Temporal trend analysis of vegetation cover response to environmental factors and residential development Har-HaNegev, Israel

Why was Har-HaNegev selected?

This area includes a national park, the UNESCO World Heritage Incense Route, and national reserves.

Negev Desert - Israel’s largest land resource. Government policy encourages redirecting population growth to this region.
Objective - to assess the impacts of environmental factors and populated areas on vegetation cover change through a multi-decadal time period in a dryland area that includes protected nature reserves.
Har-HaNegev research site

- Covers an area of 445 km²
- Average annual rainfall – 80-100 mm

Vegetation pattern – patchy and more abundant closer to the streams.

150 documented vegetation species, 32 of which are classified as endangered species.
Nature reserves – 24%
Firing zones – 60%
13 Agricultural settlements

Individual family farm

Kibbutz and Community Settlement

Methodology

Study site
10 villages with intensive grazing activity
Military facilities

Avdat archeological site

Jailing facility

10 government facilities
Dataset

27 summer Landsat images (1987-2016)

Normalized SAVI for each year

Temporal trend analysis of vegetation cover change using the contextual Mann-Kendall significance test.

One map with a Z-score for each pixel, representing trend.

Significant change:
- $z<-1.96$ and $z>1.96 \rightarrow p<0.05$
- $z<-2.58$ and $z>2.58 \rightarrow p<0.01$
Analysis of environmental and human-derived covariates effect on vegetation cover change

Boosted regression trees
Spatial analysis

- 50,000 random points
- Only significant Z-score point considered (=12,788)
- Getis-Ord Gi* for hotspot analysis
- Geographically weighted regression between the hotspots and elevation and distance from streams

Methodology analyses

Results

Conclusions

- CMK test Z-score
- Relative influence of environmental covariates
- Residential effects in various distances

Results

Background

Objective

Analyses

Methodology

Conclusions

References

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Effects of distance from populated areas on vegetation cover change

Buffers of different distances from settlements centroids

What is the ratio between significant positive and negative Z-score?
Contextual Mann-Kendall Z-score map

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CMK test Z-score

Relative influence of environmental covariates

Spatial analysis

Residential effects in various distances

SAVI Z-Score

High : 6.27

Low : -5.61

NPA reserves

0 4 8 16 24 Km
Relative influence of environmental and human-induced covariates on vegetation cover change

<table>
<thead>
<tr>
<th>Covariate</th>
<th>Relative Influence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elevation</td>
<td>17.08</td>
</tr>
<tr>
<td>Slope</td>
<td>14.64</td>
</tr>
<tr>
<td>Distance from populated areas</td>
<td>14.57</td>
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<tr>
<td>Aspect</td>
<td>13.57</td>
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<tr>
<td>Military fire zones</td>
<td>10.89</td>
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<tr>
<td>Land cover</td>
<td>10.25</td>
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<tr>
<td>Lithology</td>
<td>8.29</td>
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<tr>
<td>Distance from streams</td>
<td>6.59</td>
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<tr>
<td>Nature reserves</td>
<td>2.60</td>
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<tr>
<td>Soils</td>
<td>1.34</td>
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</tbody>
</table>

**Results**

- CMK test
- Z-score
- Relative influence of environmental covariates
- Spatial analysis
- Residential effects in various distances

**Conclusions**

**Background**

**Methodology**

**Objective**
Spatial trends of vegetation cover change

GWR VCC ~ elevation: R² = 0.98
GWR VCC ~ distance from streams R² = 0.93
Effects of distance from populated areas on vegetation cover change

Differences between settlement types for each distance

<table>
<thead>
<tr>
<th>Distance from centroid (m)</th>
<th>Agricultural settlements</th>
<th>Livestock settlements</th>
<th>Government facilities</th>
</tr>
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<tbody>
<tr>
<td>100</td>
<td>a</td>
<td>a</td>
<td>b</td>
</tr>
<tr>
<td>200</td>
<td>a</td>
<td>a</td>
<td>b</td>
</tr>
<tr>
<td>500</td>
<td>a</td>
<td>b</td>
<td>c</td>
</tr>
<tr>
<td>1000</td>
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<td>b</td>
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</tr>
<tr>
<td>3000</td>
<td>a</td>
<td>b</td>
<td>a</td>
</tr>
<tr>
<td>4500</td>
<td>a</td>
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</table>

Differences between distances for each settlement type

<table>
<thead>
<tr>
<th>Settlement type</th>
<th>100 m</th>
<th>200 m</th>
<th>500 m</th>
<th>1000 m</th>
<th>1500 m</th>
<th>3000 m</th>
<th>4500 m</th>
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<tbody>
<tr>
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<td>bc</td>
<td>d</td>
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<tr>
<td>Livestock settlements</td>
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<td>a</td>
<td>b</td>
<td>cd</td>
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<tr>
<td>Government facilities</td>
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<td>a</td>
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</tr>
</tbody>
</table>
Sum of relative influence of predictors that may change due to future development - 38.31%
Conclusions

• The settlement type affects patterns of VCC.
• Environmental covariates with strongest effect - elevation and slope.
• Vegetation cover is most sensitive along streams.
• Protected areas have a great potential in preserving and increasing vegetation cover.
• Management strategies should be implemented to initiate further conservation and restoration processes.
• Governmental and municipal regulations are required before population increases and degradation processes expand further.
• Negative VCC in drylands have irreversible effects influencing the vegetation pattern and organization in space, altering the ecosystem structure and function.
Thank you for your attention