# SocModelScenarios

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Function:

$\frac{dF_1}{dt} = r_1 F_1(1 - F_1) - \frac{h_1 * F_1(1-X_1)}{F_1+s_1} - i_2 F_1 + i_1 F_2$

$\frac{dF_2}{dt} = r_2 F_2(1 - F_2) - \frac{h_2 * F_2(1-X_2)}{F_2+s_2} - i_1 F_2 + i_2 F_1$

$\frac{dX_1}{dt} = k_1 X_1(1 - X_1)[\frac{1}{F_1+c_1} - \omega_1 + d_1(2X_1 - 1) + \rho_1(2X_2 - 1)]$

$\frac{dX_2}{dt} = k_2 X_2(1 - X_2)[\frac{1}{F_2+c_2} - \omega_2 + d_2(2X_2 - 1) + \rho_2(2X_1 - 1)]$

Table 1: Default parameter values used in this analysis

| Parameter | Population_1 | Population_2 | Def |
|---|---|---|---|
| r | 0.35 | 0.35 | Fish net growth |
| s | 0.8 | 0.8 | Supply and demand |
| h | 0.5 | 0.5 | Harvesting efficiency |
| k | 1.014 | 1.014 | Social learning rate |
| $\omega$ | 0.35 | 0.35 | Conservation cost |
| c | 1.5 | 1.5 | Rarity valuation |
| d | 0.5 | 0.5 | Social norm strength (within pop) |
| i | 0.2 | 0.2 | Fish immigration (from patch) |
| $\rho$ | 0.5 | 0.5 | Social norm strength (opposite pop) |

Table 2: Starting values used in this analysis

| Parameter | Population_1 | Population_2 |
|---|---|---|
| F | 0.406 | 0.406 |
| X | 0.240 | 0.240 |

