The Salmonid Population Viability Project

Lahontan Cutthroat Trout

river basin CENTER

TROUT UNLIMITED

USGS science for a changing world

FOREST SERVICE U.S. DEPARTMENT OF AGRICULTURE

U.S. DEPARTMENT OF THE INTERIOR BUREAU OF LAND MANAGEMENT

U.S. FISH & WILDLIFE SERVICE

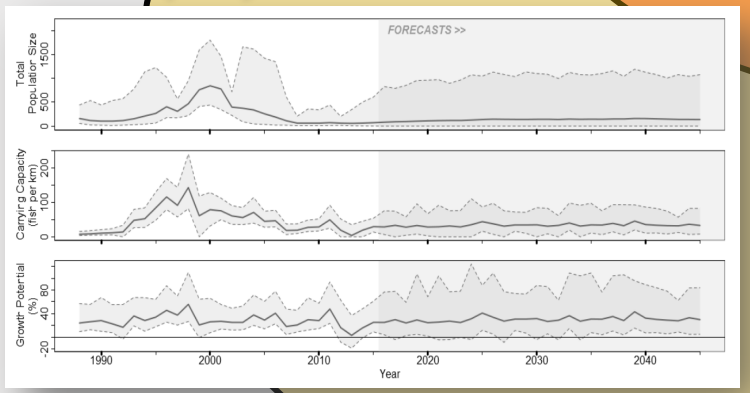
NASA

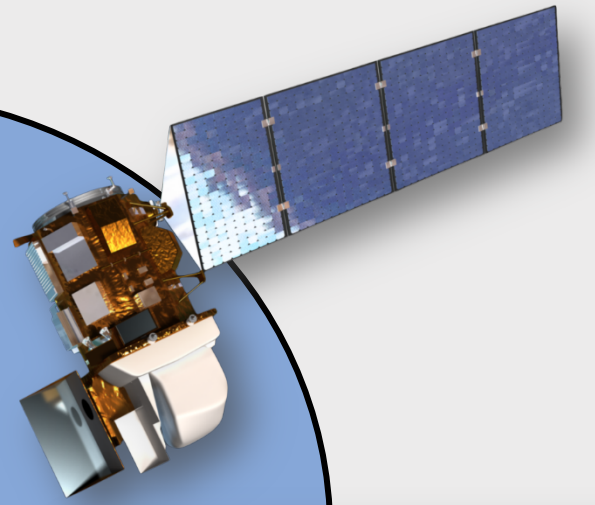
Applied Conservation

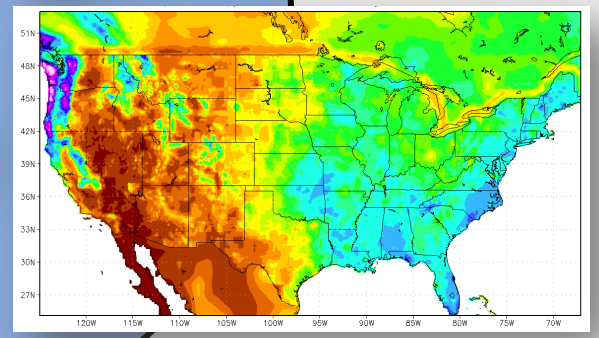
U.S. FISH & WILDLIFE SERVICE
DEPARTMENT OF THE INTERIOR

NEVADA DEPARTMENT OF WILDLIFE

$$N_{t+1} = N_t e^{r(1 - N_t/K)}$$







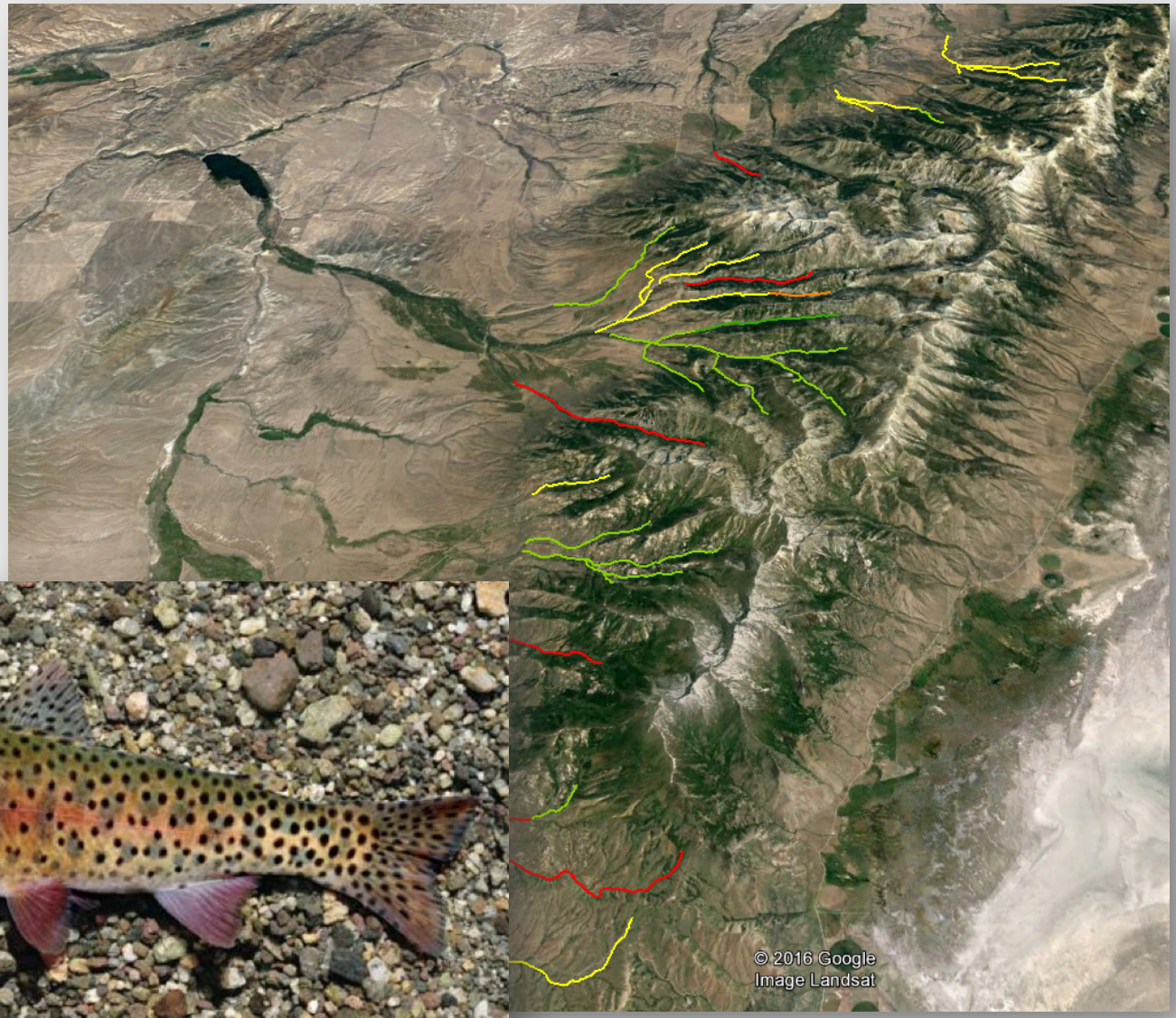
NASA

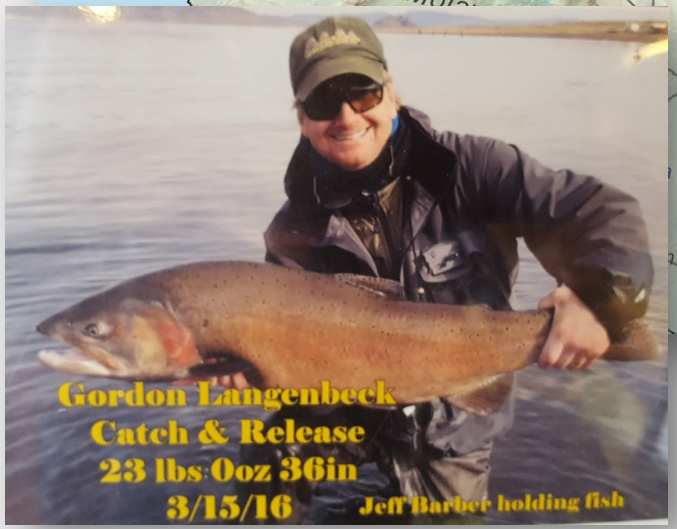
Theoretical Ecology

Remote Sensing

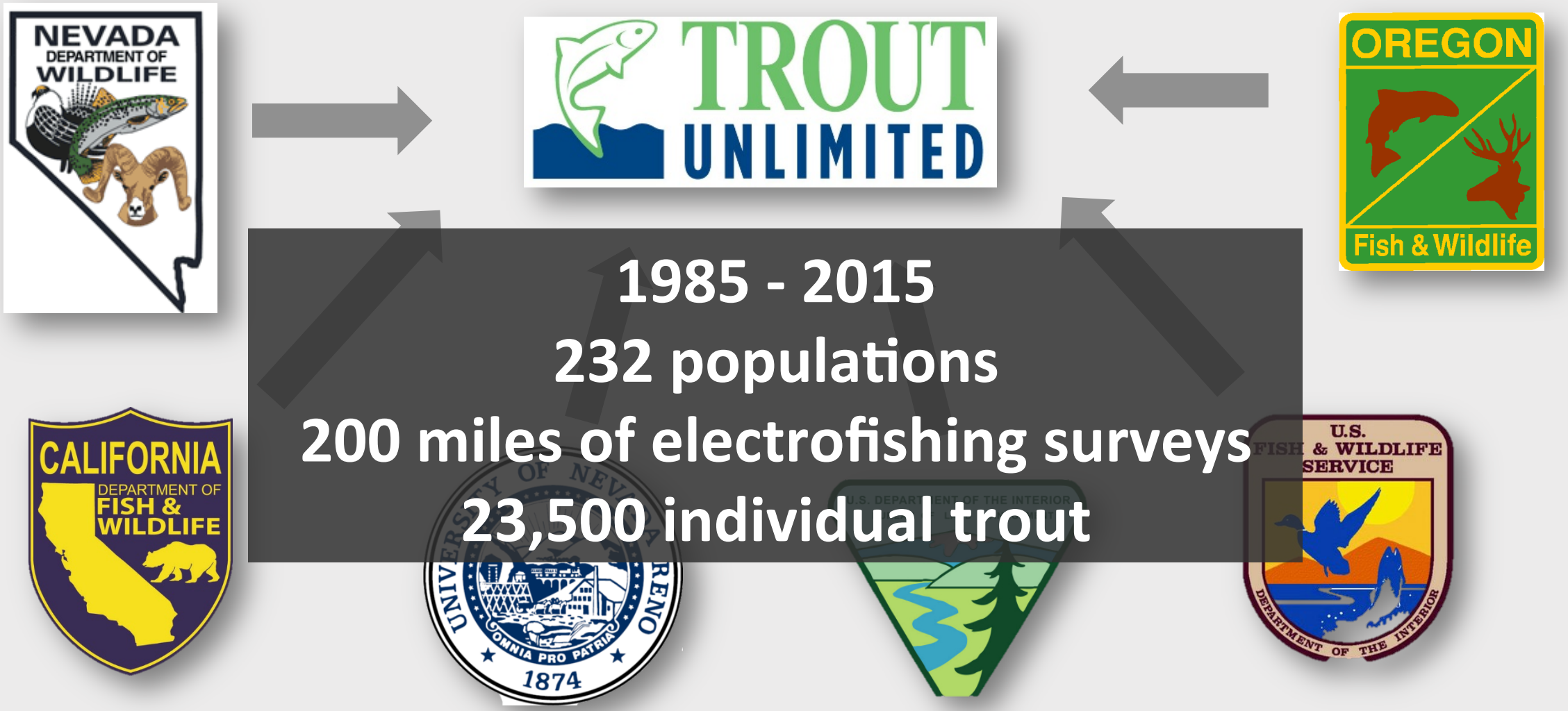
Lahontan Cutthroat Trout

(*Oncorhynchus clarkii henshawi*)





