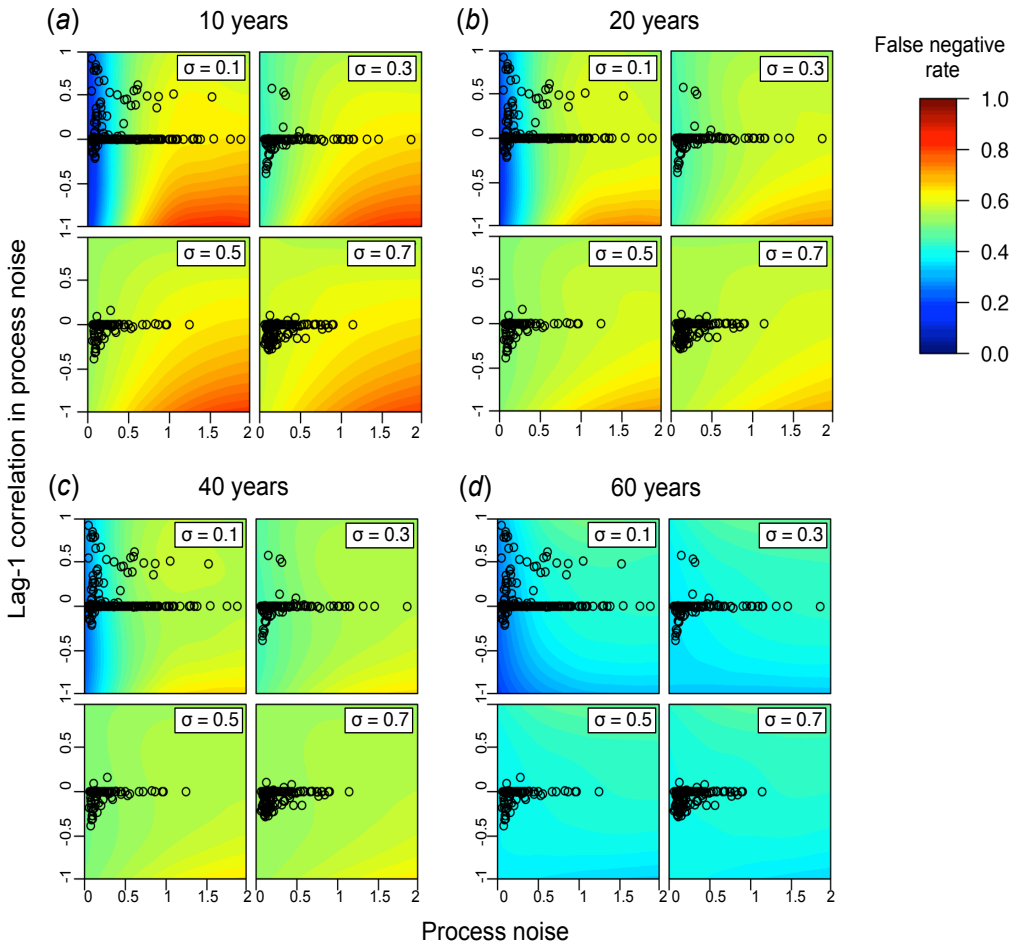
Supporting Information

List of population IDs from the Global Population Dynamics Database for the time series used in this analysis.