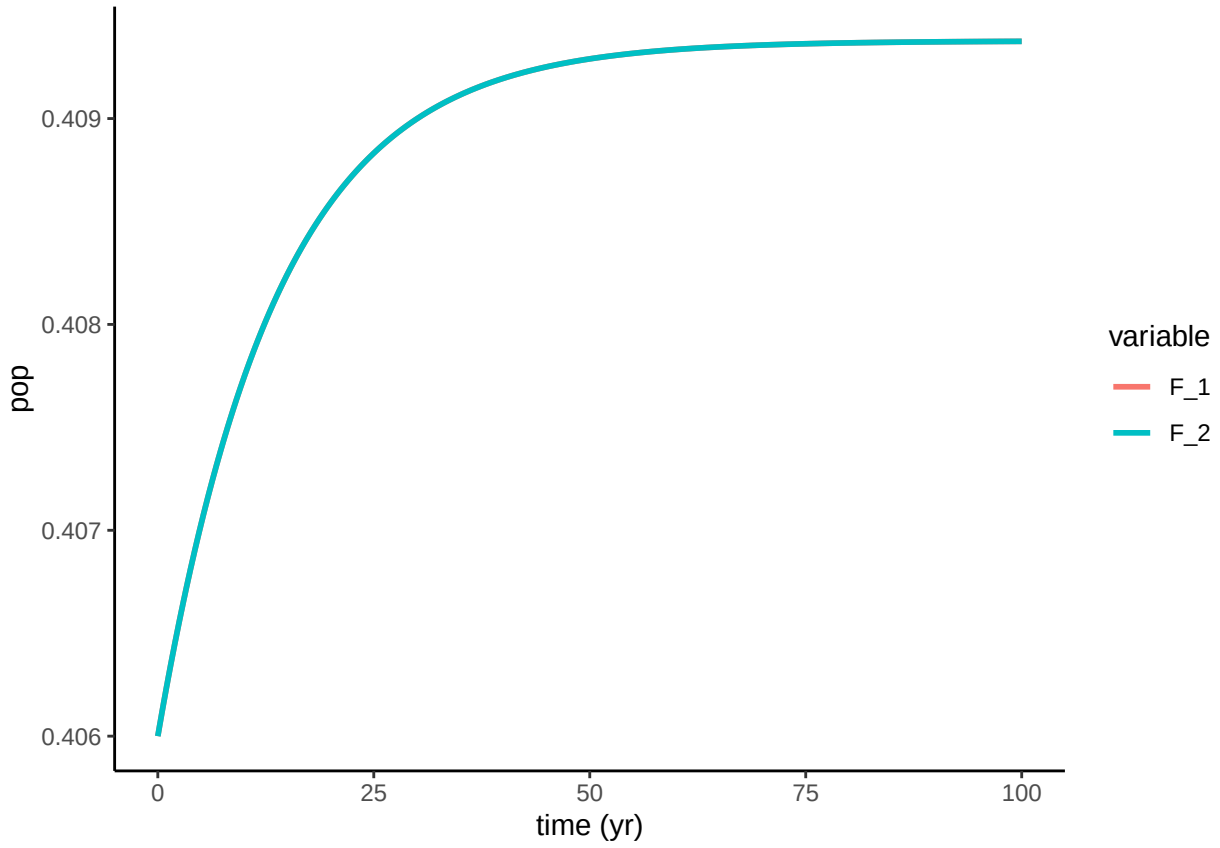


Figure 1: Model without social dynamics

Observations:

