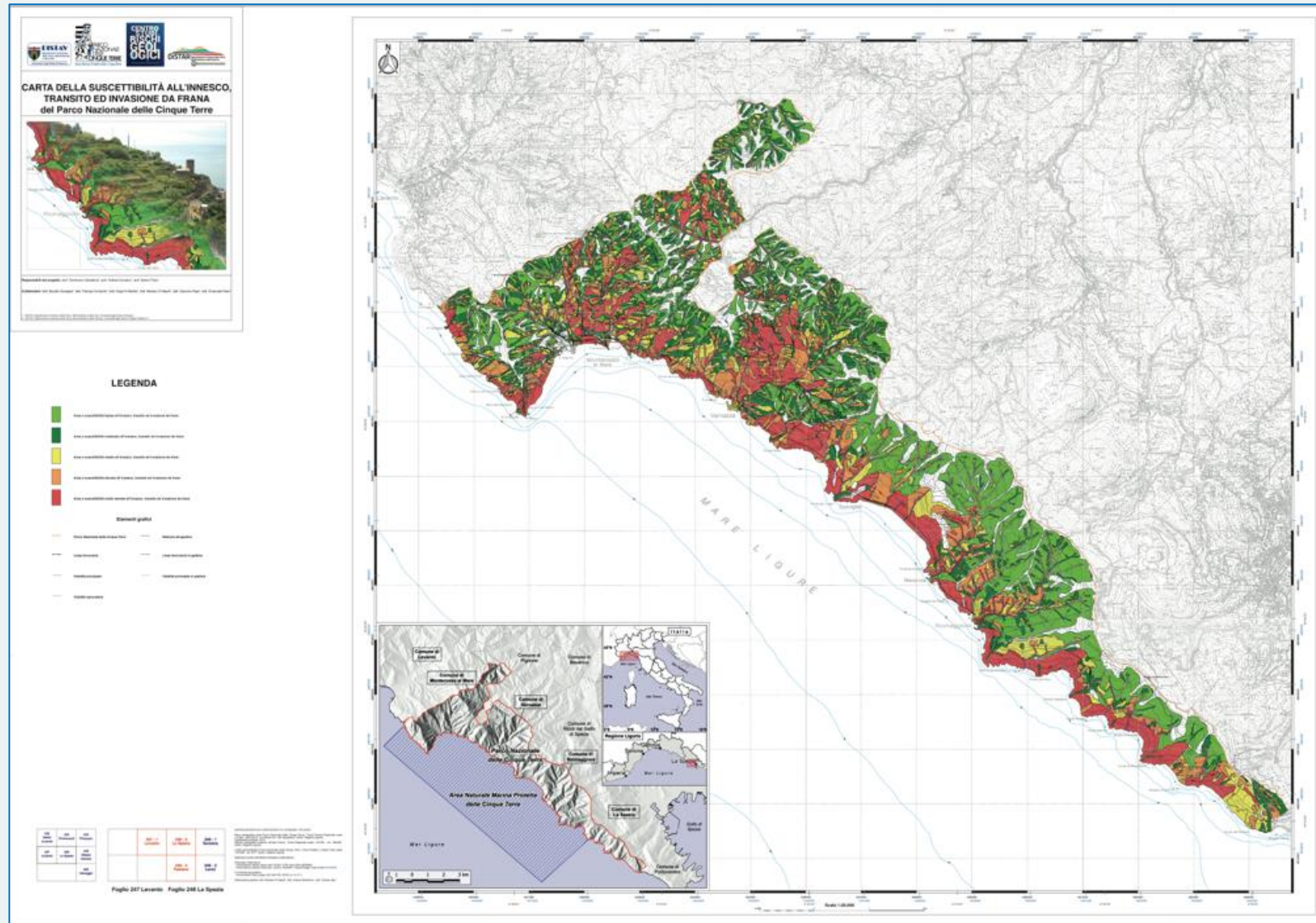
General overview of Cinque terre morphological and land use features

Susceptibility map (triggering and run-out) of the Cinque terre National Park (Raso et al. 2020 – Di Napoli et al. 2020)

Landslide susceptibility is the likelihood of a landslide occurring in an area on the basis of local terrain conditions (Brabb, 1984).

The elaboration of susceptibility map can be obtained through:

- Heuristic methods
- Deterministic methods
- Statistical-probabilistic methods

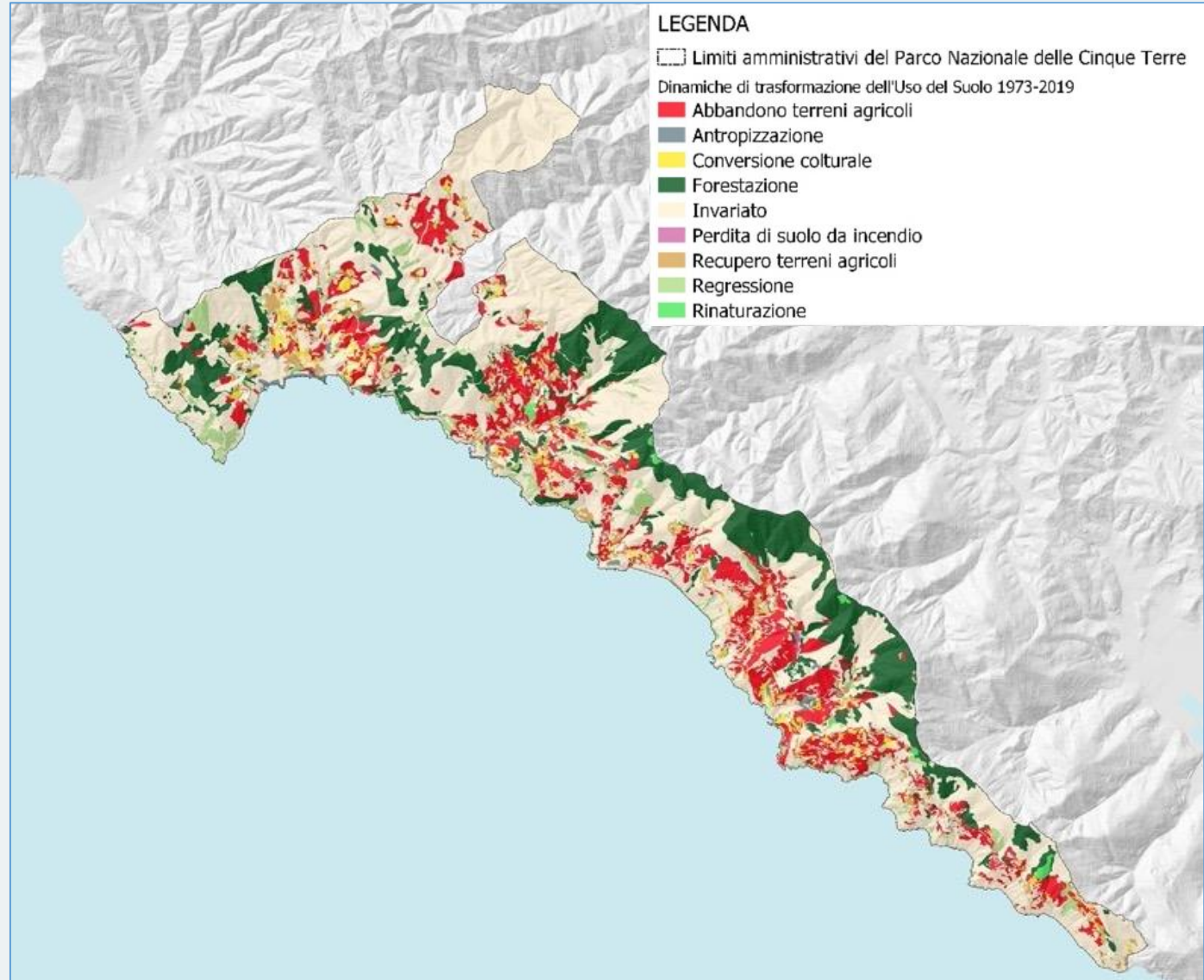


General overview of Cinque terre morphological and land use features

Land use and forest management dynamics (1973 – 2019)

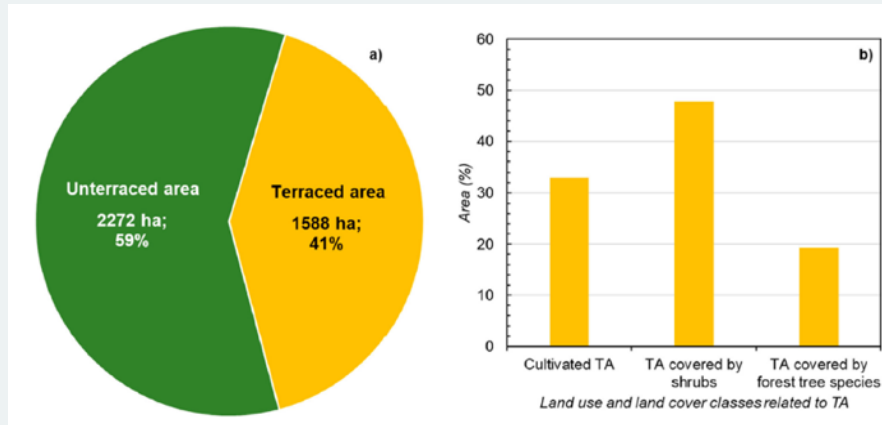
The most widespread degradation process that compromises the integrity and therefore the **authenticity of the agricultural landscape** of the Cinque Terre, concerns the abandonment of crops and the renaturalization that occurs through successive phases of **recolonization** of the fields, pastures, terraces and embankments **by the arboreal and shrubby vegetation**.