Lahontan Cutthroat Trout: Database



1985 - 2015

232 populations

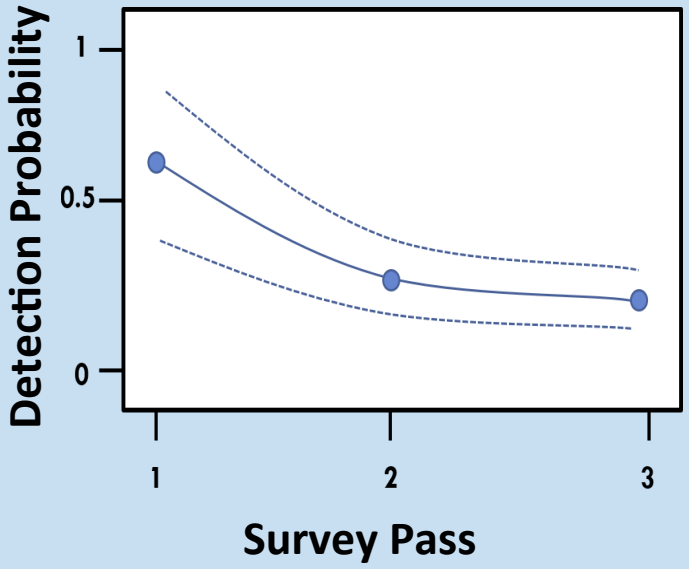
200 miles of electrofishing surveys

23,500 individual trout

Spatio-Temporal Population Viability Analysis

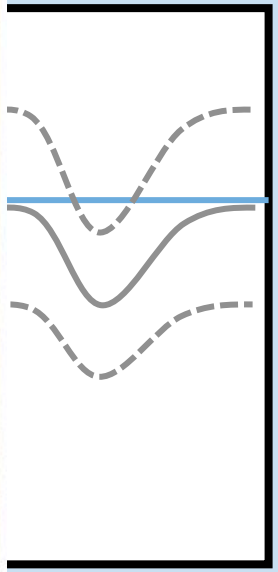
Observation Model

Site abundance = observed + unobserved animals



Sampling Model

Process Model



Lahontan Cutthroat Trou

Secure | https://trout.shinyapps.io/lahontan/

Lahontan Cutthroat Trout Population Simulator

Population:

Abel

Forecast year:

2020 2045 2115

2020 2030 2040 2050 2060 2070 2080 2090 2100 2110 2115

Future Conditions

Reset

Population extent (km):

7.32

Non-native trout:

- Use historic densities
- Set a constant density (slider below)

139 per km 2,000 per km

0 200 400 600 800 1,000 1,200 1,400 1,600 1,800 2,000

Stream habitat:

Temperature

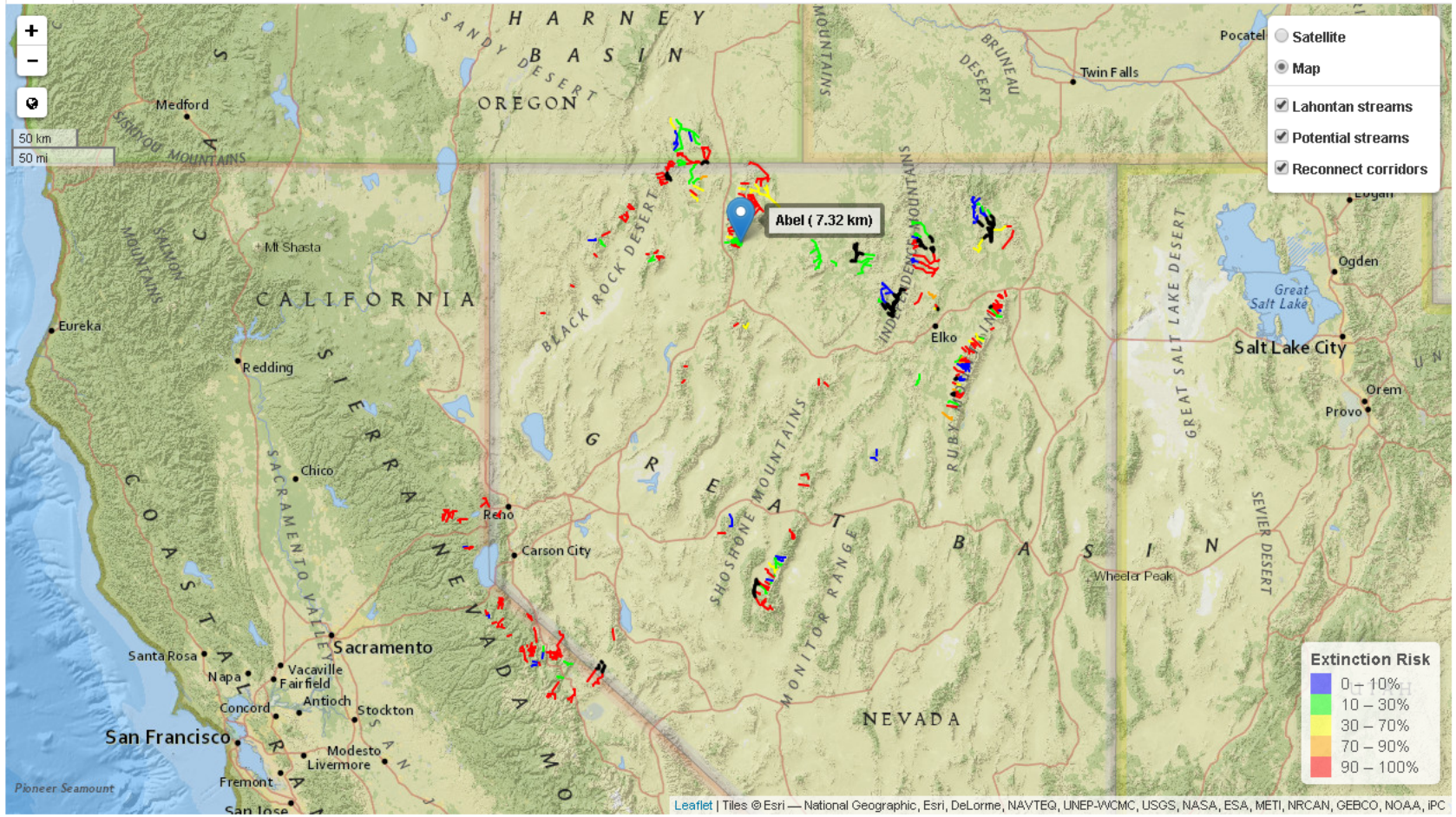
0 1

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1

High flow

0 1

Map | Population | Habitat | Effects | Detection | Data | Help | About



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Lahontan Cutthroat Trout Population Simulator

Population:

Abel

- Abel
- Abel&SHReconnect
- Ackler
- Alles
- Alles&DeeringReconnect
- Andorno
- Bartlett

Population extent (km):

7.32

Non-native trout:

- Use historic densities
- Set a constant density (slider below)

139 per km — 2,000 per km

0 200 400 600 800 1,000 1,200 1,400 1,600 1,800 2,000

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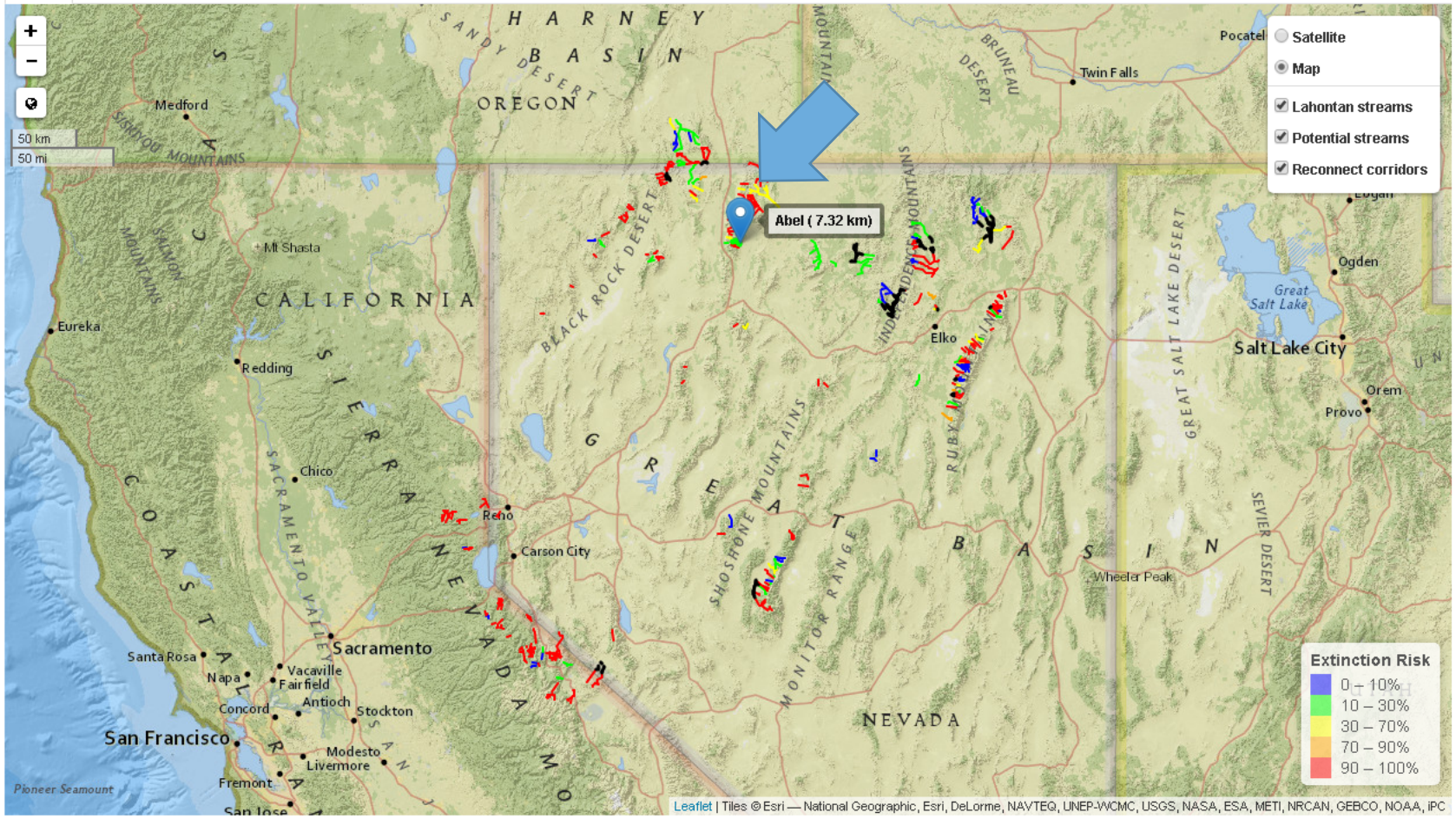

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Lahontan Cutthroat Trou

Doug

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Lahontan Cutthroat Trout Population Simulator

Population:

Abel

Forecast year:

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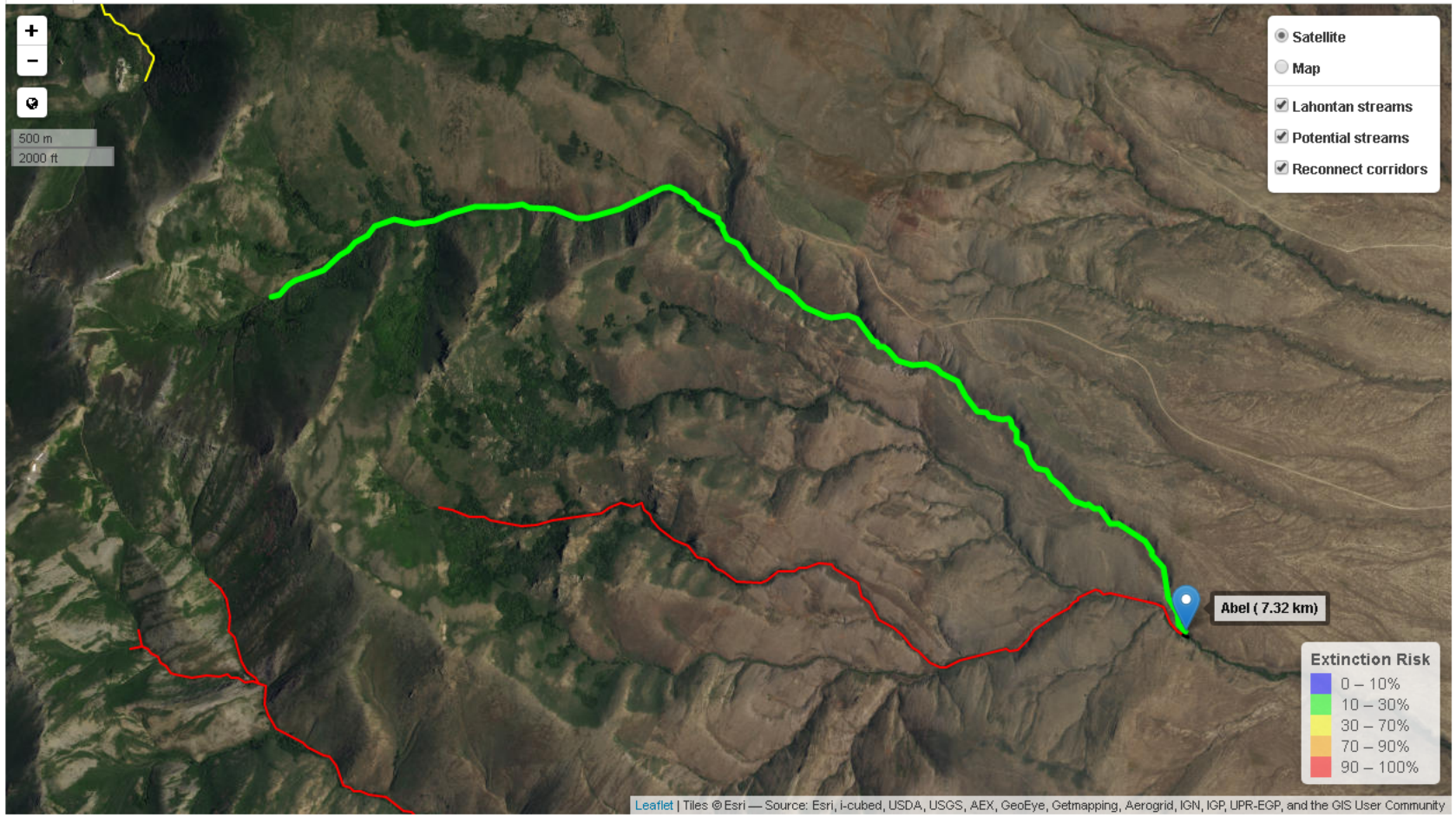