- Fishing remains sustainable UNLESS more than 50% of people are fishing

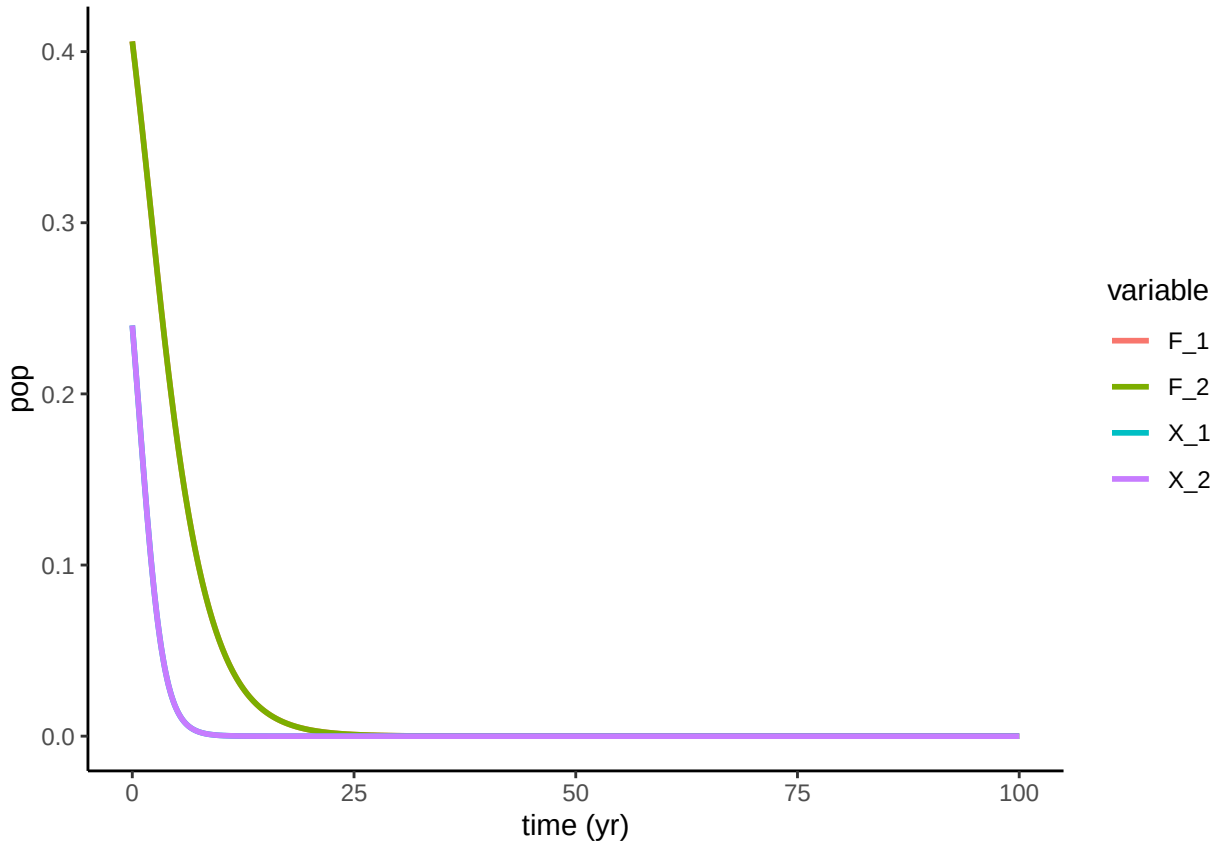


Figure 2: New Model with social dynamics

Observations:

- Still decreasing. Indicates that human dynamics consistently have fishers above 50%

# Scenarios

## One group tanking whole system

Table 3: Default parameter values used in this analysis

| Parameter | Population_1 | Population_2 | Def |
|---|---|---|---|
| r | 0.4 | 0.4 | Fish net growth |
| s | 0.8 | 0.8 | Supply and demand |
| h | 0.25 | 0.25 | Harvesting efficiency |
| k | 1.014 | 1.014 | Social learning rate |
| $\omega$ | 0.2 | 0.2 | Conservation cost |
| c | 1.5 | 1.5 | Rarity valuation |
| d | 0.5 | 0.5 | Social norm strength (within pop) |
| i | 0.2 | 0.2 | Fish immigration (from patch) |
| $\rho$ | 0.5 | 0.5 | Social norm strength (opposite pop) |