Other geomorphological and phytosanitary nature are indirectly and directly related to other severe issues such as **forest fires**, which represents a socio-territorial problem. The **forestation process** is the most widespread dynamic and has affected about 21% of the Park territory



General overview of Cinque terre morphological and land use features

Land use and vegetation cover



- About 16 km² out of 38 (total surface of the CTNP) are terraced (presence of dry stone walls)
- The terraces bounded by dry stone walls are found either in currently cultivated areas (a, b) or mixed (e), recently abandoned – shrub covered (c, d), or wooded areas (f)

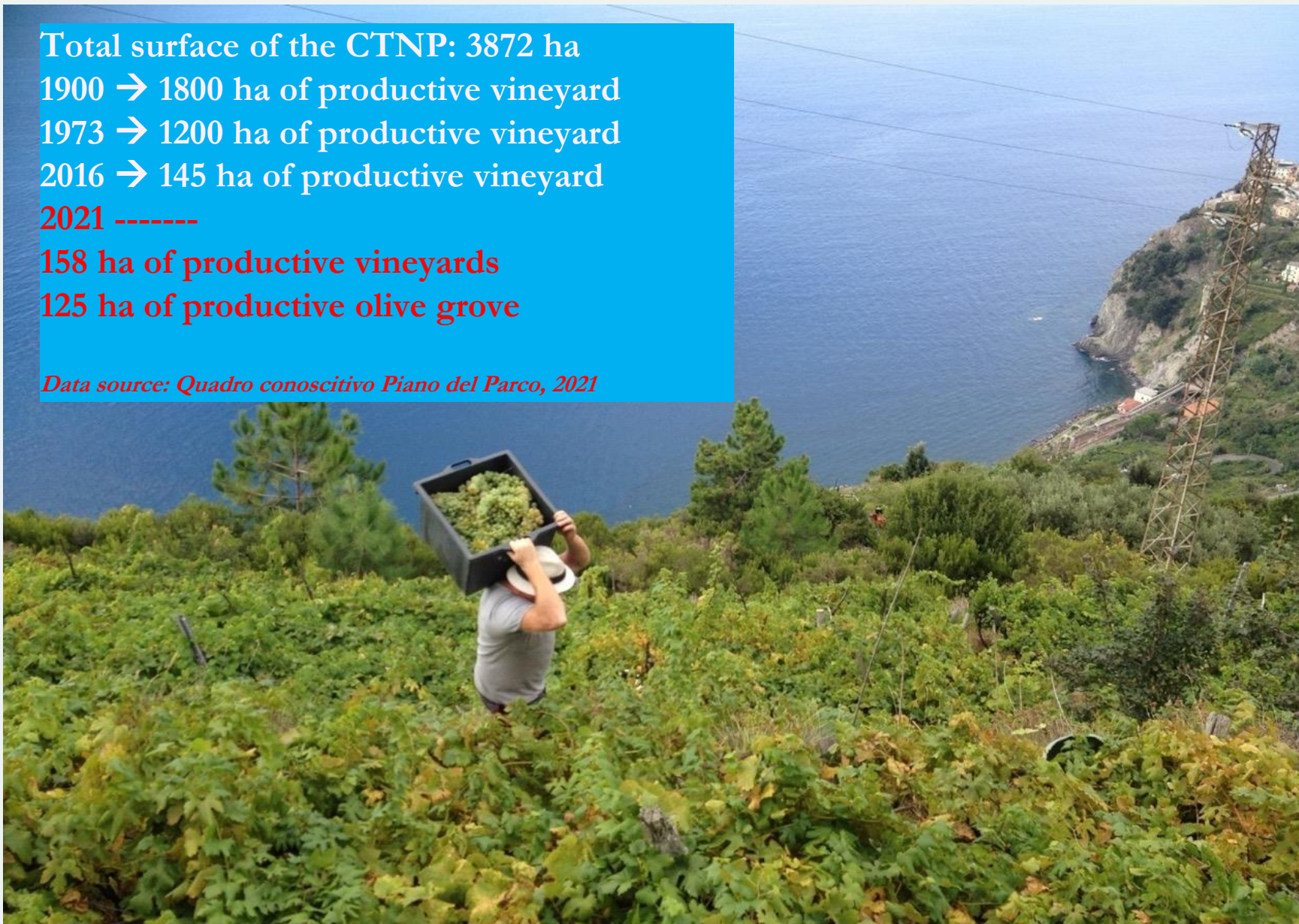


Raso et al., 2020

Terraced landscape in 5 terre: rise, decline and (slight) resumption

Total surface of the CTNP: 3872 ha
1900 → 1800 ha of productive vineyard
1973 → 1200 ha of productive vineyard
2016 → 145 ha of productive vineyard
2021 -----
158 ha of productive vineyards
125 ha of productive olive grove

Data source: Quadro conoscitivo Piano del Parco, 2021



STONEWALLSFORLIFE project



PROJECT LOCATION: Parco Nazionale delle Cinque Terre (Liguria - Italy); Parc del Garraf (Catalonia - Spain).

Grant Agreement no. LIFE18 CCA/IT/001145

Sub-programme:

CLIMATE CHANGE ADAPTATION

BUDGET INFO:

Total amount: 3,714,493 €

% EC Co-funding: 2,039,748 € (55%)

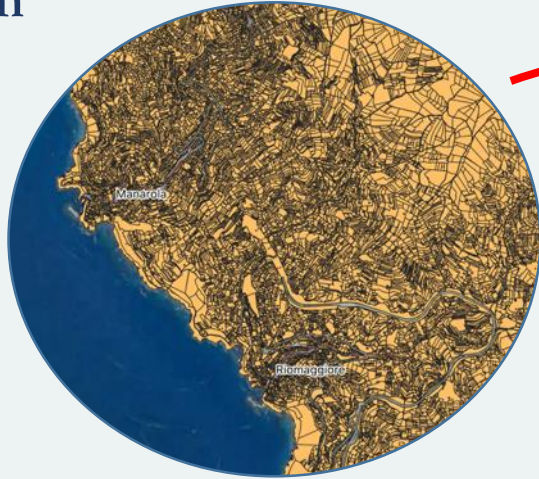
July 2019 – September 2024

www.stonewalls4life.eu



The strategy

Extreme parcelling of the cadastral system



Development of the farms



High frequency of natural phenomena

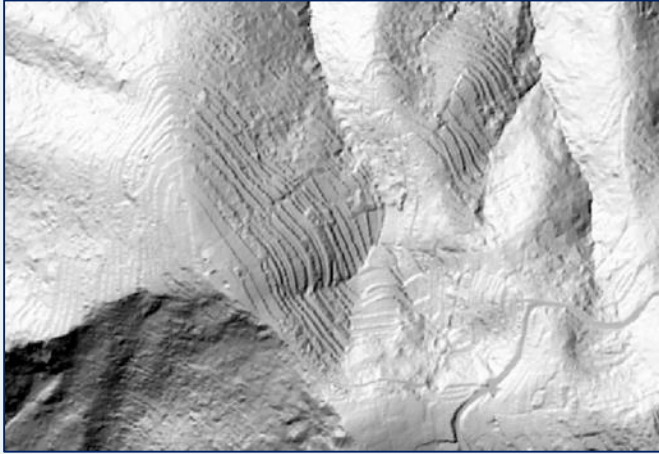


Risk awareness

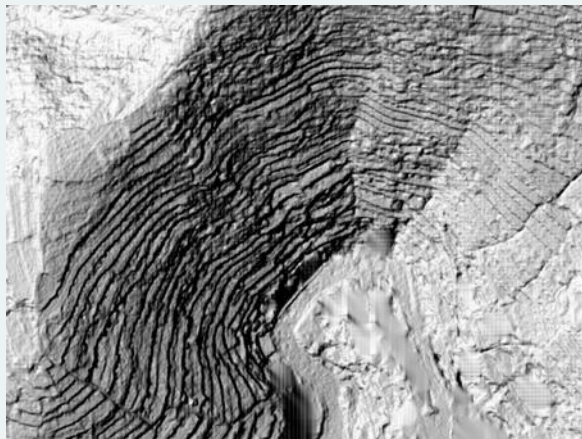


Activity carried out (2019 – 2022)