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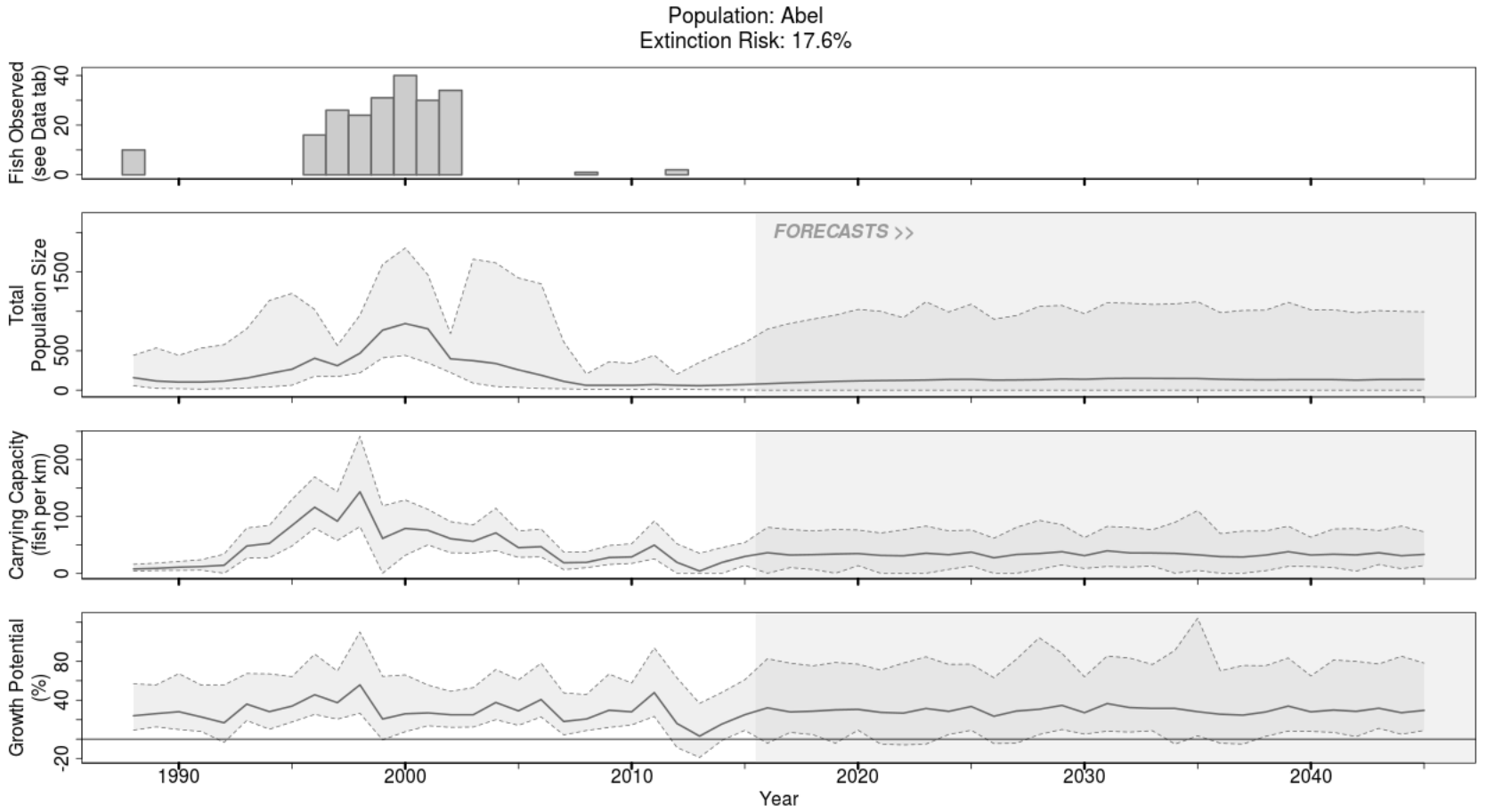

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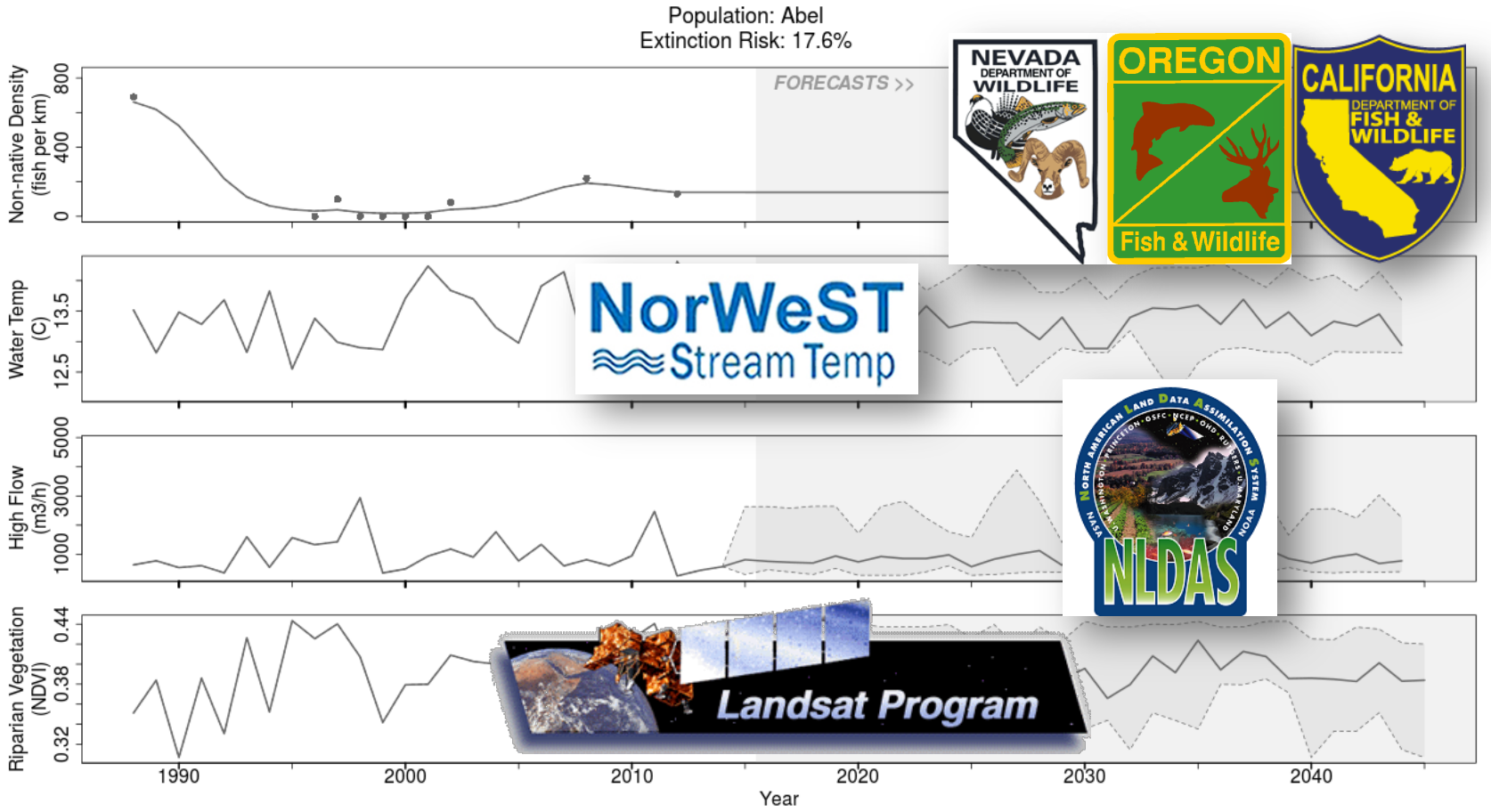

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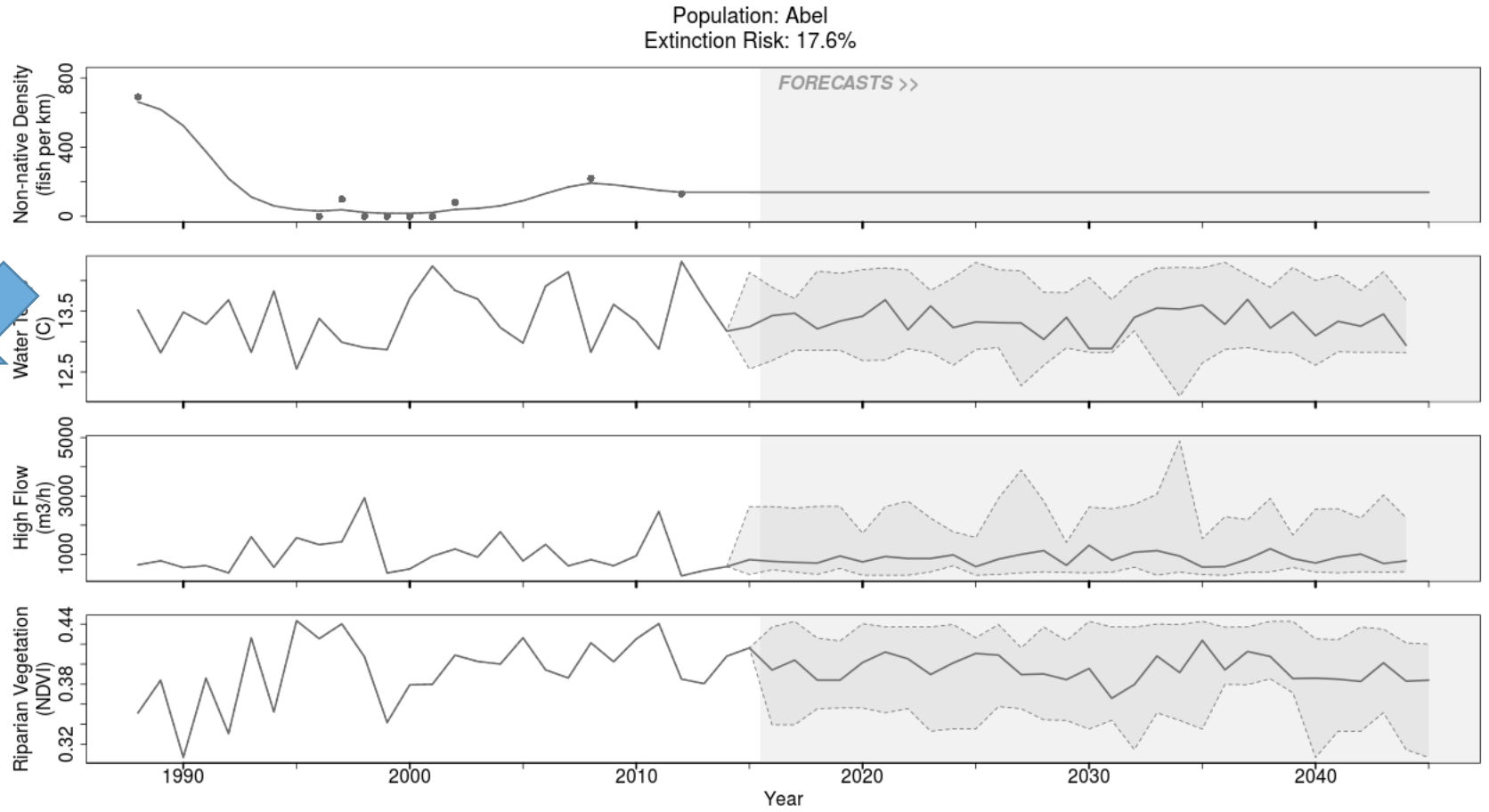

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* Assumes introduced fish are reproductive adults that all survive.
* Reintroduction schedule will be repeated throughout simulation.
* Add negative numbers of fish to simulate removals.