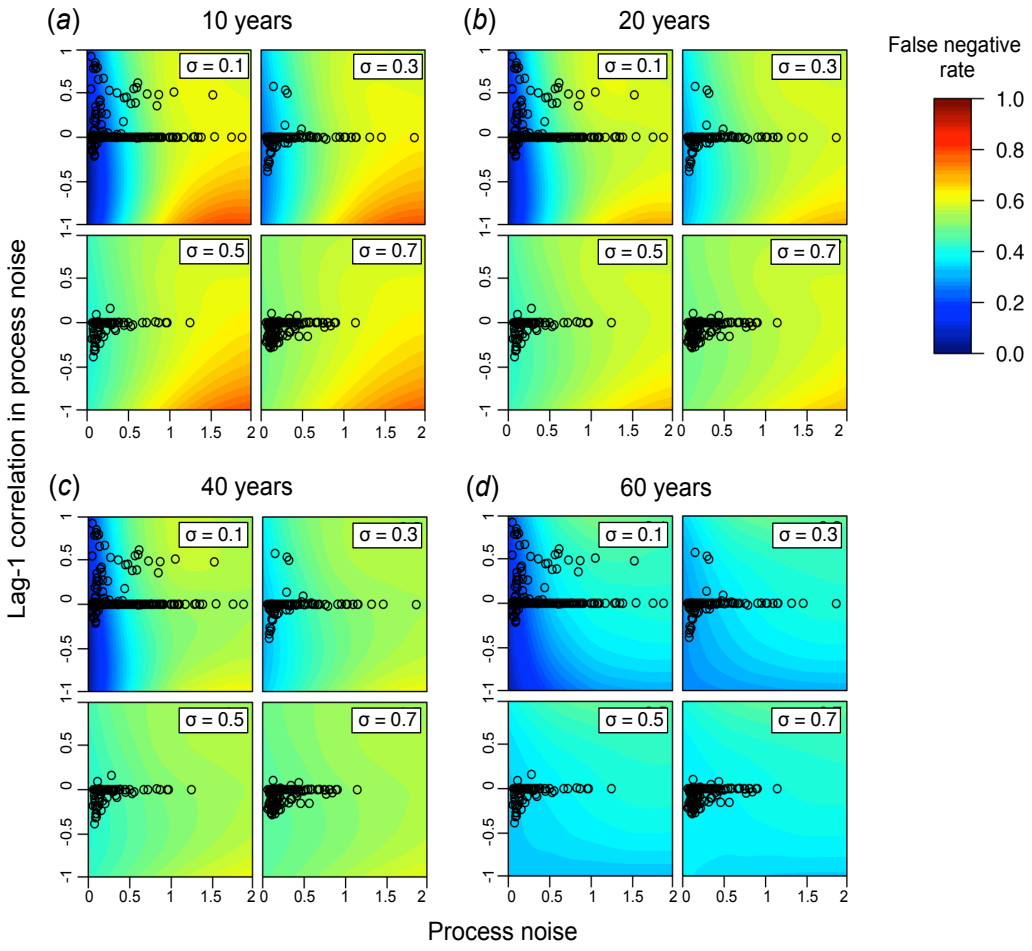
1,8,9,10,11,12,13,14,15,16,17,18,56,57,58,59,60,61,1159,1160,1163,1166,1170,1174,1181,1185,1188,1189,1207,1235,1239,1347,1356,1357,1358,1359,1360,1361,1362,1363,1364,1365,1366,1367,1377,1403,1405,1505,1507,1508,1516,1517,1522,1526,1536,2726,2732,2733,2736,2737,2757,2758,2771,2774,2775,2778,2780,2781,5029,5032,5033,5034,5035,5036,5037,5038,5039,5040,5044,5045,5047,5049,5054,5055,6522,6527,6528,6529,6530,6531,6532,6533,6534,6535,6536,6537,6538,6633,6673,6674,6676,6677,6678,6688,7041,7042,7051,9200,9207,9211,9270,9271,9272,9273,9276,9277,9279,9280,9330,9331,9395,9400,9436,9437,9438,9439,9440,9441,9442,9443,9444,9445,9446,9447,9460,9506,9507,9715,9736,9793,9794,9795,9796,9797,9855,9856,9857,9858,9859,9860,9861,9862,9863,9864,9865,9866,9867,9868,9869,9870,9871,9872,9873,9874,9875,9876,9877,9878,9879,9880,9881,9882,9883,9884,9885,9886,9887,9888,9893,9896,9897,9898,9899,9901,9902,9903,9904,9907,3,5,6,7,1523,1524,6634,6764,6765,6863,6864,6865,6866,6867,6868,6869,6870,6871,6872,6873,6874,6875,6876,6877,6878,6879,6880,6881,6882,6883,6884,6885,6886,6887,6888,6889,6890,6891,6892,6893,6894,6895,6896,6897,6898,6899,6900,6901,6902,6903,6904,6905,6906,6907,6908,6909,6910,6911,6912,6913,6914,6915,6916,6917,6918,6919,6920,6921,6922,6923,6924,6925,6926,6927,6928,6929,6930,6931,6932,6933,6934,6935,6936,6937,6938,6939,6940,6941,6942,6943,6944,6945,6946,6947,6948,6949,6950,6951,6953,6955,6956,6957,6958,6959,6960,6961,6962,6963,6964,6965,6966,6967,6968,6970,6971,6972,6973,6974,6975,6