High-detail digital products



DTM 1m x 1m



DTM 20cm x 20cm

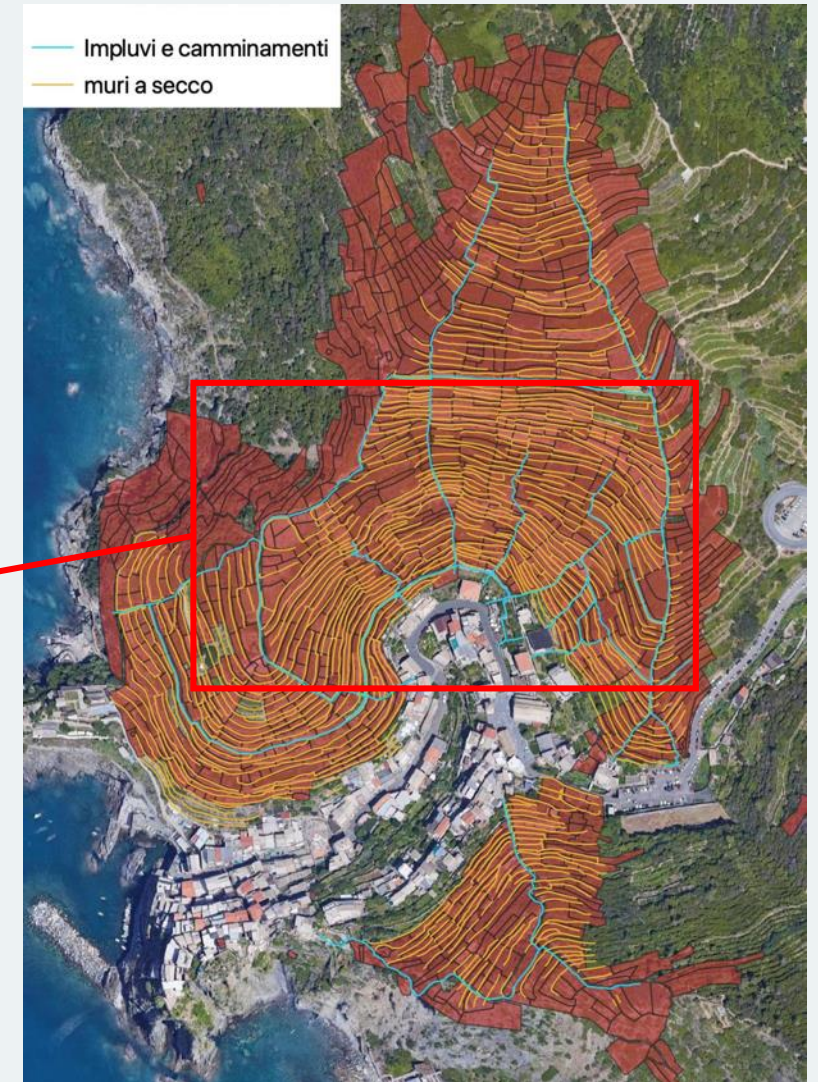


3D models + high res ortophotos (1 pxl
= 5 cm)



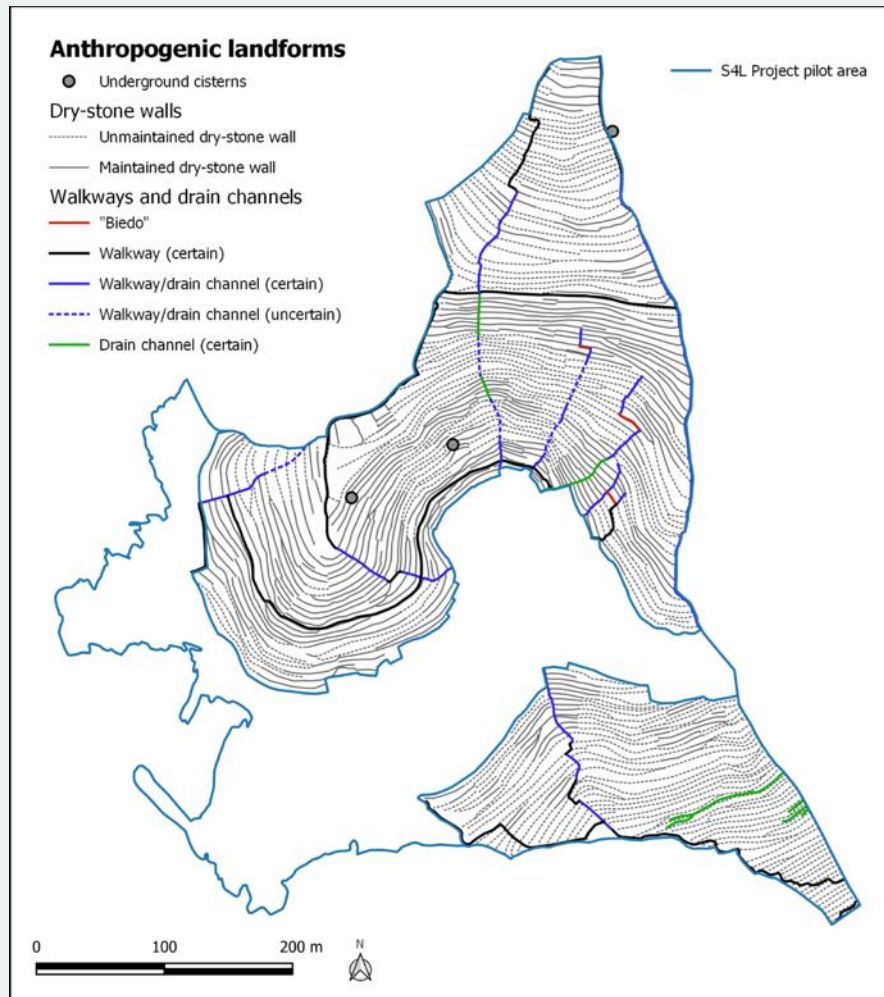
Digitalization of dry stone walls
linear elements (vectors)

Digitalization of main morphological features



Activity carried out (2019 – 2022)

Anthropogenic landforms and geological survey at the pilot site



Activity carried out (2019 – 2022)

Invasive vegetation removal and dry stonewalls topographical survey



December 2021



February 2022

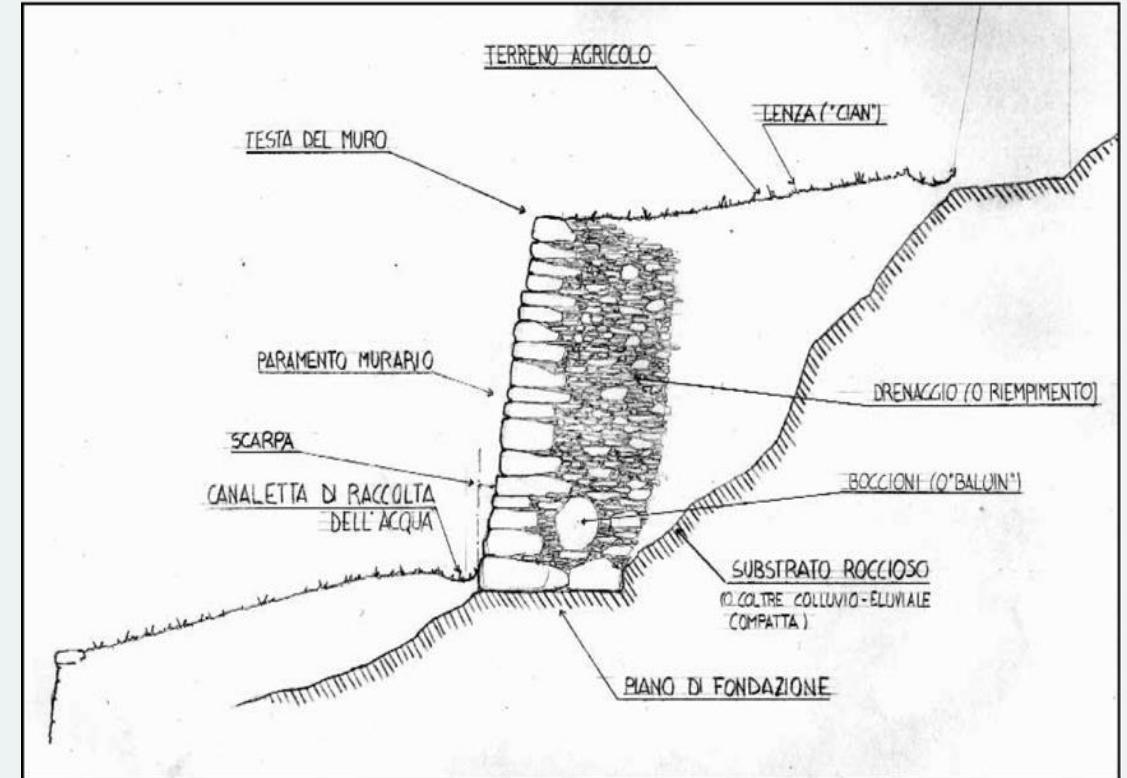
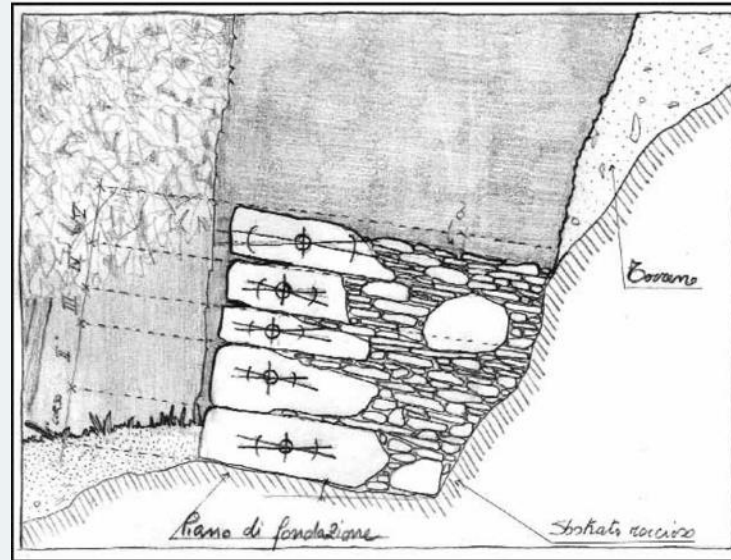
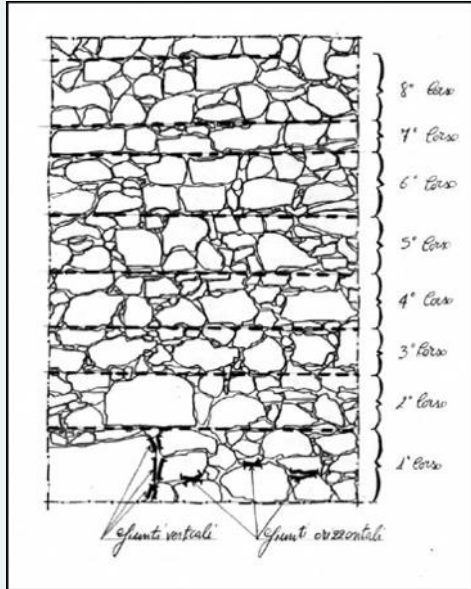
Activity carried out (2019 – 2022)