Simulation Settings

Credible interval for plots:

0.5 0.95 0.99

0.5 0.55 0.6 0.65 0.7 0.75 0.8 0.85 0.9 0.95 0.99

Number of simulat re is slower):

1 10 50

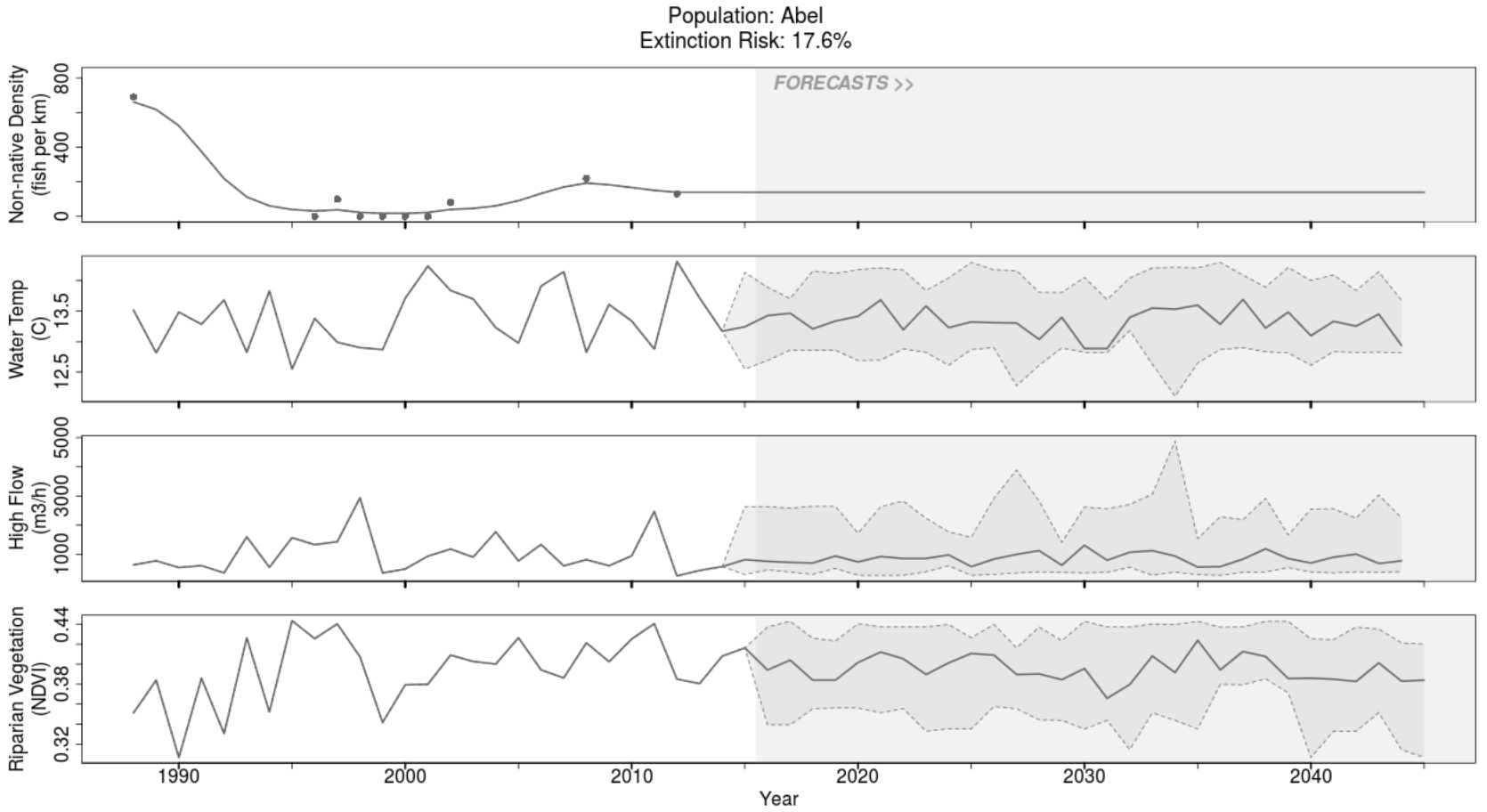
1 6 11 16 21 26 31 36 41 46 50

Number of MCMC samples (more is slower):

500 2,000

500 700 900 1,100 1,300 1,500 1,700 1,900 2,000

Map | Population | Habitat | Effects | Detection | Data | Help | About



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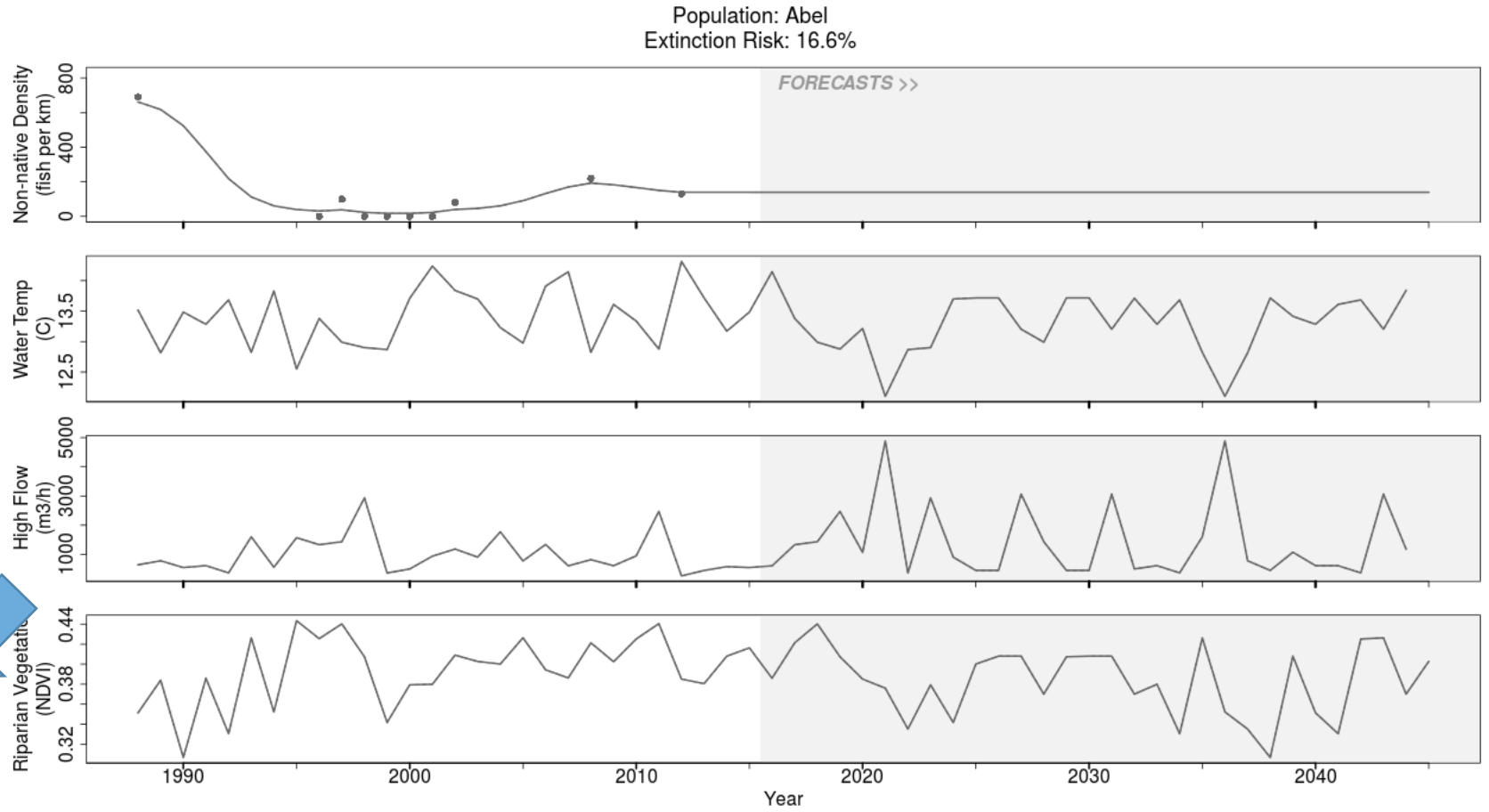

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Stre **:**

Temp

0 1

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1

High flow

0 1

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1

Riparian vegetation (NDVI)

0 1

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1

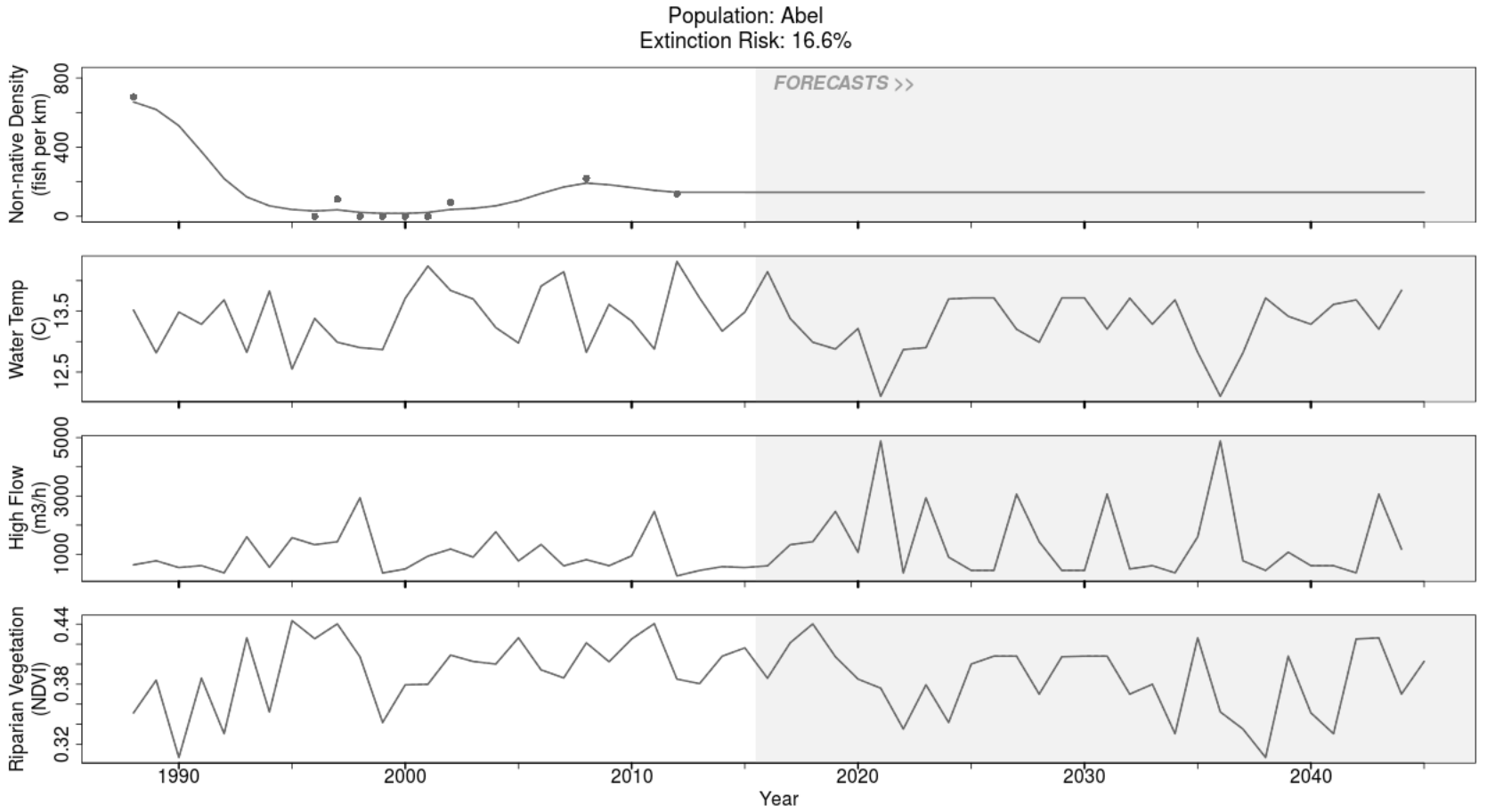
Maintain historical levels of environmental variability among years.