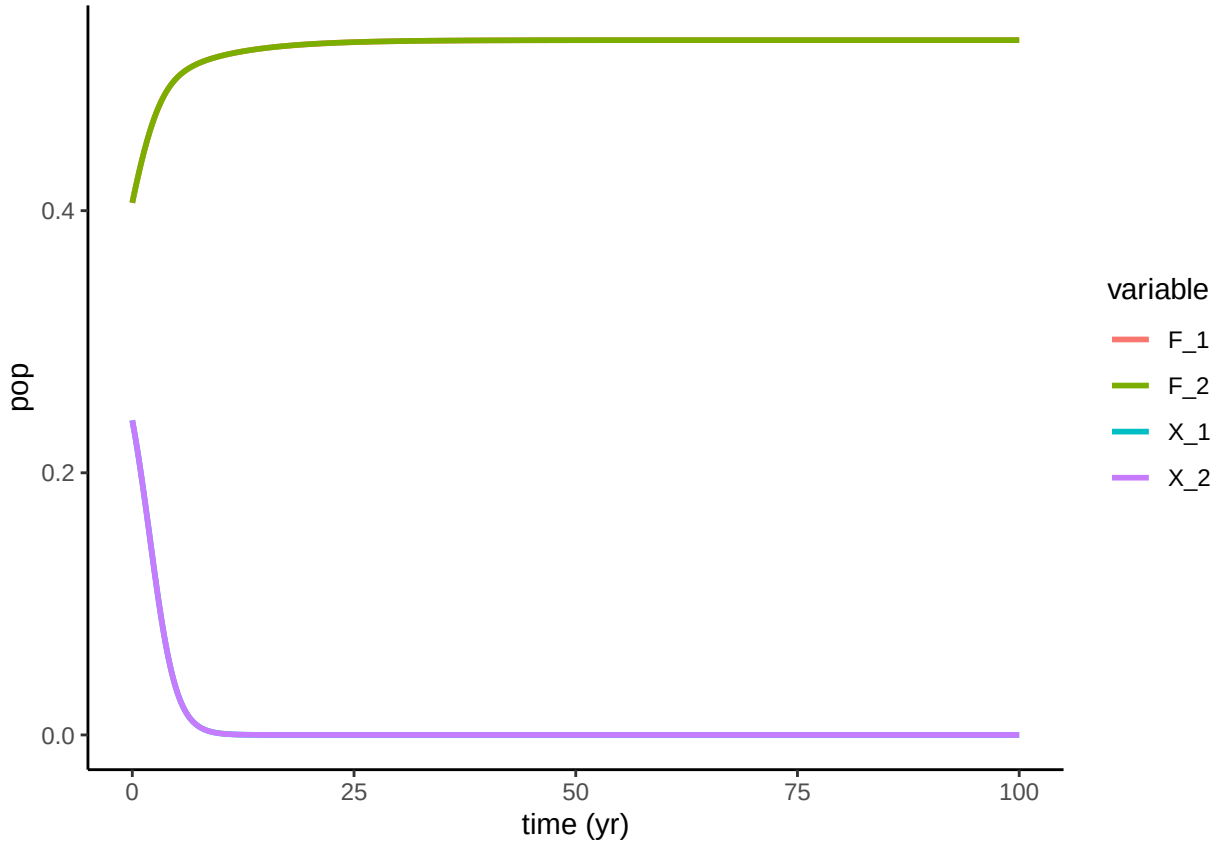


Figure 3: Changing fish growth, conservaiton cost, and harvesting efficiency for sustainable practices