976,6977,6978,6982,6983,6985,6986,6987,6989,6990,6991,6992,6993,6994,6995,6996,7119,9185,9186,9187,9188,9191,9192,9232,9308,9381,9519,9641,9688,9689,9690,9691,9947,9948,9949,9950,9951,44,45,46,47,1314,1315,1316,1317,1318,1319,1320,1321,1322,1323,1324,1325,1327,1328,1329,1331,1333,1334,1336,1337,1339,1340,1341,1342,1343,1348,1349,1350,1351,1352,1353,1354,1355,1368,1369,1402,2721,2722,5019,5020,6588,6589,6590,6713,6714,6715,6770,7048,7059,7060,7061,7088,7089,7091,7092,7093,7094,7096,7115,9245,9247,9294,9355,9357,9370,9371,9372,9373,9374,9375,9376,9377,9378,9379,9391,9393,9463,9513,9515,9692,9693,9694,9695,9696,9698,9699,9700,9702,9703,9704,9705,9706,9707,9708,9709,9710,9711,9712,9713,9714,9717,9718,9720,9721,9722,9723,9724,9725,9726,9727,9728,9728,9730,9731,9732,9733,9734,9738,9739,9740,9832,9894,1090,1093,1097,1101,1102,1104,1106,1109,1111,1112,1115,1116,1602,1612,1613,1618,1626,1628,1633,1660,1664,1667,1667,1670,1671,1674,1783,1792,1826,1828,1829,1830,1831,1857,1858,1860,1865,1866,1868,1869,1870,1875,1876,1877,1878,1879,1880,1881,1882,1883,1884,1885,1886,1887,1888,1889,1893,1894,1927,1941,1949,1964,1965,1966,1968,1968,1971,1973,1974,1976,1978,1981,1982,1983,1984,1986,1987,1988,1990,1991,1992,1993,1994,1998,1999,2003,2004,2005,2006,2007,2008,2009,2011,2012,2013,2015,2016,2017,2018,2019,2020,2024,2025,2026,2027,2028,2031,2032,2033,2034,2066,2096,2097,2098,2759,6059,6061,6144,6541,6542,6547,6549,6550,6552,6553,6554,6555,6558,6561,6564,6565,6566,6567,6568,6570,6571,6582,6657,7022,7025,7067,9835,9836,9837