* Sliders define the range of historical values used for forecasting (0 = min, 0.5 = median, 1 = max). Open the Habitat tab to watch changes.

Demographic Stochasticity:

0.25 0.68 2

Map | Population | Habitat | Effects | Detection | Data | Help | About



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Lahontan Cutthroat Trout Population Simulator

Population:

Abel

Forecast year:

2020 2045 2115

Stream habitat:

Temperature

0 0.5 1

High flow

0 1

Riparian vegetation (NDVI)

0 1

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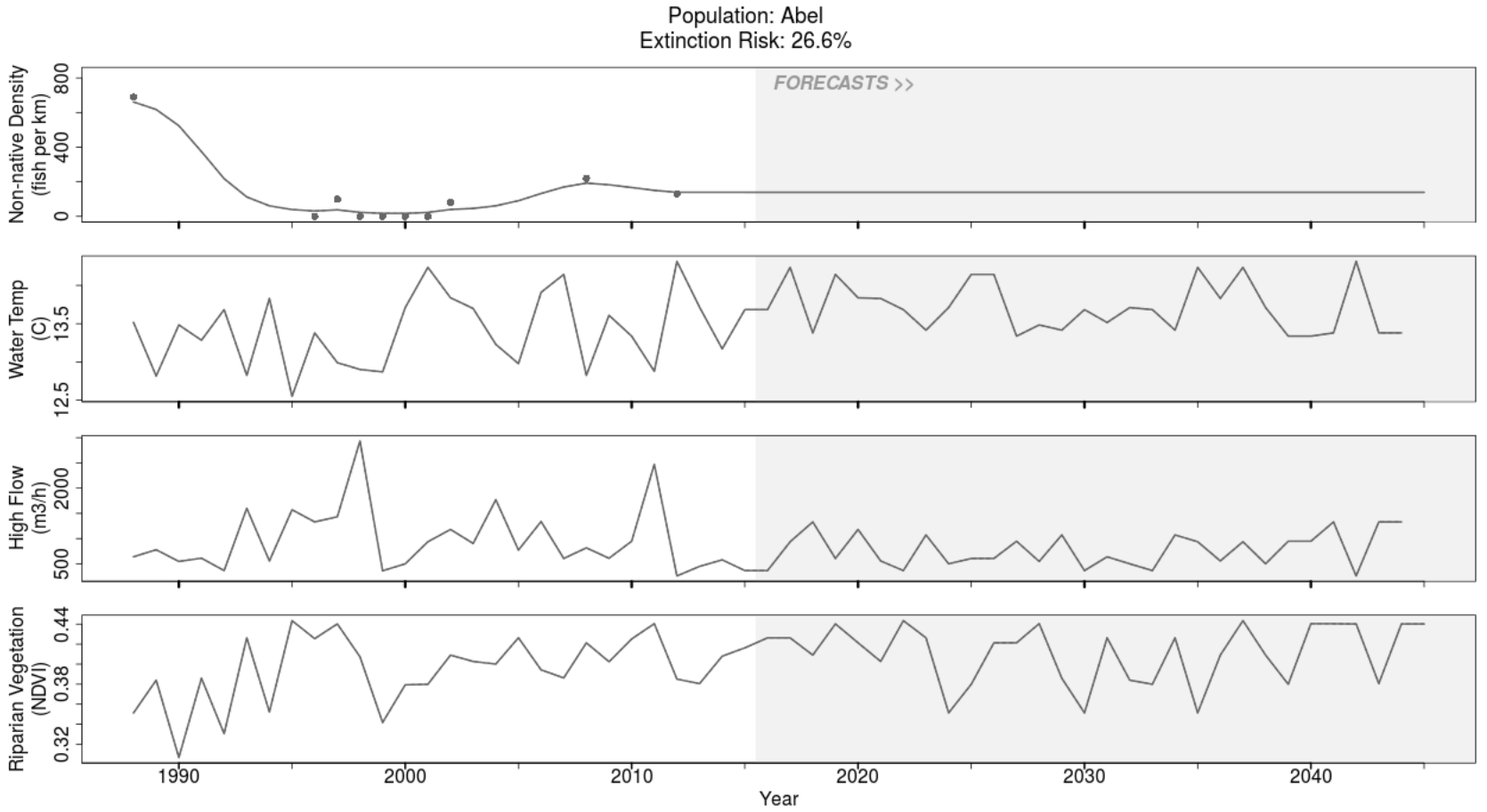

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Temperature

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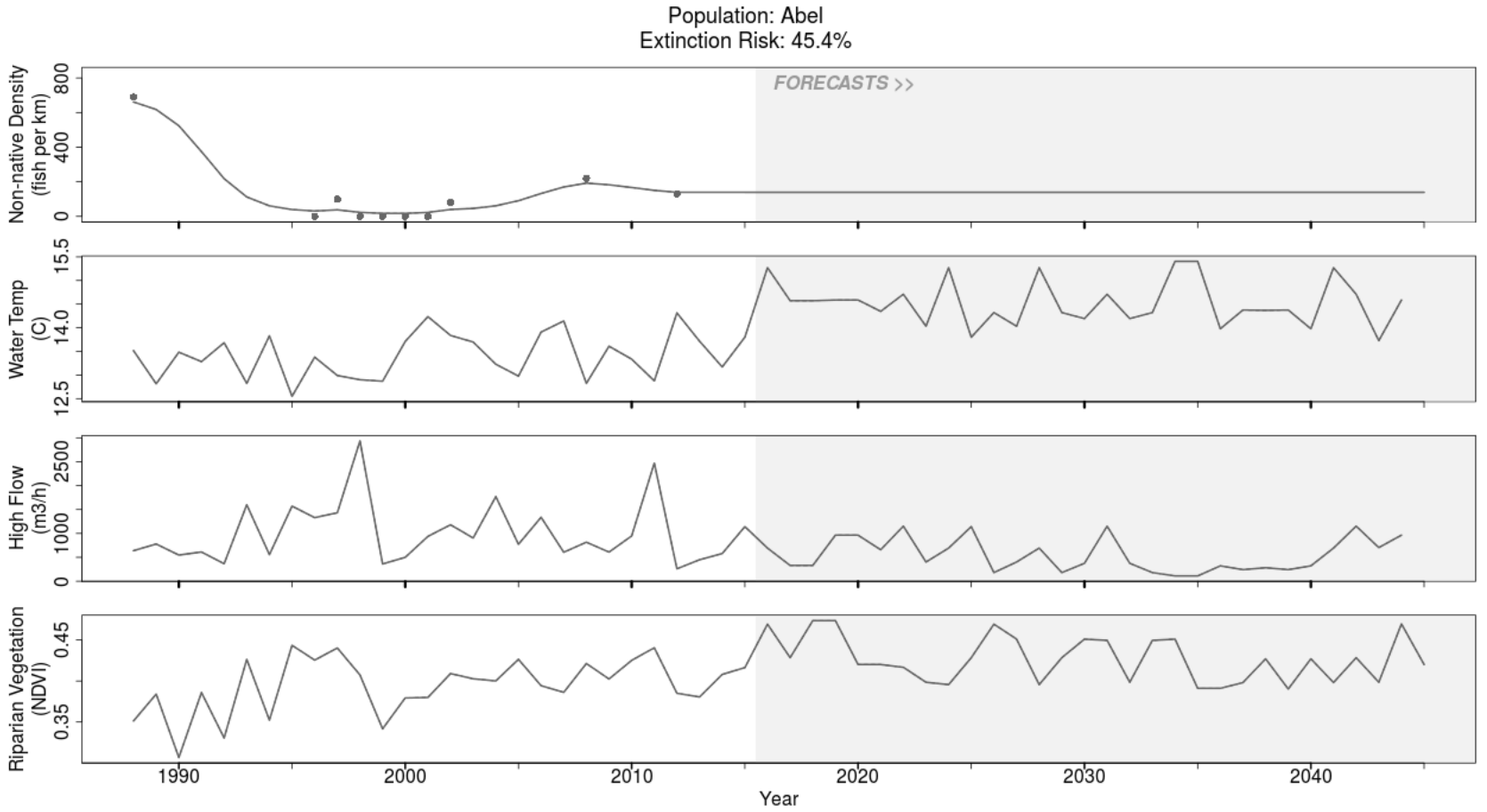

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Use histo es

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139 per km 2,000 per km

0 200 400 600 800 1,000 1,200 1,400 1,600 1,800 2,000

Stream habitat:

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0 1

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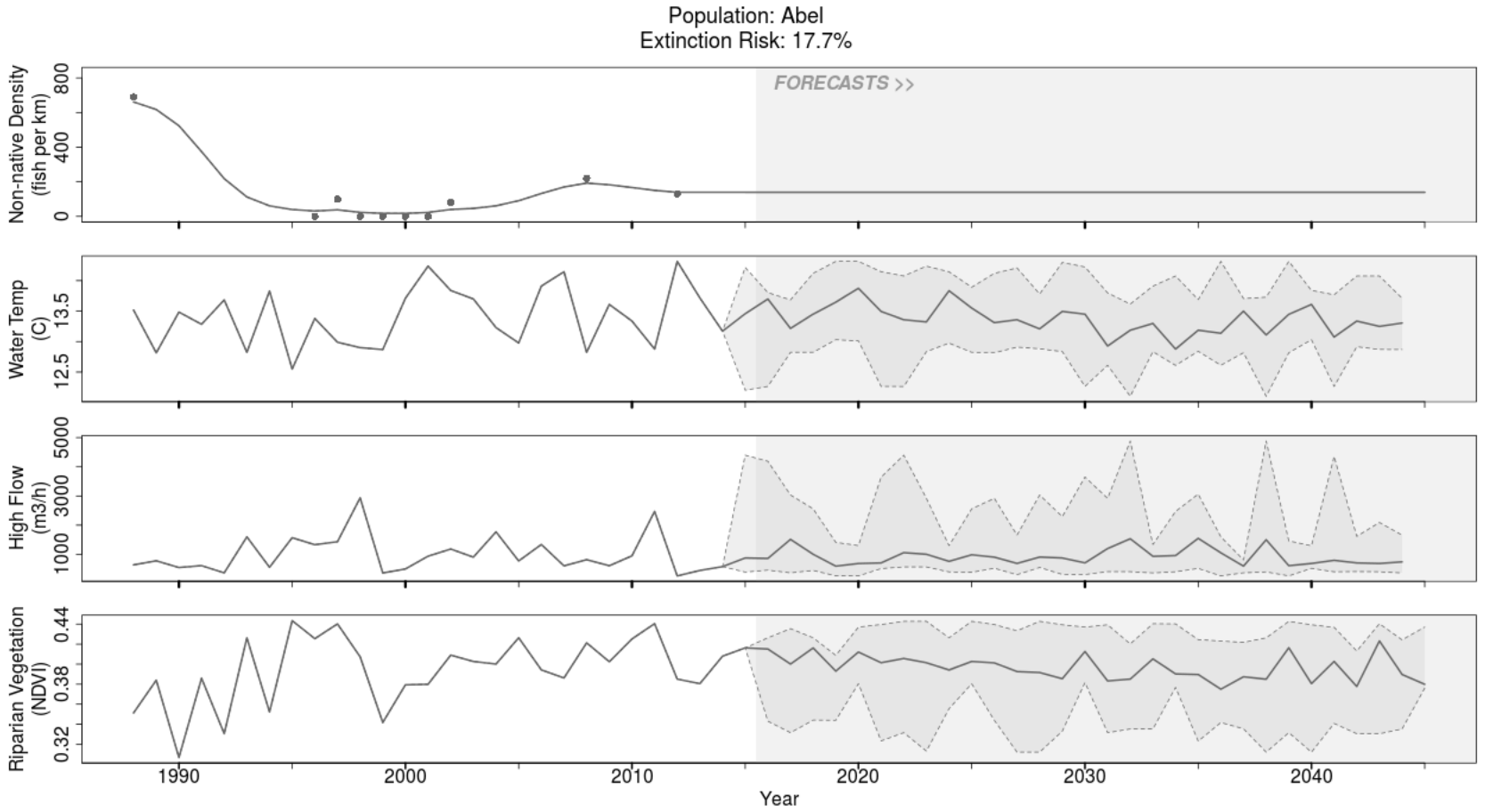