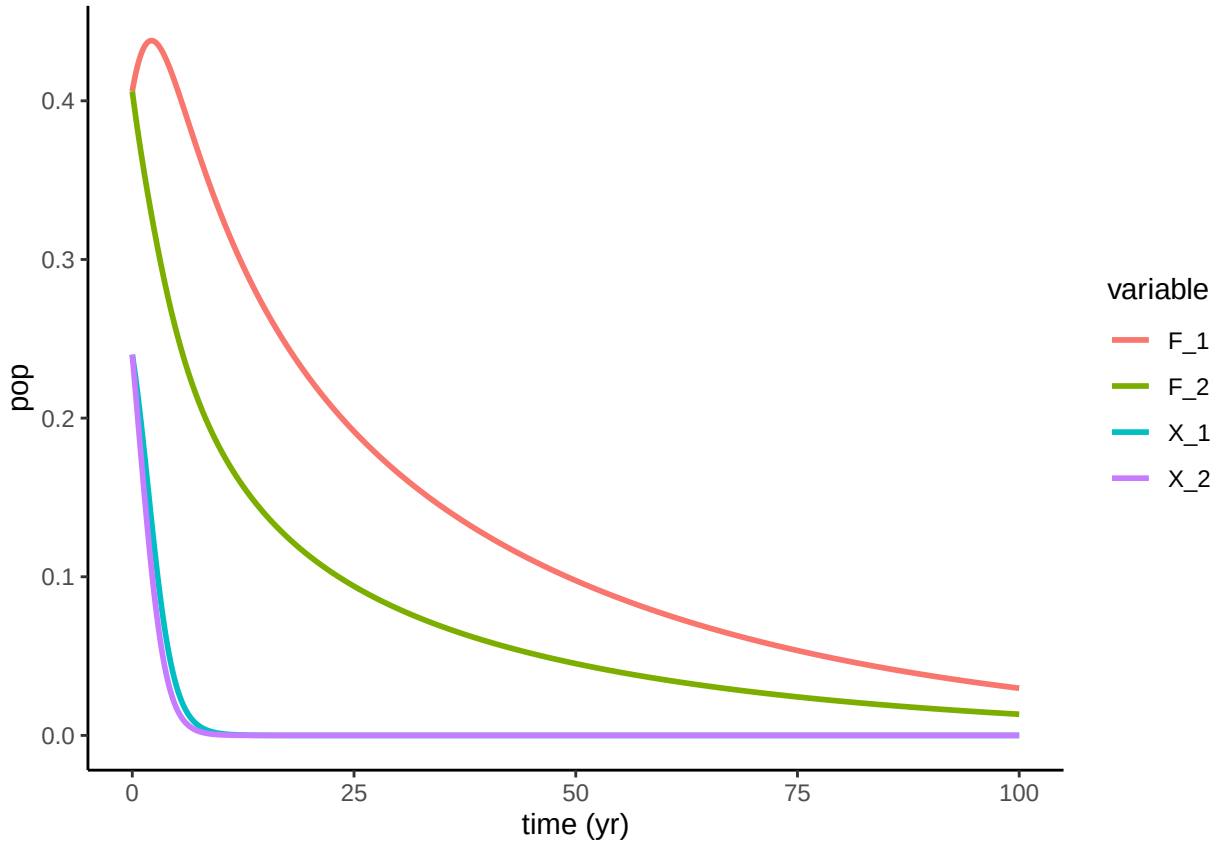


Figure 4: One group unsustainable practices scenario. Shows that one groups bad fishing can tank whole system

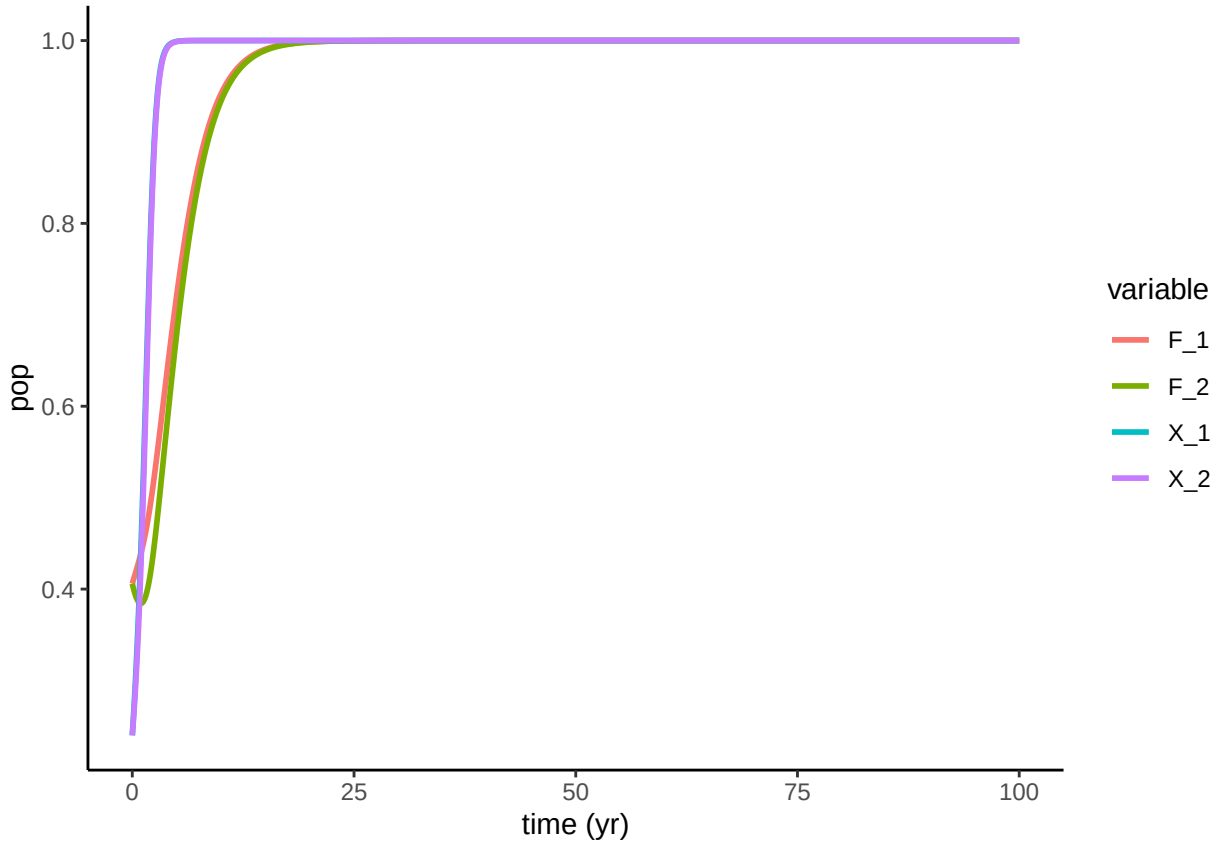


Figure 5: However, changing the rarity valuation parameters can recover the system