Invasive vegetation removal and dry stonewalls topographical survey



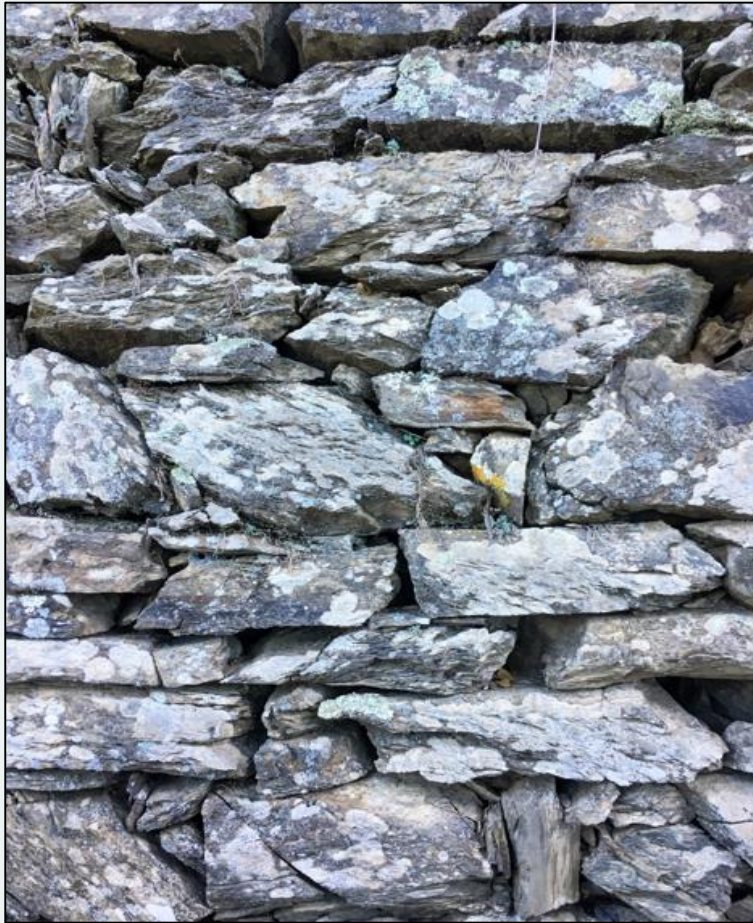
February 2022

The role played by dry-stone walls in slope stability

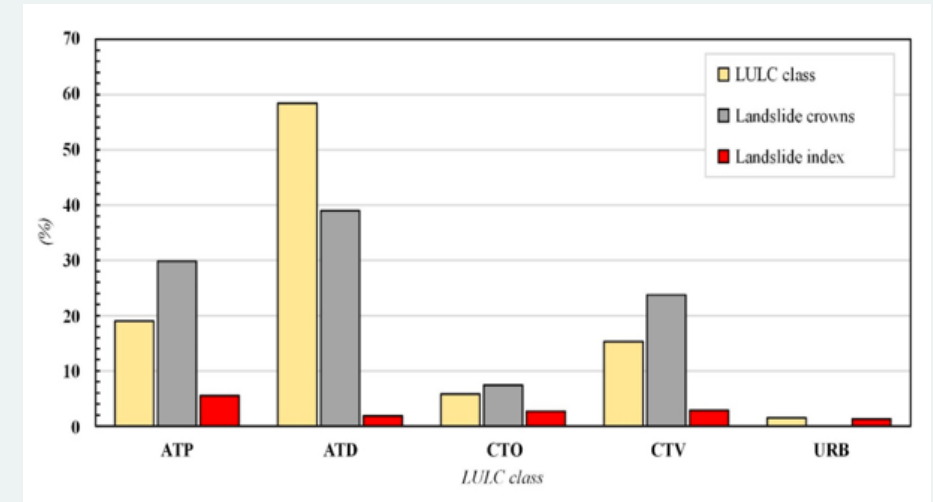
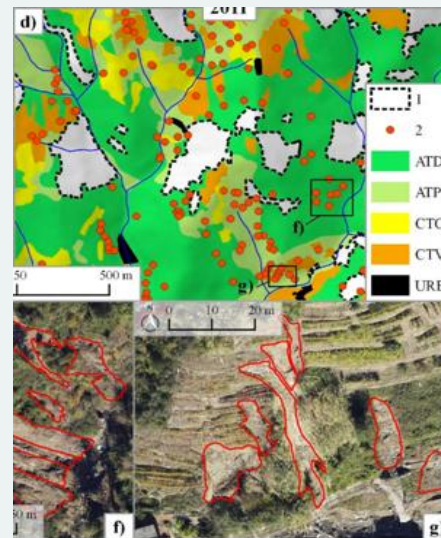


Cinque Terre dry-stone walls structure scheme, by
«Manuale dei muri a secco» LIFE PROSIT project, 2009

When do dry-stone-walls assolve their function in order to decrease **landslides** and **flash flood** triggering?



«when the hydraulic conductivity of the wall is greater than that of soil, for any combination of duration and return period, the wall is able to successfully drain the water from its backfill» (Camera et al., 2012)