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Future Conditions

Reset

Population extent (km):

7.32

Non-native trout:

- Use historic densities
- Set a constant density (slider

0 per km 700 per km 2,000 per km

0 200 400 600 800 1,000 1,200 1,400 1,600 1,800 2,000

Stream habitat:

Temperature

0 1

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1

High flow

0 1

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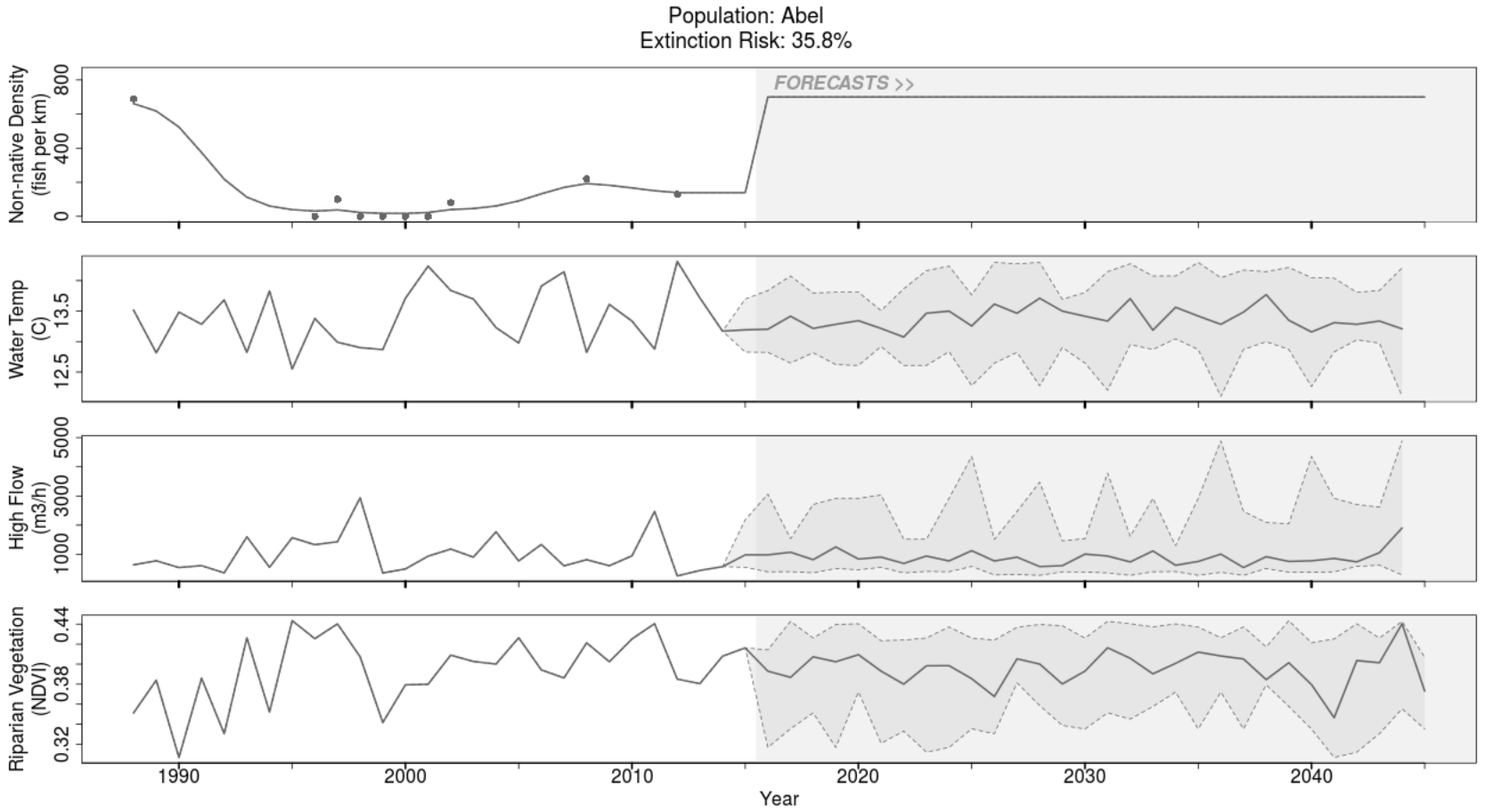

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Temperature

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High flow

0 1

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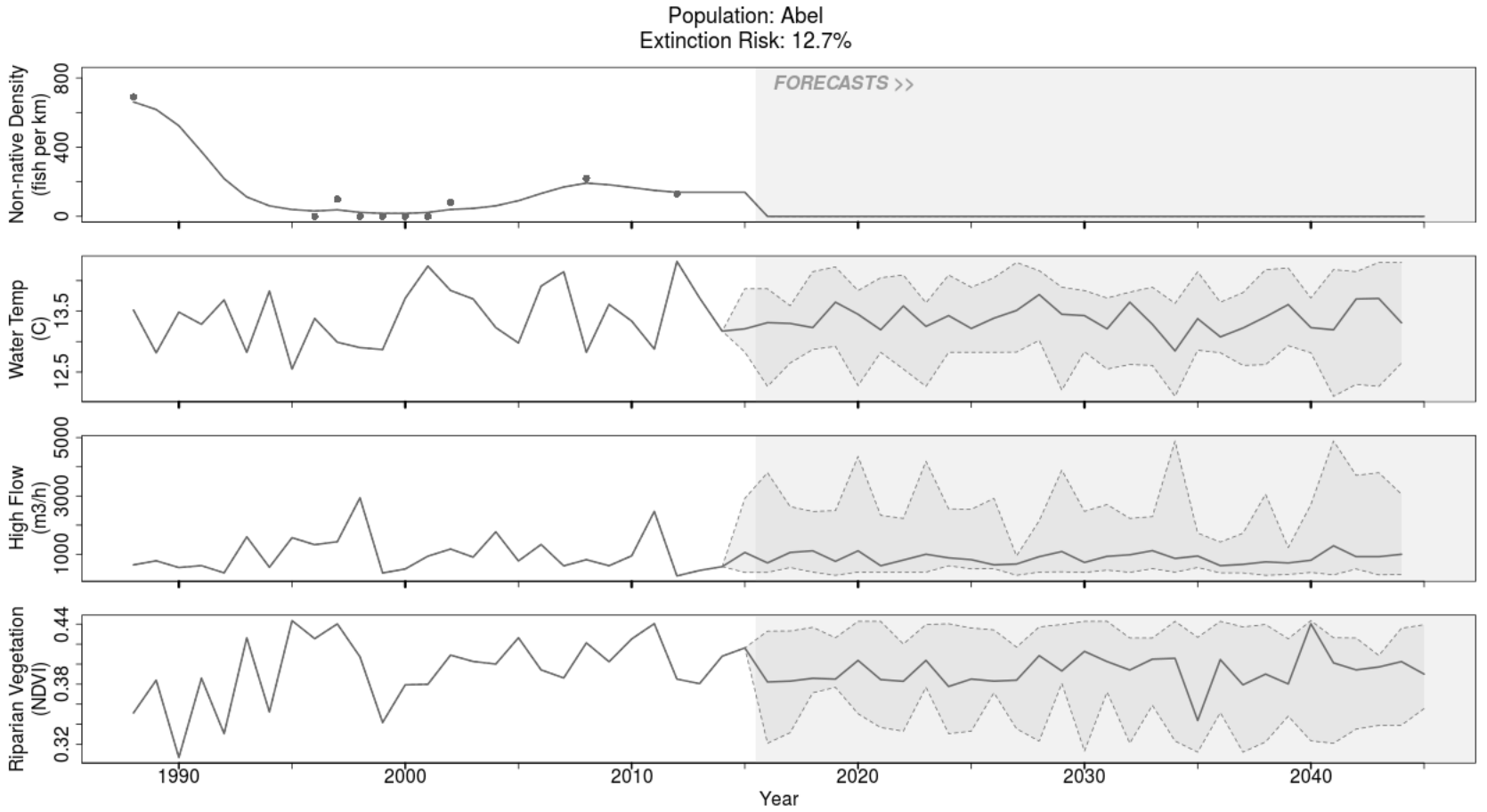

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Stream habitat:

Temperature

0 1

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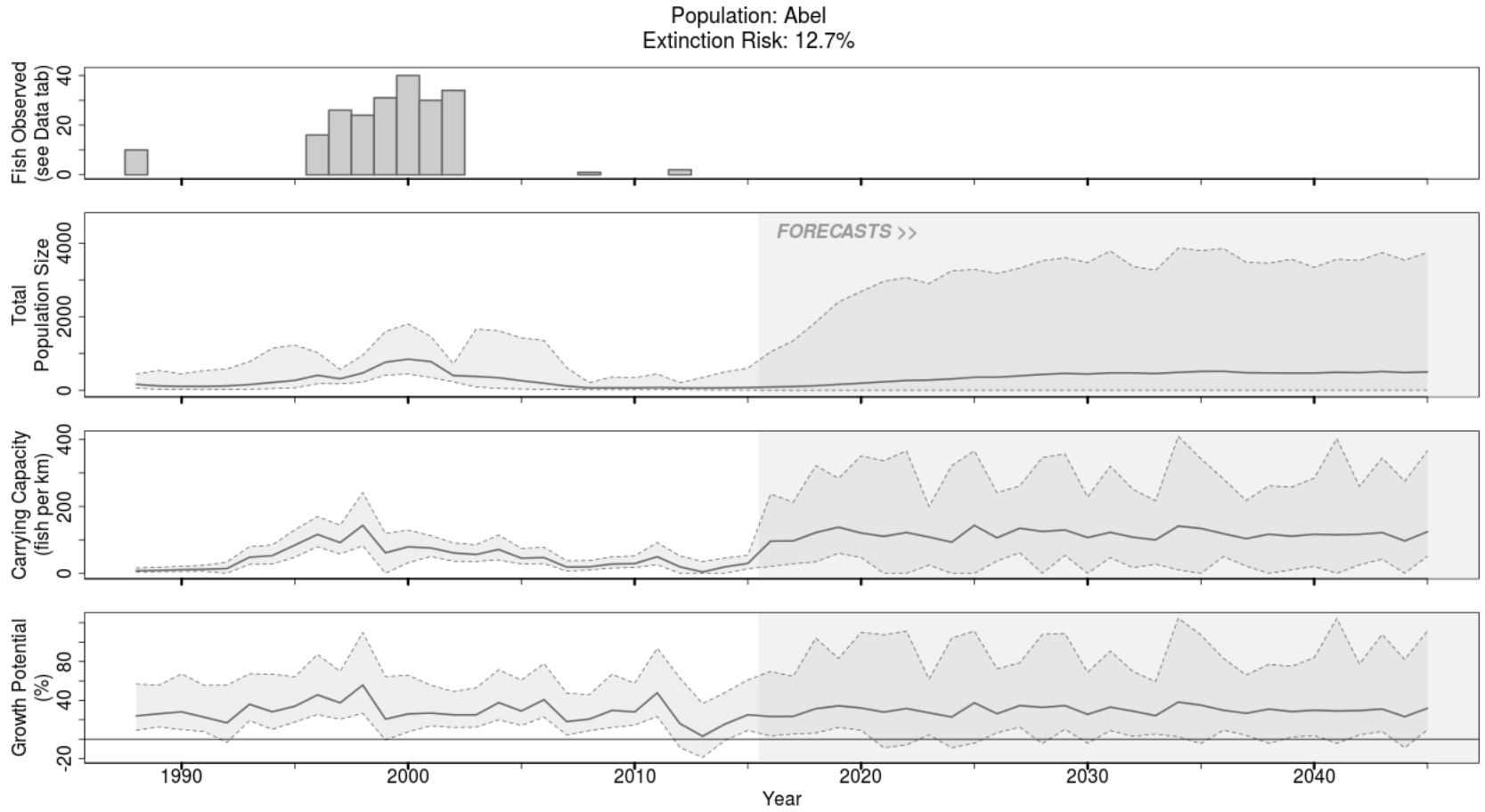
High flow

0 1

Map | Population | Habitat | Effects | Detection | Data | Help | About



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Lahontan Cutthroat Trout Population Simulator

Population:

Abel

CA_CharityValley
CA_ColdStream
CA_Deep
CA_Deer
CA_Desert
CA_Dog
CA_Dunderberg&Dog

Population extent (km):

7.32

Non-native trout:

- Use historic densities
- Set a constant density (slider below)

0 per km — 2,000 per km

0 200 400 600 800 1,000 1,200 1,400 1,600 1,800 2,000

Stream habitat:

Temperature

0 — 1

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1

High flow

0 — 1

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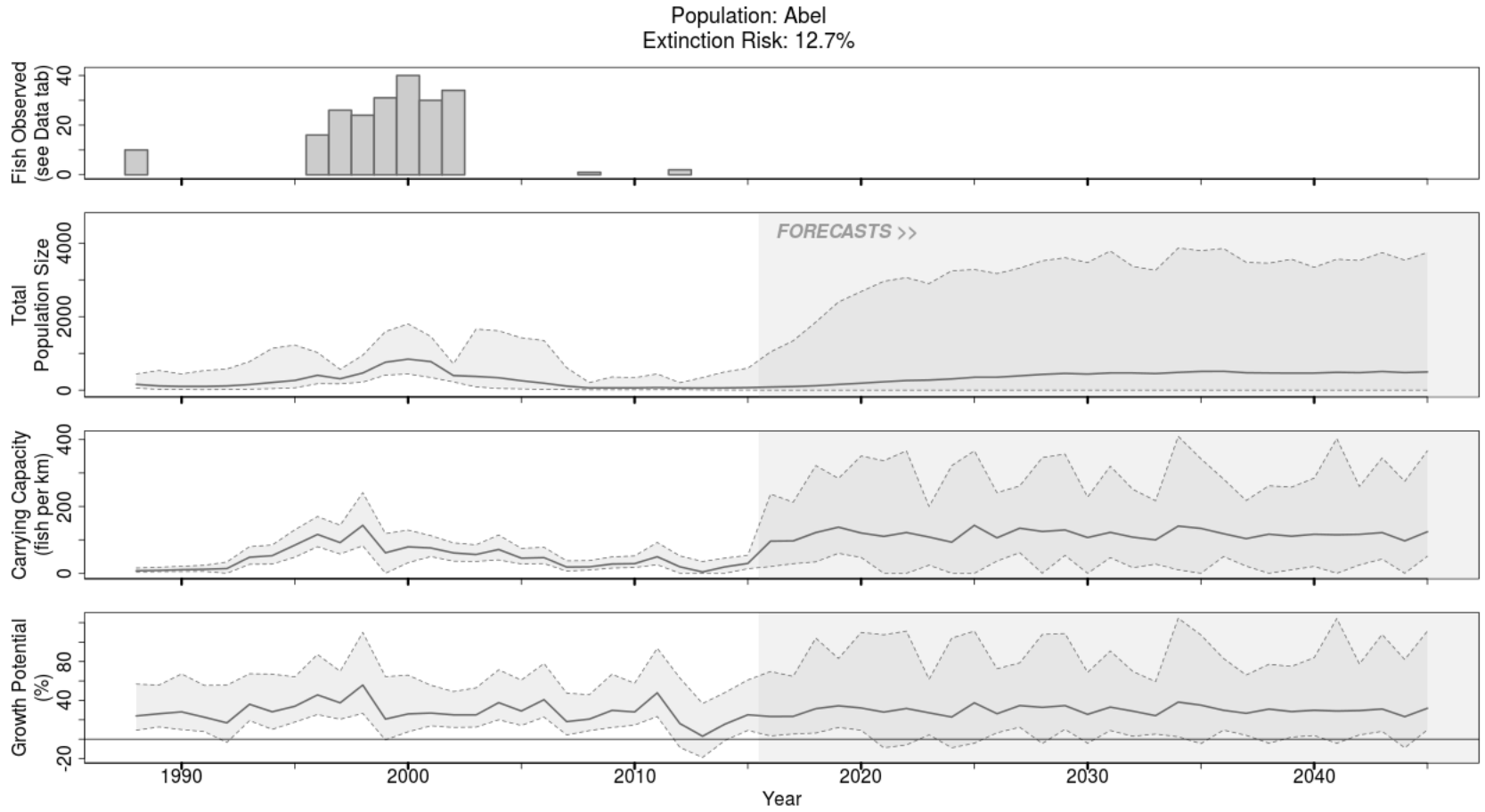

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Lahontan Cutthroat Trout Population Simulator

Population:

CA_Deep

Forecast year:

2020 2045 2115

2020 2030 2040 2050 2060 2070 2080 2090 2100 2110 2115

Future Conditions

Reset

Population extent (km):

42.57

Non-native trout:

- Use historic densities
- Set a constant density (slider below)

0 per km 2,000 per km

0 200 400 600 800 1,000 1,200 1,400 1,600 1,800 2,000

Stream habitat:

Temperature

0 1

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1

High flow

0 1

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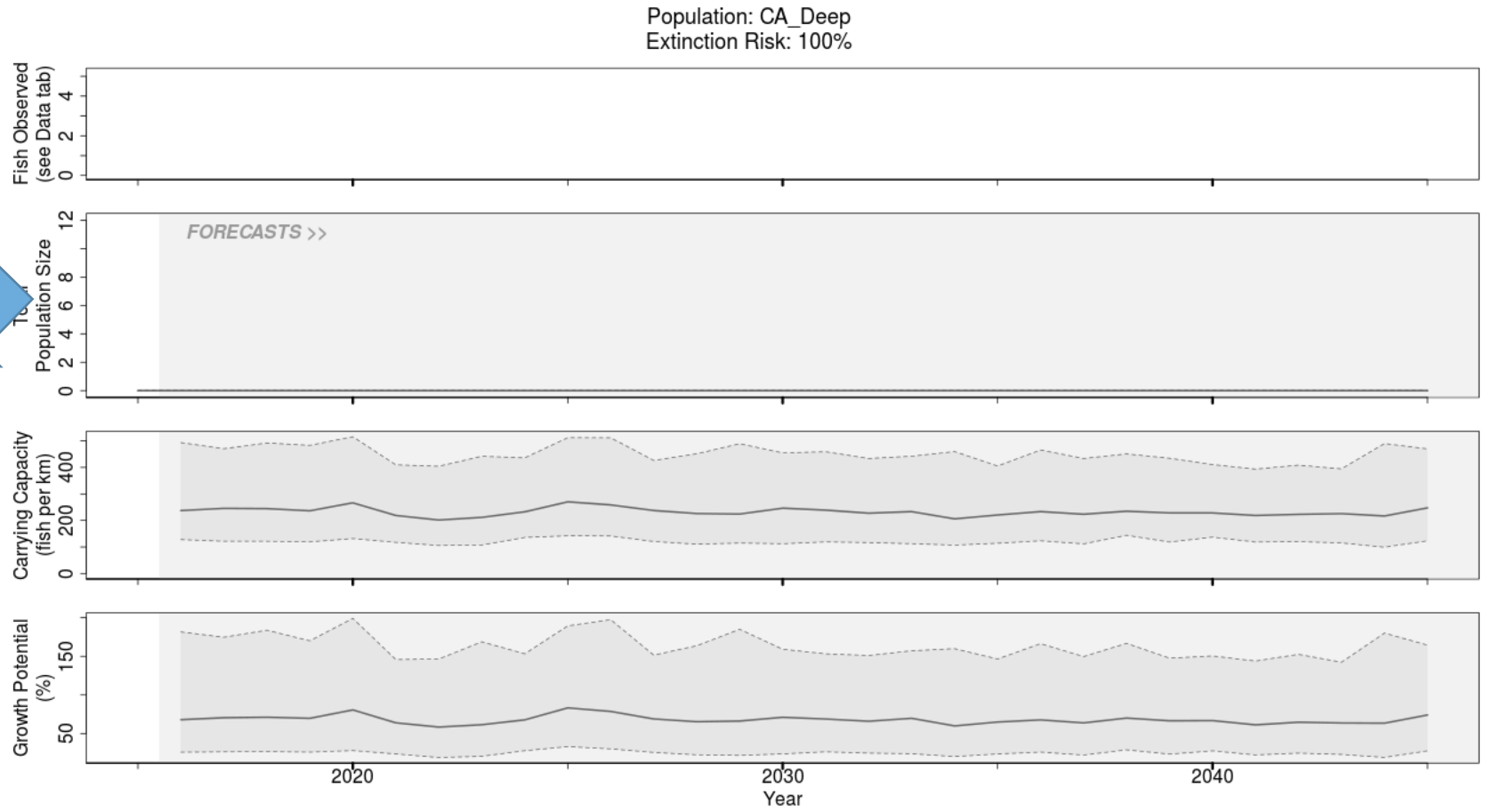

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Reintroductions

Add x fish/year **for t years,**

0 1

followed by...

x fish/year **for t years**

0 99

* Assumes introduced fish are reproductive adults that all survive.
* Reintroduction schedule will be repeated throughout simulation.
* Add negative numbers of fish to simulate removals.

Simulation Settings

Credible interval for plots:

0.5 0.95 0.99

0.5 0.55 0.6 0.65 0.7 0.75 0.8 0.85 0.9 0.95 0.99

Number of simulations (more is slower):

1 10 50

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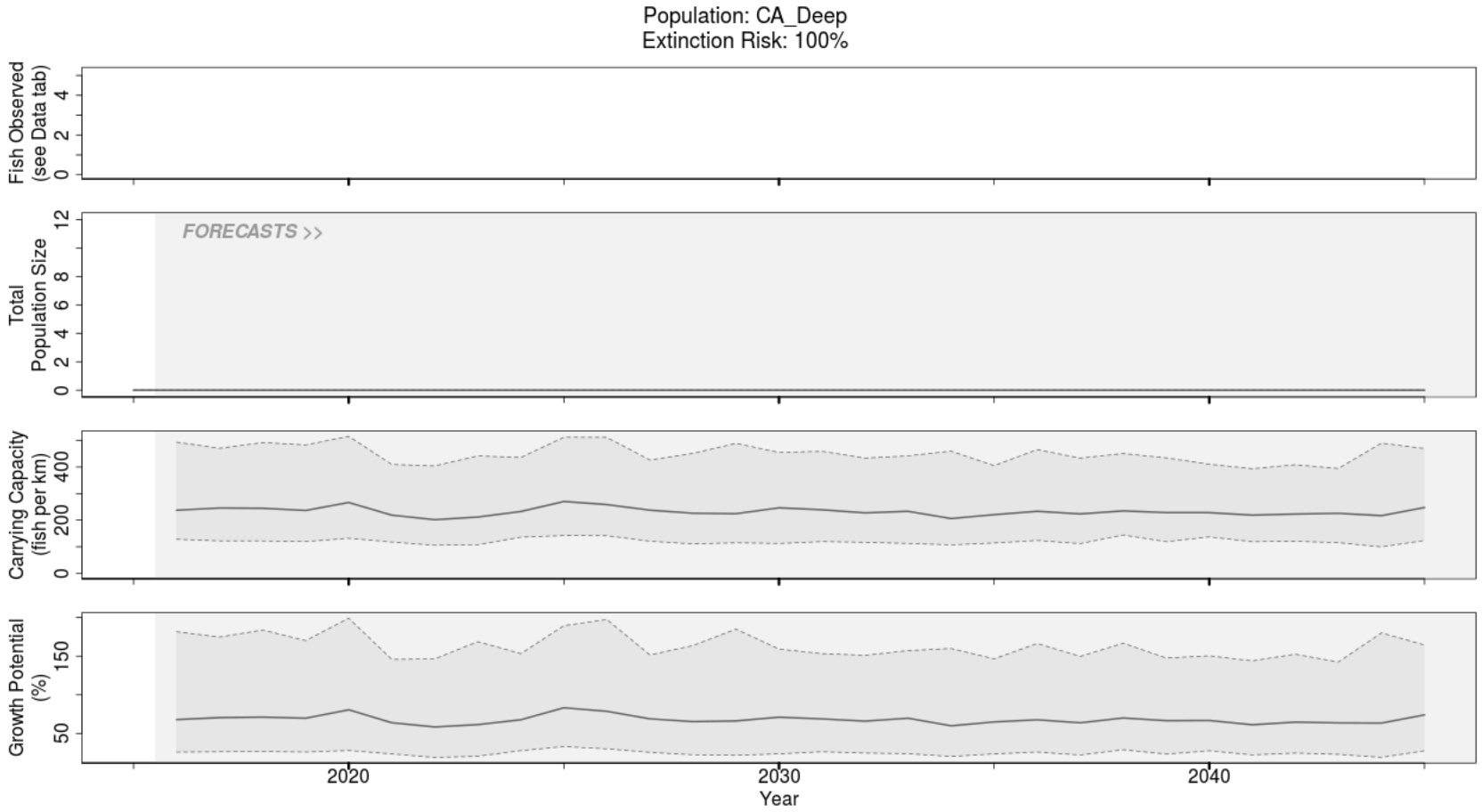

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Lahontan Cutthroat Trout Population Simulator

Population:

CA_Deep

Forecast year:

2020 2045 2115

2020 2030 2040 2050 2060 2070 2080 2090 2100 2110 2115

Reintroductions

Add x fish/year **for t years,**

50 1

followed by...

x fish/year **for t years**

0 99

* Assumes introduced fish are reproductive adults that all survive.
* Reintroduction schedule will be repeated throughout simulation.
* Add negative numbers of fish to simulate removals.