Figure S1. Probability (coloured contours) of the false negative rate (failing to correctly classify a declining population as at risk of extinction). Figures are (S1a) 30% decline, (S1b) 50% decline, and (S1c) 80% decline in abundance, assuming density-independent dynamics, shown across a range of process noise (in SD units), lag-one autocorrelation in process noise, and observation error (in SD units; sigma in the upper right corner of each plot) given a 10-, 20-, 40-, or 60-year observation window (panels a-d, respectively, within each of Figures S1a, S1b, and S1c). Open circles show empirically estimated autocorrelated process noise and observation error for different taxa based on time series from the Global Population Dynamics Database (see text).

S1*a*. 30 percent decline threshold



S1*b*. 50 percent decline threshold.



S1*c*. 80 percent decline threshold.

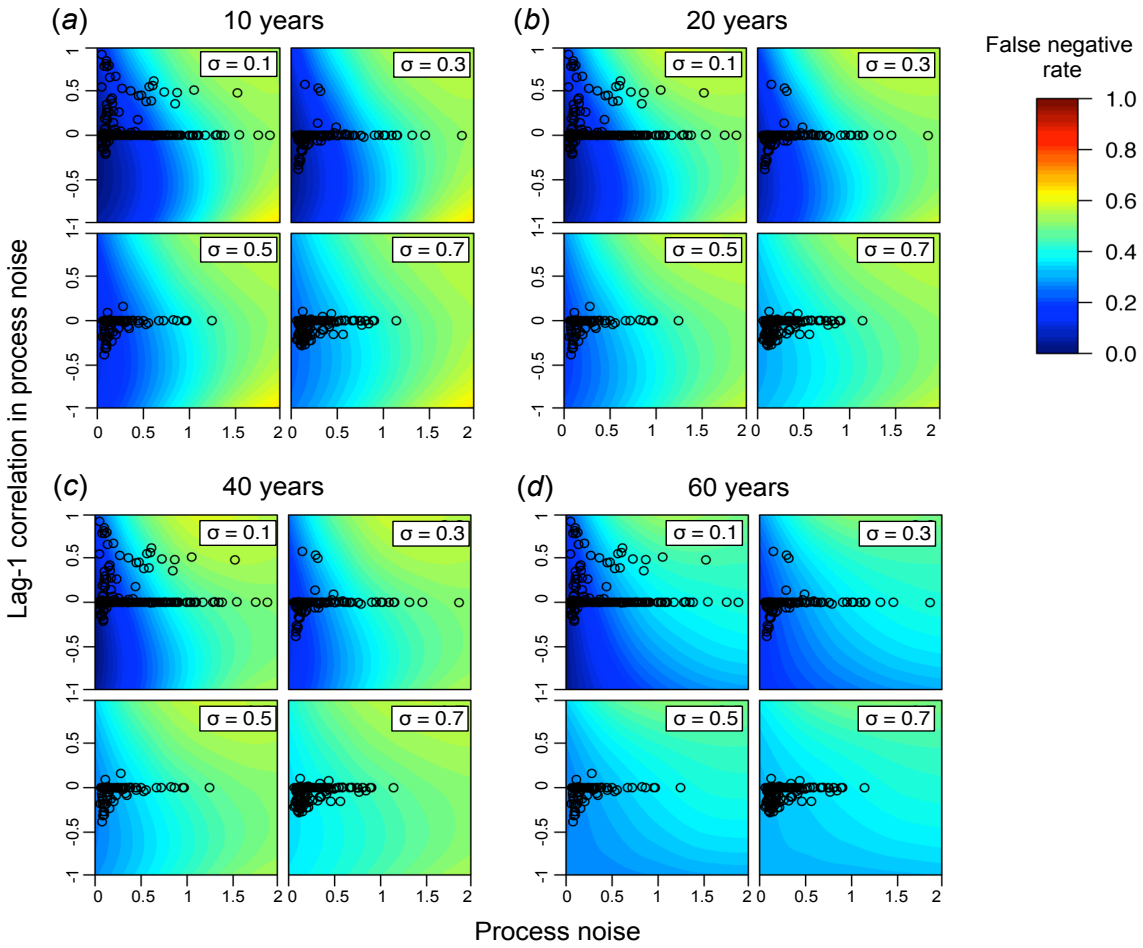
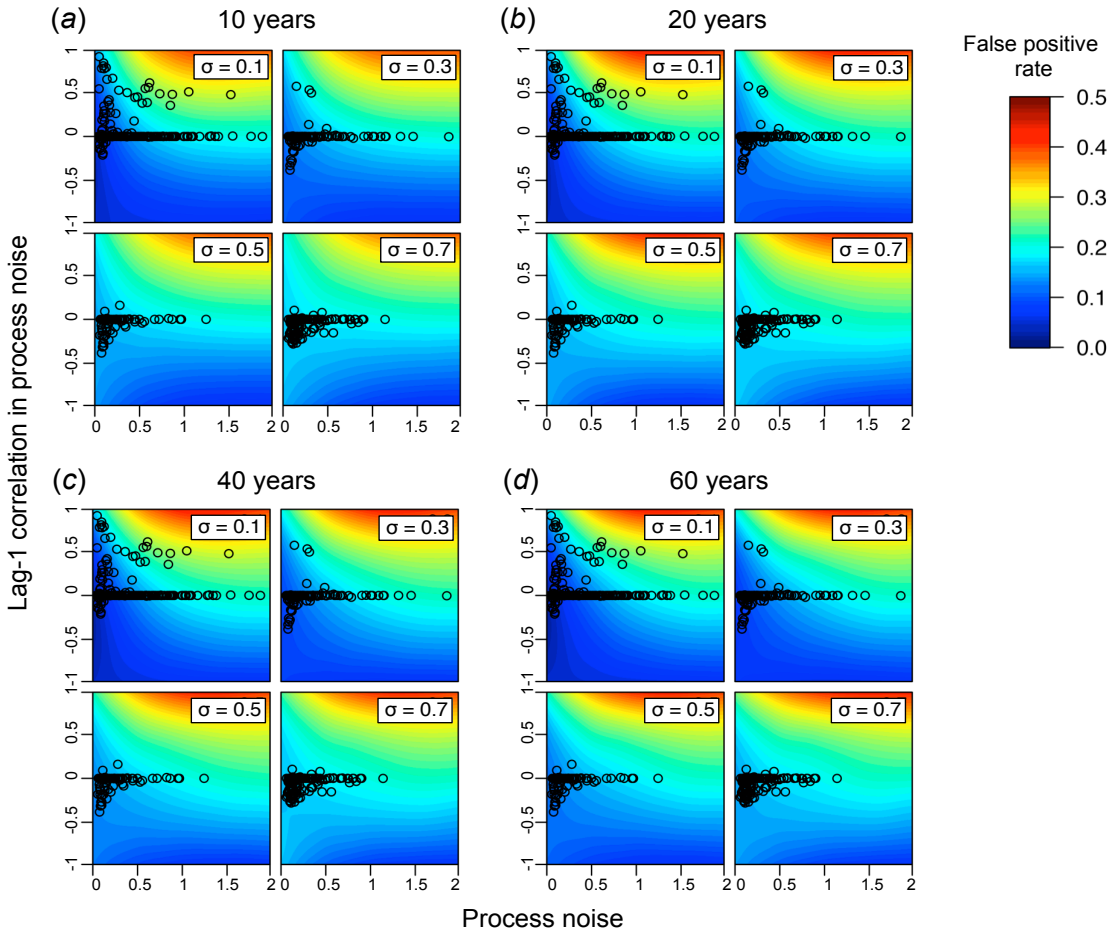