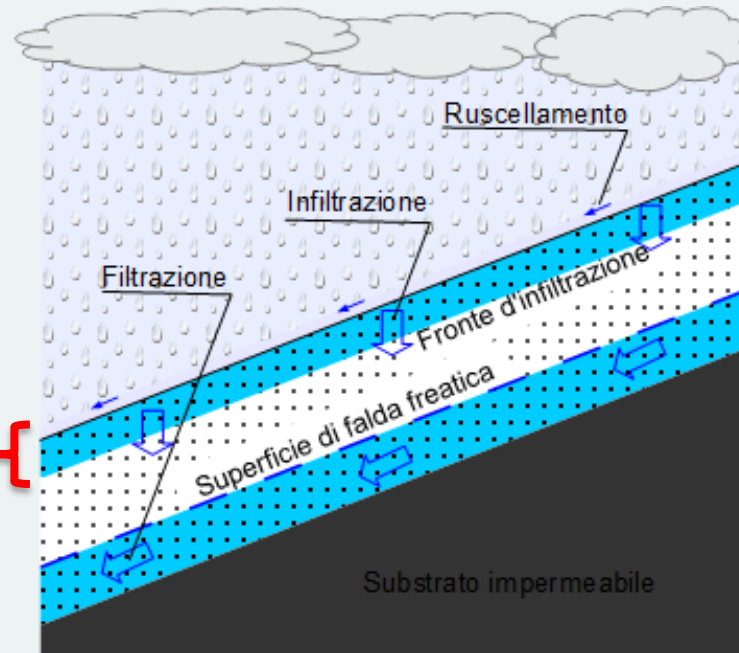
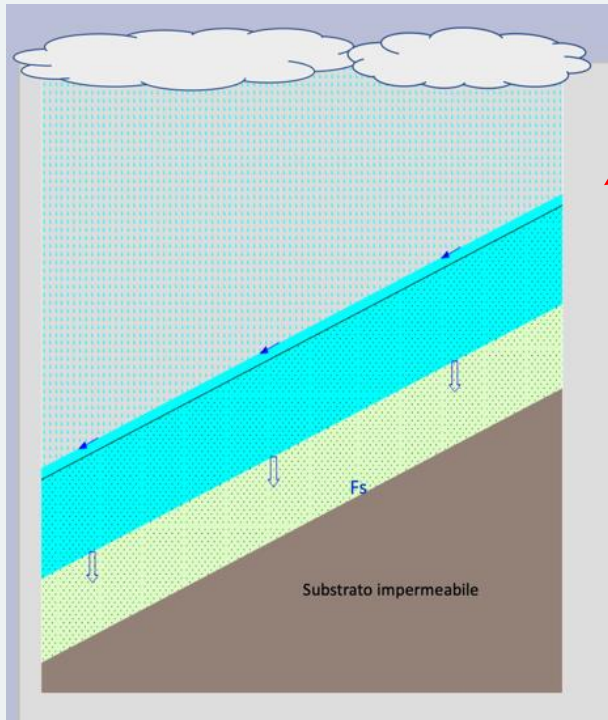
«this research showed that shallow landslides triggered on CT were on average characterized by lower magnitude than those occurred on ATP and ATD. This outcome is consistent with similar studies and testifies the negative consequences induced by the cessation of terrace cultivation and maintenance on slope stability» (Pepe et al., 2019)

The role played by dry-stone walls in slope stability

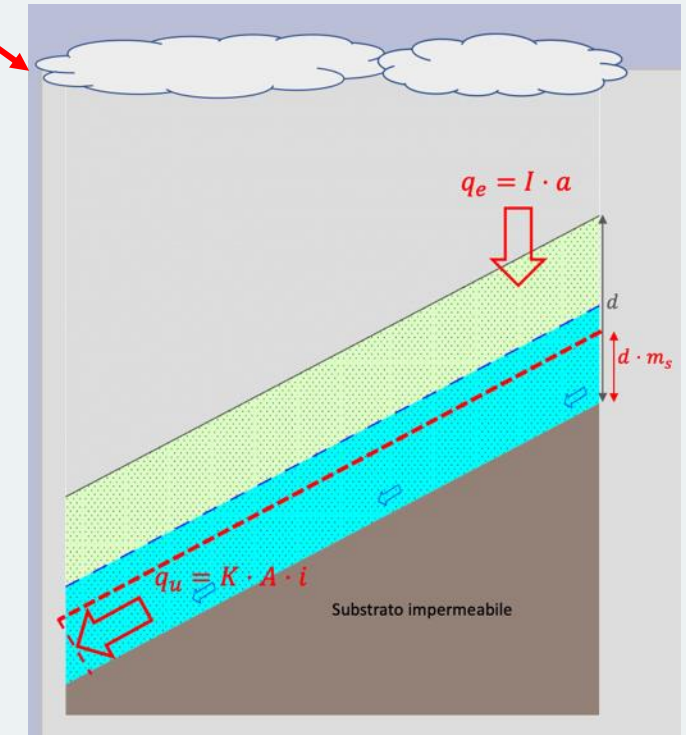
Soil shear strength loss

- Hydrogeological slope model

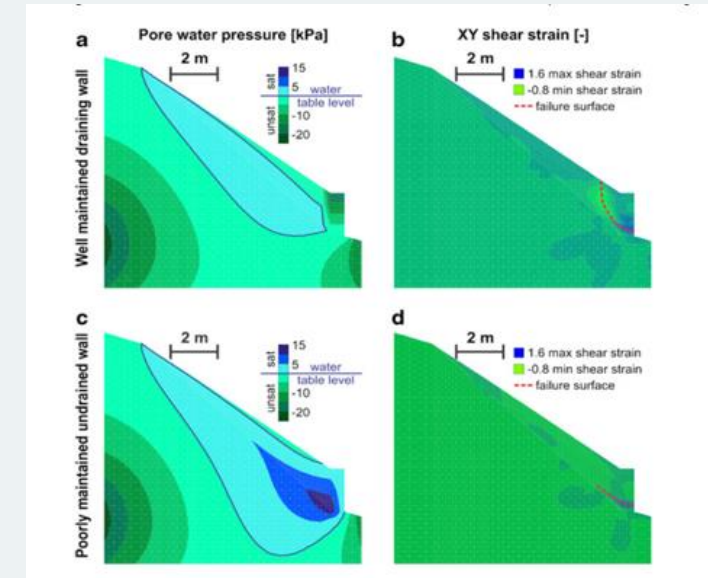
- High intensity, short rainfall** (es. 5 terre flash flood event, 2011)



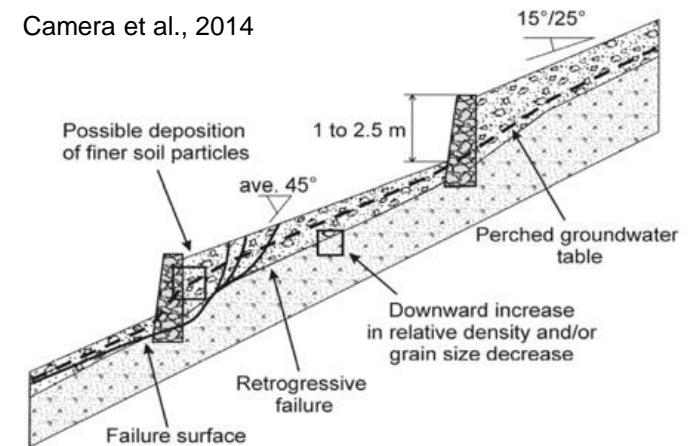
- Low to medium intensity, prolonged rainfall** (es. seasonal rainfall regime)