Simulation Settings

Credible interval for plots:

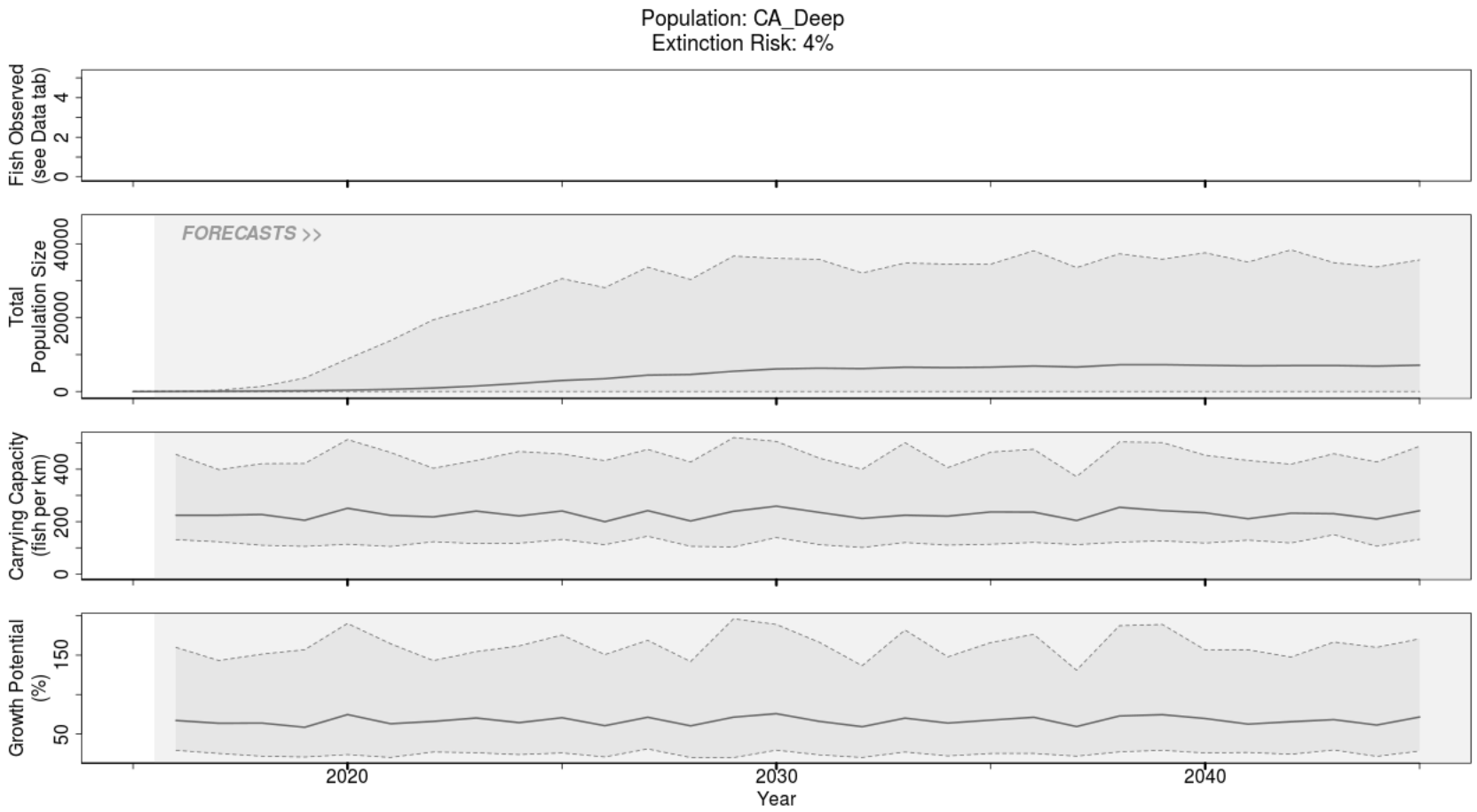
0.5 0.95 0.99

0.5 0.55 0.6 0.65 0.7 0.75 0.8 0.85 0.9 0.95 0.99

Number of simulations (more is slower):

1 10 50

Map | Population | Habitat | Effects | Detection | Data | Help | About



Last Update: Tue Apr 25 18:24:54 2017

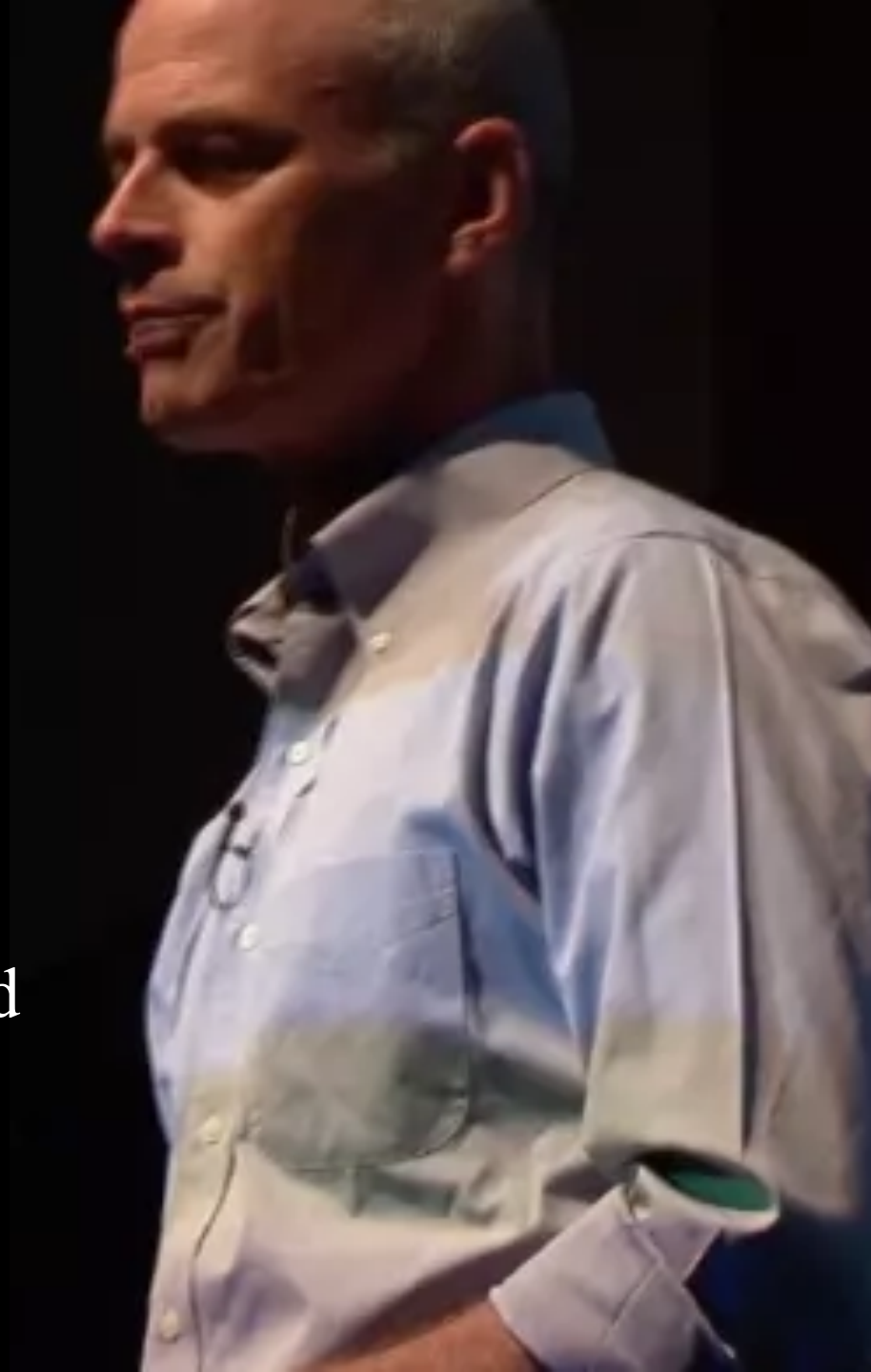

"I am thrilled with the outputs and their applicability to real time decision making…"
"The results have exceeded my expectations…"
--Lee Ann Carranza
U.S. Fish & Wildlife Service
TROUT UNLIMITED
FOREST SERVICE
US
DEPARTMENT OF AGRICULTURE
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
U.S. FISH & WILDLIFE SERVICE
DEPARTMENT OF THE INTERIOR
NEVADA
DEPARTMENT OF WILDLIFE
OREGON
Fish & Wildlife
CALIFORNIA
DEPARTMENT OF FISH & WILDLIFE

“The prospect of using this to make better informed decisions about where to focus restoration and reintroduction efforts is truly game-changing.”

“I can honestly say that in my more than 15 years now with Trout Unlimited that was the most exciting and potentially important presentation I’ve ever heard.”

-- Chris Wood, CEO Trout Unlimited

TROUT UNLIMITED

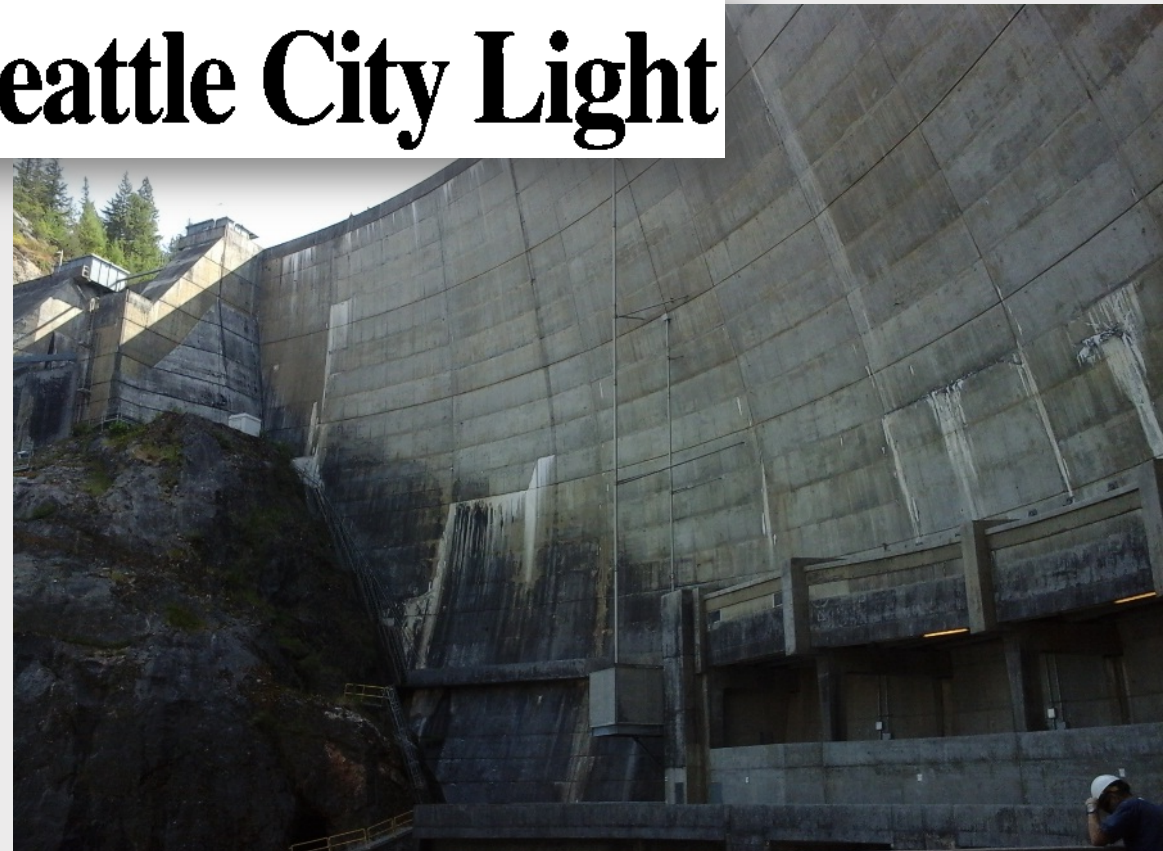


CDMetaPOP

Genetic population viability assessment for meta-populations

Individual-based simulations of fish movements and population genetics

Seattle City Light



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Computational Ecology Laboratory

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