## Heirarchy in decision making

Table 4: Default parameter values used in this analysis

| Parameter | Population_1 | Population_2 | Def |
|---|---|---|---|
| r | 0.35 | 0.35 | Fish net growth |
| s | 0.8 | 0.8 | Supply and demand |
| h | 0.5 | 0.25 | Harvesting efficiency |
| k | 0.17 | 1.014 | Social learning rate |
| $\omega$ | 0.35 | 0.35 | Conservation cost |
| c | 1.5 | 1.5 | Rarity valuation |
| d | 0.5 | 0.5 | Social norm strength (within pop) |
| i | 0.1 | 0.4 | Fish immigration (from patch) |
| $\rho$ | 0.5 | 0.5 | Social norm strength (opposite pop) |

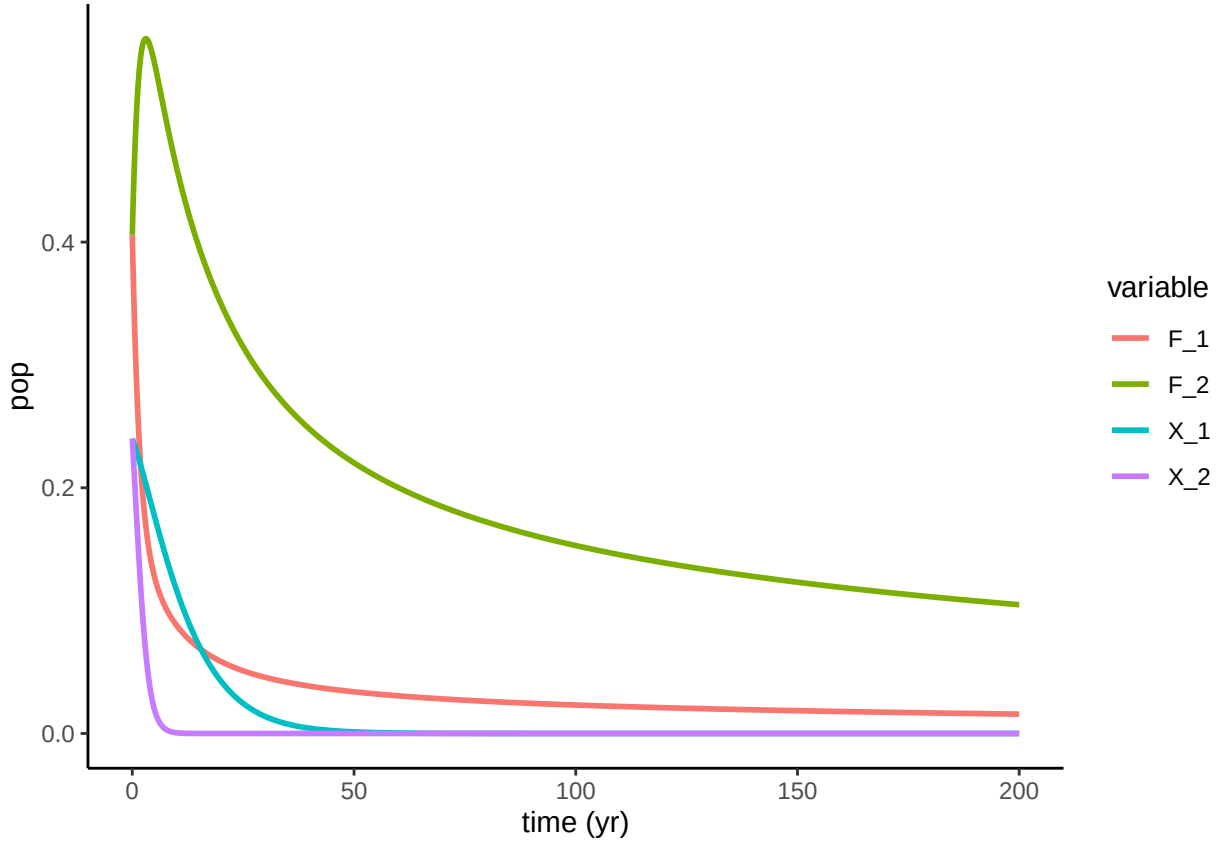


Figure 6: model with different fishing conditions in each patch

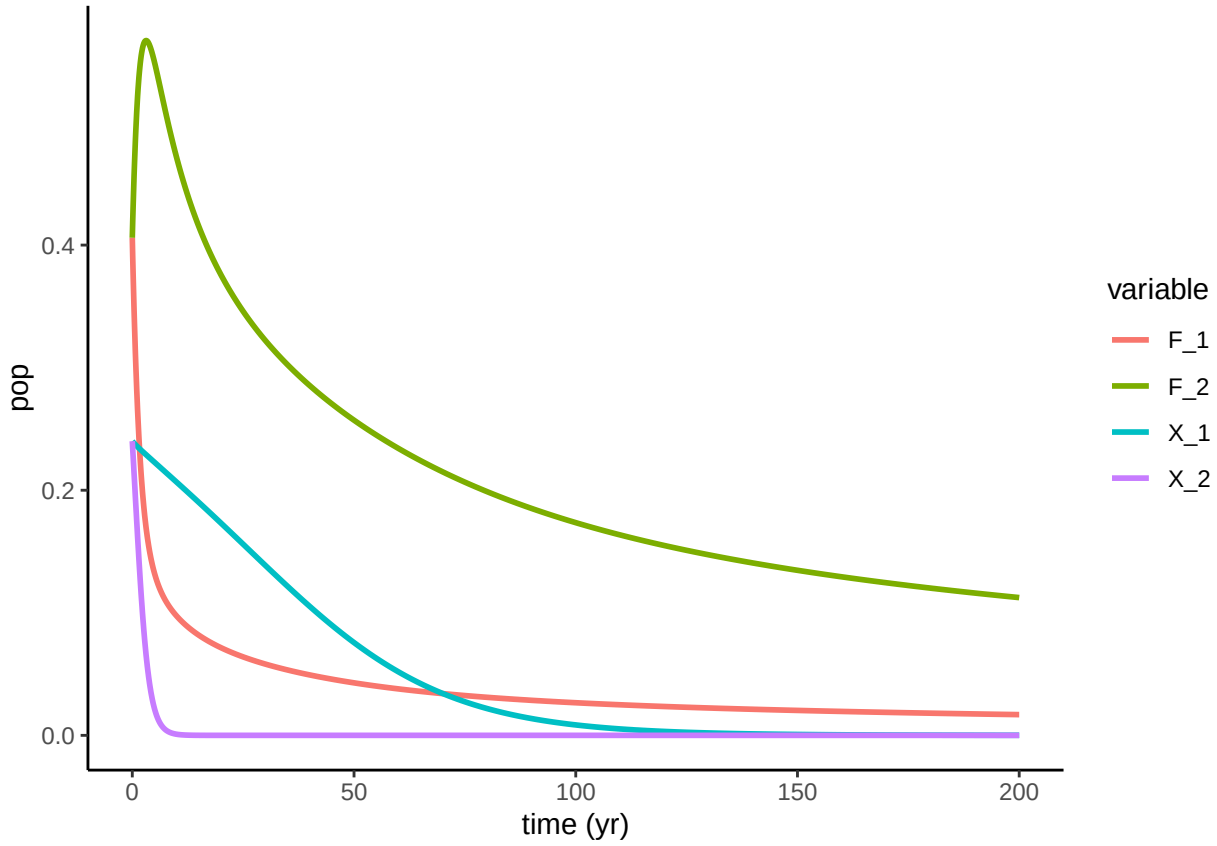


Figure 7: model with social inequity. idk does similar stuff but allows x1 to fish more