The role played by dry-stone walls in slope stability



Camera et al., 2014

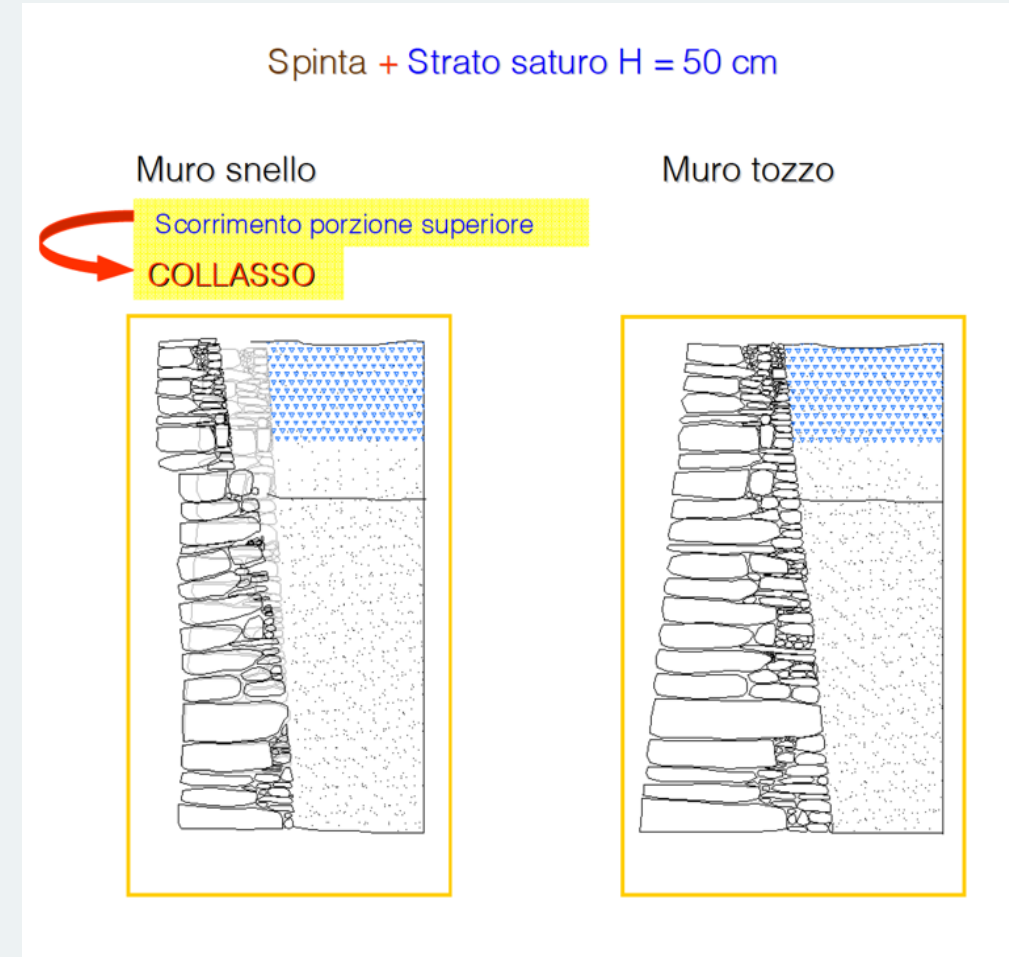


The role played by dry-stone walls in slope stability

Soil shear strength loss

- Dry stone walls collapse

Head of the wall:
sentiero 508
Vernazza -
Reggio

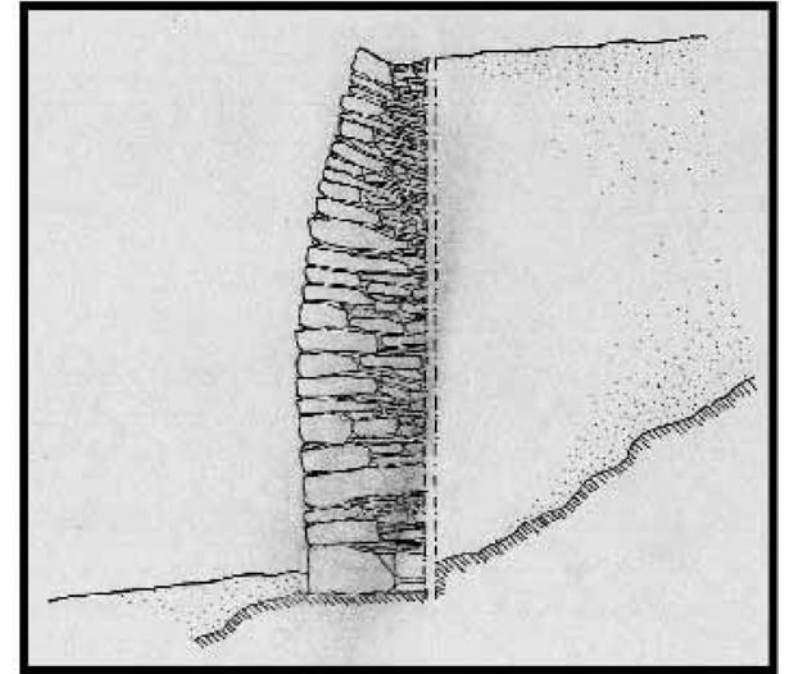


The role played by dry-stone walls in slope stability

Soil shear strength loss

- Dry stone walls collapse

Entire wall facing:
sentiero SVA 592
Vernazza -
Monterosso



"spanciamiento" di tutta la superficie

Tratto da «Manuale per la costruzione dei muri a secco», Parco Nazionale delle Cinque Terre

STONEWALLS
DRY-STONE WALLS FOR CLIMATE CHANGE ADAPTATION

The role played by dry-stone walls in slope stability

Soil shear strength loss

- Wall reconstruction: wall facing + draining system recovery

*Sentiero 508
Reggio -
Vernazza*



The role played by dry-stone walls in slope stability

Soil shear strength loss

- Wall reconstruction: wall facing + draining system recovery

*Sentiero 508
Reggio -
Vernazza*



The Trail maintenance crew (Manutentori)

- **Who:** 18 skilled-workers enrolled in the CTNP «Manutentori» register
- **Where:** the whole network of CTNP trails (130 km)
- **What:** Rural hydraulics, watershed management, dry-stone walls and straicases, forestry interventions



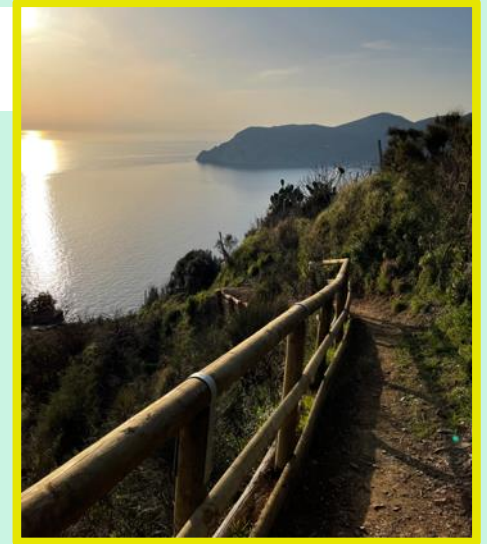
130 km of trails – main features



Ridge trails –
horizontal



Ridge trails -
vertical



Halfway trails

Coastal trails



The Trail maintenance crew: personnel distribution

Subdivision criteria:

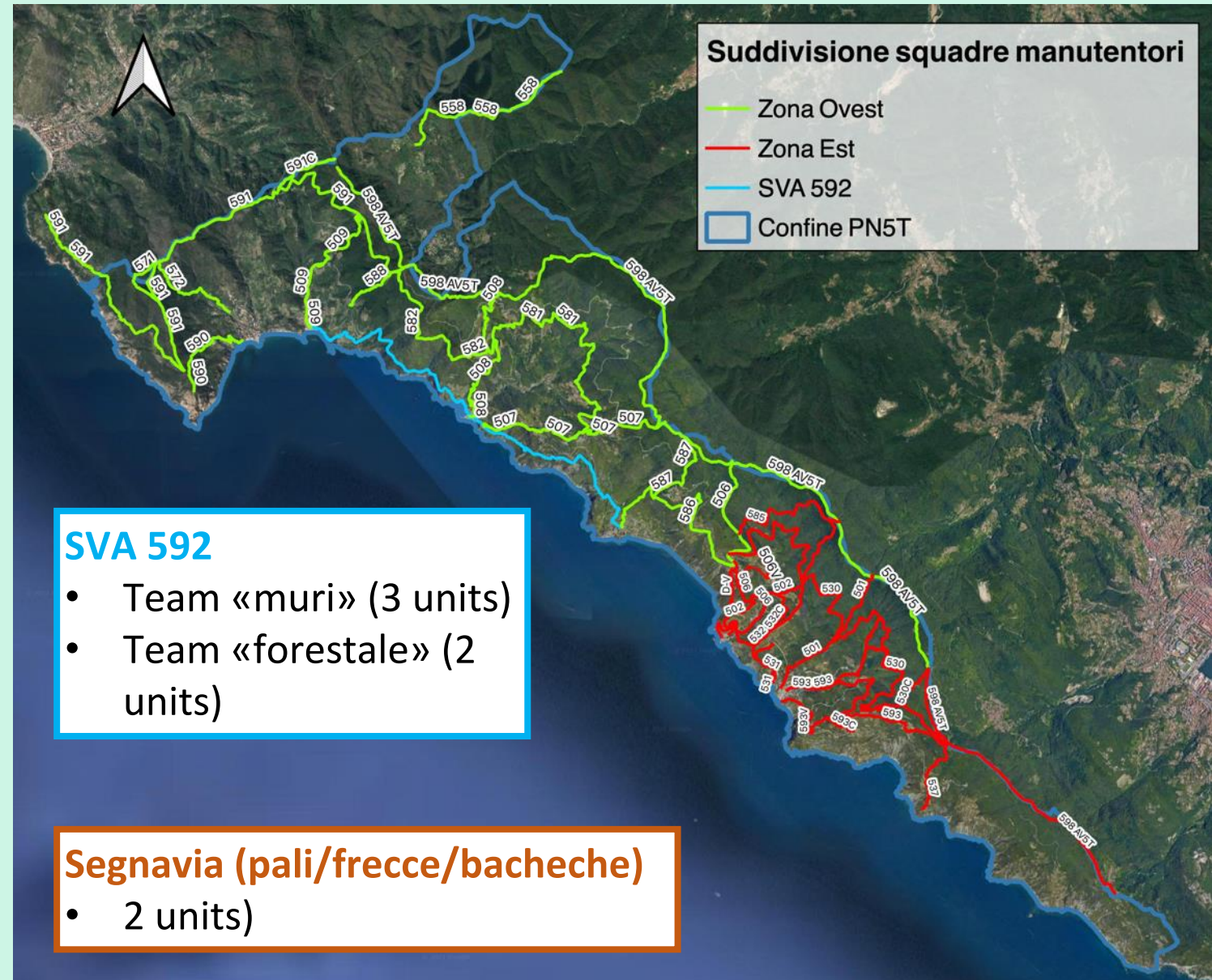
- 1) Geographical
- 2) Type of work

West area

- Team «muri» (3 units)
- Team «forestale» (3 units)

East area

- Team «muri» (3 units)
- Team «forestale» (3 units)



The *Trail maintenance crew* (Manutentori): quick interventions

Water runoff

- water run-off control through surficial drainage network restore and repair



Sentiero 508 Reggio - Vernazza



Sentiero 590 Fegina – Sant'Antonio del Mesco

The *Trail maintenance crew* (Manutentori): quick interventions

conventional harvest of dead/sick trees and brushwood

Before



After



Before



After



The *Trail maintenance crew* (Manutentori): quick interventions

Scrubland cover/ land use and management

cleaning trails from invasive vegetation

- Trail widening (at least 1 – 2 meters) in order to **decrease wildfire risk**

- *Photo: AV5T (Ulex europaeus, «Ginestrone»)*

AV5T- before



AV5T- after



The *Trail maintenance crew* (Manutentori): medium-sized interventions



***Realization
of recreational areas
AV5T trail***



***Small landslides drainage and
restoration works***

509 trail



***Repairing of stone
stairs: 502 trail***



***Creation of
Wood stairs***

591C trail

The *Trail maintenance crew* (Manutentori): medium-sized interventions

Dry stone walls reconstruction: wall facing + draining system recovery (head of the wall)



The *Trail maintenance crew* (Manutentori): medium-sized interventions

Dry stone walls reconstruction : wall facing + draining system recovery (entire wall facing)

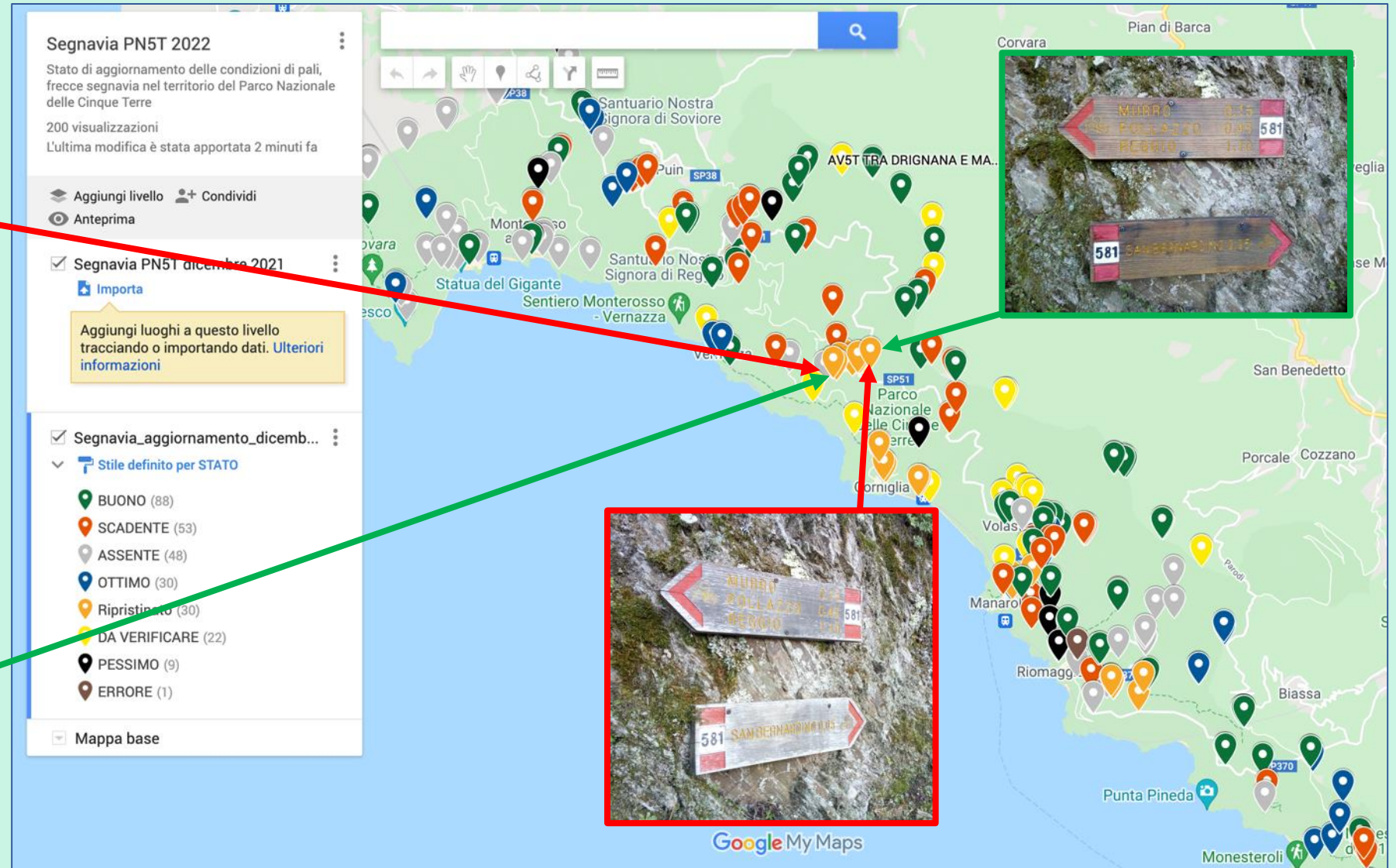


Very poor



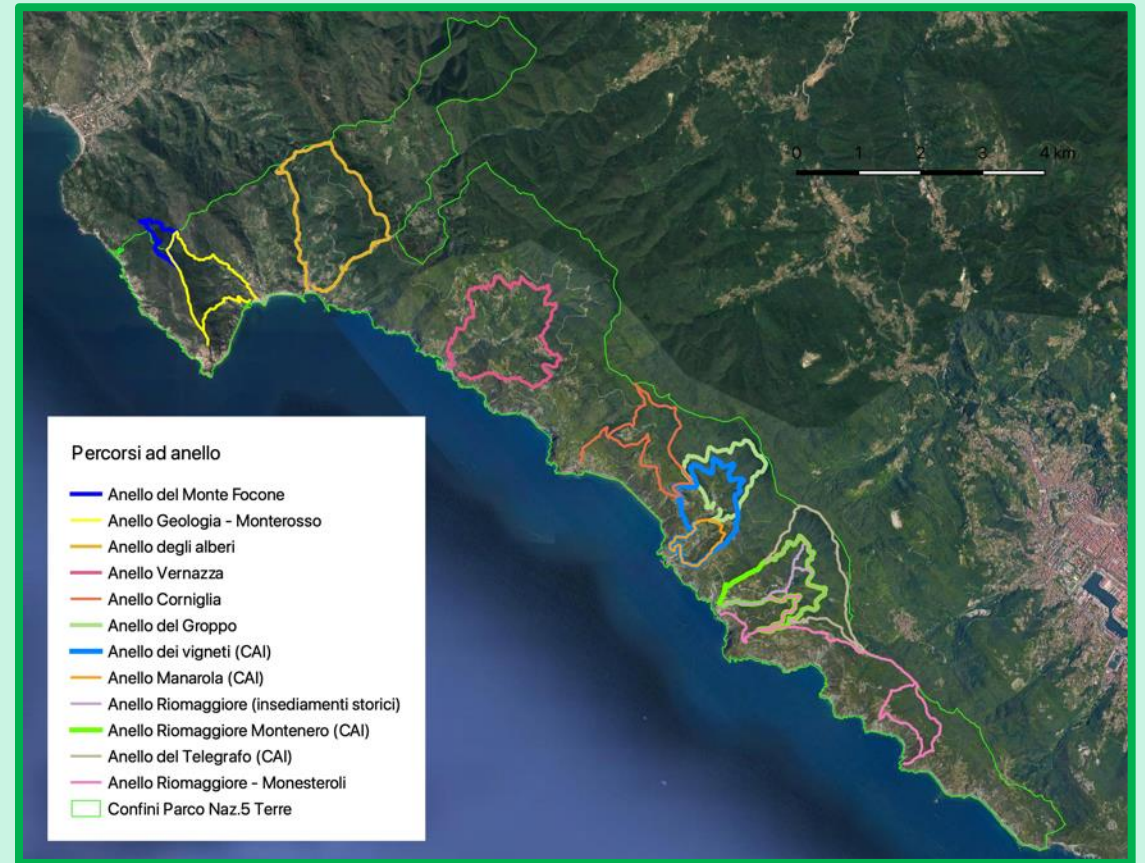
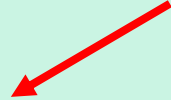
The *Trail maintenance crew* (Manutentori): medium-sized interventions

Shared cloud project update: more than 300 georeferenced and categorized waypoints



Work in progress – database construction through GIS

Routes for the new IOS – Android App version (*linear* – *ring*) – App V3



Work in progress – new App and trail map (2022)