Table 5: Default parameter values used in this analysis

| Parameter | Population_1 | Population_2 | Def |
|---|---|---|---|
| r | 0.4 | 0.4 | Fish net growth |
| s | 0.8 | 0.8 | Supply and demand |
| h | 0.35 | 0.35 | Harvesting efficiency |
| k | 1.014 | 1.014 | Social learning rate |
| $\omega$ | 0.15 | 0.15 | Conservation cost |
| c | 1.5 | 1.5 | Rarity valuation |
| d | 0.5 | 0.5 | Social norm strength (within pop) |
| i | 0 | 0 | Fish immigration (from patch) |
| $\rho$ | 0.5 | 0.5 | Social norm strength (opposite pop) |

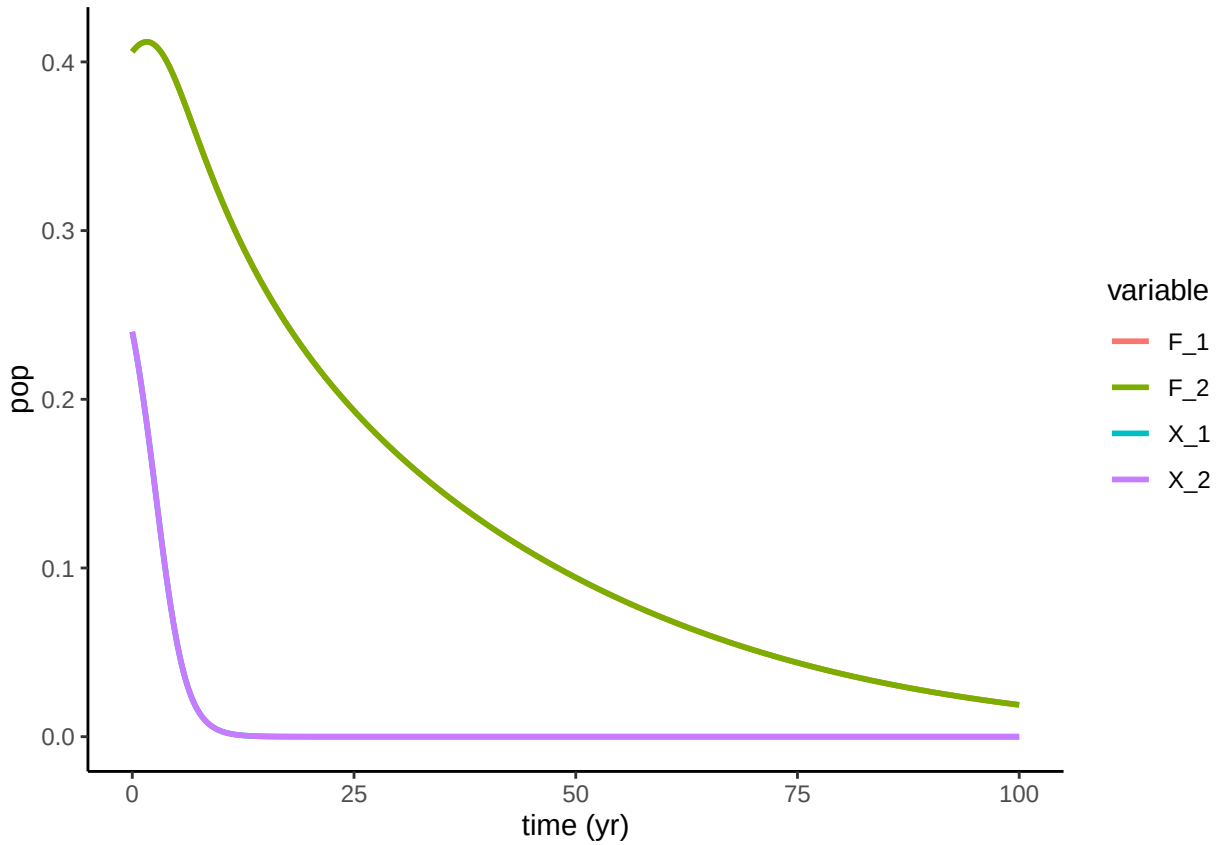


Figure 8: Changing fish growth, conservaiton cost, and harvesting efficiency for sustainable practices