ENG

PARCO NAZIONALE DELLE CINQUE TERRE

Hiking Guide



Hiking



Trail Running



Mountain bike



Family



Map



Settlements







<https://www.pn5t.it/mappe/#/tuttiSentieri?filterUsi=r>

PARCO NAZIONALE DELLE CINQUE TERRE

 I SENTIERI
  THE TRAILS
  LES SENTIERS
  DIE WANDERWEGE



ITINERARI TEMATICI / THEME ITINERARIES
ITINERAIRES THEMATIQUES / THEMENWEGE

-  **SANTUARI E CHIESE** / SANCTUARIES AND CHURCHES
SANTUAIRES ET EGLISES / KIRCHEN UND HEILIGTUMER
-  **NATURA** / NATURE / NATURE / NATURE
-  **ANTICHI INSEDIAMENTI** / ANCIENT SETTLEMENTS
HAUPTSTÄDTE ANTIKE SIEDLUNGEN
-  **PASSAGGIO DEI VIGNETI TERRAZZATI** / TERRACED VINEYARD LANDSCAPES
PASSAGE DES VIGNOLES EN TERRASSES / TERRASSTERTE WEINLANDSCHAFT

| N° | P | A | S | D | T | HE |
|-----|------------------------|--------------------|------|-----|------|----|
| 101 | ROMAGGIORE | SELLA LA CROCE | 2150 | 560 | 1:30 | EE |
| 102 | MANAROLA | SELLA M. GALERA | 3100 | 650 | 2:30 | EE |
| 103 | MANAROLA V. DISCOVOLO | MANAROLA MARINA | 650 | 85 | 0:20 | T |
| 104 | SANT'ANTONIO | SCHARRA | 2400 | 350 | 1:35 | EE |
| 105 | SCHARRA | INNESTO SENT. 515 | 800 | 290 | 0:50 | EE |
| 106 | MANAROLA | SELLA MARVESE | 3950 | 586 | 2:40 | EE |
| 107 | GRUPPO | VOLASTRA | 450 | 95 | 0:20 | E |
| 108 | TORIL GRUPPO | INNESTO SENT. 506 | 1100 | 180 | 0:35 | E |
| 109 | VERNAZZA | CHIOLETTA | 3100 | 597 | 2:20 | EE |
| 110 | VERNAZZA | FOCE DIBAGNANA | 3150 | 485 | 2:15 | E |
| 111 | MONTEROSSO | MAO SOVORE | 2750 | 451 | 1:45 | EE |
| 112 | CAMPAGLIA | IL PERISCO | 1150 | 308 | 1:30 | EE |
| 113 | PERISCO | C. CONO | 500 | 50 | 0:20 | EE |
| 114 | IL CROSO | NUNTO | 600 | 277 | 1:00 | EE |
| 115 | TELEGRATO | VOLASTRA | 9950 | 171 | 2:50 | T |
| 116 | BRANAPINE | CAIA SCALA SANTA | 750 | 110 | 0:20 | EE |
| 117 | ROMAGGIORE | MANAROLA (BECCARA) | 1250 | 235 | 1:00 | EE |
| 118 | PARCH CORNOLIO | VIA BECCARA | 340 | 25 | 0:15 | E |
| 119 | BECCARA | COSTA CORNOLIO | 1100 | 160 | 0:30 | E |
| 120 | INNESTO 502 | COSTA CORNOLIO | 750 | 3 | 0:30 | E |
| 121 | ROMAGGIORE (vini. 510) | VIA DEI SANTUARI | 1350 | 395 | 1:00 | E |
| 122 | INNESTO 513 | VIA DEI SANTUARI | 350 | 120 | 0:30 | E |
| 123 | SANT'ANTONIO | FOSSOLA | 1450 | 506 | 1:25 | EE |
| 124 | CAMPAGLIA | FOSSOLA (STRADA) | 3200 | 157 | 1:45 | E |
| 125 | BIVIO 504 | MONESTRUCI | 1100 | 419 | 1:10 | E |
| 126 | TELEGRATO | PUNTA PINEDA | 1450 | 512 | 2:30 | EE |
| 127 | COLLA DEI BAGARI | MONTE V. O' FOCONE | 410 | 125 | 0:20 | EE |
| 128 | FIGINA | COLLA DEI BAGARI | 1600 | 320 | 1:05 | EE |
| 129 | MACROCCO 572 | MONTE ROSSO | 1200 | 430 | 1:00 | EE |
| 130 | REGGIO | S. BERNARDINO | 5000 | 26 | 2:30 | EE |
| 131 | REGGIO | IL TERME | 2750 | 234 | 1:15 | EE |
| 132 | VOLASTRA | SELLA M. GALERA | 1900 | 290 | 0:45 | E |
| 133 | VOLASTRA | C. S. FRANCA | 2300 | 82 | 0:50 | E |
| 134 | CORNGIJA | CHIOLETTA | 2450 | 511 | 2:30 | EE |
| 135 | MONTEROSSO | TERME | 2010 | 510 | 1:45 | EE |
| 136 | MONTEROSSO | S. ANTONIO MESCO | 2700 | 298 | 1:15 | EE |
| 137 | LEVANTO | S. ANTONIO MESCO | 4350 | 293 | 2:15 | E |
| 138 | IL TERME | S. ANTONIO MESCO | 7250 | 241 | 1:55 | E |
| 139 | COLLA GRITTA | SELLA CHIOLETTA | 1200 | 254 | 0:40 | E |
| 140 | ROMAGGIORE | MANAROLA | 1100 | 20 | 0:25 | E |
| 141 | MANAROLA | CORNGIJA | 2900 | 70 | 1:15 | E |
| 142 | CORNGIJA | VERNAZZA | 3450 | 185 | 1:45 | E |
| 143 | VERNAZZA | MONTEROSSO | 3600 | 170 | 2:15 | E |
| 144 | ROMAGGIORE | TELEGRATO | 4500 | 497 | 2:15 | E |
| 145 | SS 370 | MAO MONTENERO | 440 | 88 | 0:20 | E |
| 146 | ROMAGGIORE | MAO MONTENERO | 1150 | 338 | 0:55 | EE |
| 147 | PORTOFENORE | TELEGRATO | 8400 | 560 | 3:20 | E |
| 148 | TELEGRATO | CHIOLETTA | 6850 | 236 | 2:40 | E |
| 149 | CHIOLETTA | IL TERME | 4250 | 297 | 3:30 | E |
| 150 | IL TERME | CHIOLETTA | 1900 | 66 | 0:50 | E |

SCALA / SCALE / SCHELL / MASSSTAB: 1:55.000


STRADA PROVINCIALE / PROVINCIAL ROAD
 ROUTE DÉPARTEMENTALE / PROVINCIAL STRASSE
 ALTRE STRADE / OTHER ROADS / AUTRES ROUTES
 SANGUIN STADSE
 CARROZZABILI / CONVEYED TRACKS / PISTONCABLE
 BEWANDERBARE WEGE
 SCALINATA / STAIRWAY / ESCALIERS / TREPPE
 LINEE NAVIGAZIONE BATTILIBER / LINES
 NAVIGATION BATTILIBER / ROUTES / TRAMPOLINEN
 ITINERARIO DI PIÙ GIORNI / MULTI-DAY ITINERARIES
 ITINERAIRES DE PLUSIEURS JOURS / MULTI-TAGE TOUR
 SENTIERO PRINCIPALE / MAIN TRAIL
 SENTIER PRINCIPAL / HAUPTWANDERWEG
 SENTIERO DI COLLEGAMENTO / VARIANTE / TRAIL CONNECTION AND VARIANTS
 CHEMIN DE CONNEXION ET VARIATION / VERBODENDE WEG UND VARIATIONEN
 STAZIONE FERROVIA / CENTRO ACQUEDOTTO DEL MARCO CINQUE TERRE
 TRAIN STATION / STATION / PIAZZA / MARCO CINQUE TERRE
 PORTUGAL FERROVIA / CENTRO ACQUEDOTTO DEL MARCO CINQUE TERRE
 PORTUGAL FERROVIA / CENTRO ACQUEDOTTO DEL MARCO CINQUE TERRE
 PORTUGAL FERROVIA / CENTRO ACQUEDOTTO DEL MARCO CINQUE TERRE

SANTUARIO / SANCTUARY / SANCTUARIUM / HEILIGTUM
 CHIESA / CHURCH / CHAPEL / EGLISE, CHAPPELLE
 KIRCHE, KAPPELLE
 CROCE / CROSS / CROSS / CROSS / CROSS / CROSS / CROSS / CROSS
 CROCE / CROSS / CROSS / CROSS / CROSS / CROSS / CROSS / CROSS
 FONTE / SOURCE / FOUNTAIN / SPRING / FONTAINE / SOURCE
 BRUNNEN / QUERS / QUERS
 BOSCO / WOOD / WOOD / WOOD
 CONFINI / BORDI / BORDI / BORDI
 LIMITS / BORDI / BORDI / BORDI
 MEKROSCHEGGET

AREA MARINA PROTETTA / MARINE
 PROTETTES / MARINE / MARINE / PROTETTES
 MEKROSCHEGGET

ZONA C
 ZONA B
 ZONA A

N°: sentiero/trail no./sentier/Weg - P: partenza/departure/depart / Start - A: arrivo/arrival/
 arrivée/End - L: lunghezza/length/longueur/Länge - D: dislivello/elevation gain/dénivellement/
 Höhenunterschied - T: tempo/time/temps/Zeit - D: difficoltà/difficulty/difficulté / Schwierigkeit -
 T: turisti/tourists/touristes/Touristen - E: escursioni/escursions/escursions / Wanderwege
 - EE: escursioni esperti/expert escursions/tandemexpeditionen/expertes/Wanderer



Thank you for your attention!