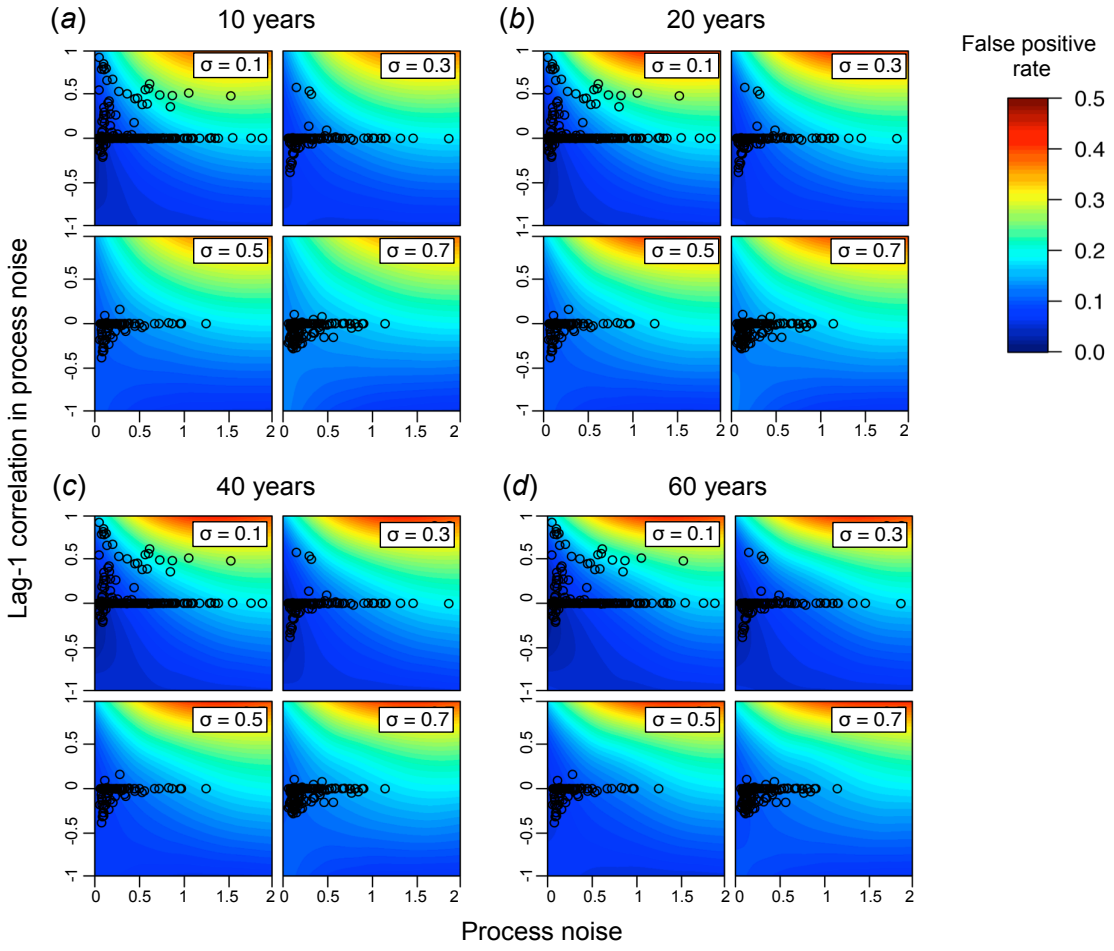
Figure S2. Probability (coloured contours) of false positive rate (falsely classifying a stable population as at risk of extinction) (i.e., greater than (S2a) 30% decline, (S2b) 50% decline, and (S2c) 80% decline in abundance), assuming density-dependent dynamics, across a range of process noise (in SD units), lag-one autocorrelation in process noise, and observation error (in SD units; sigma in the upper right corner of each plot) given a 10-, 20-, 40-, or 60-year observation window. Open circles show empirically estimated autocorrelated process noise and observation error based on time series from the Global Population Dynamics Database.

66 S2*a*. 30 percent decline threshold.



67

S2*b*. 50 percent decline threshold.



S2*c*. 80 percent decline threshold.

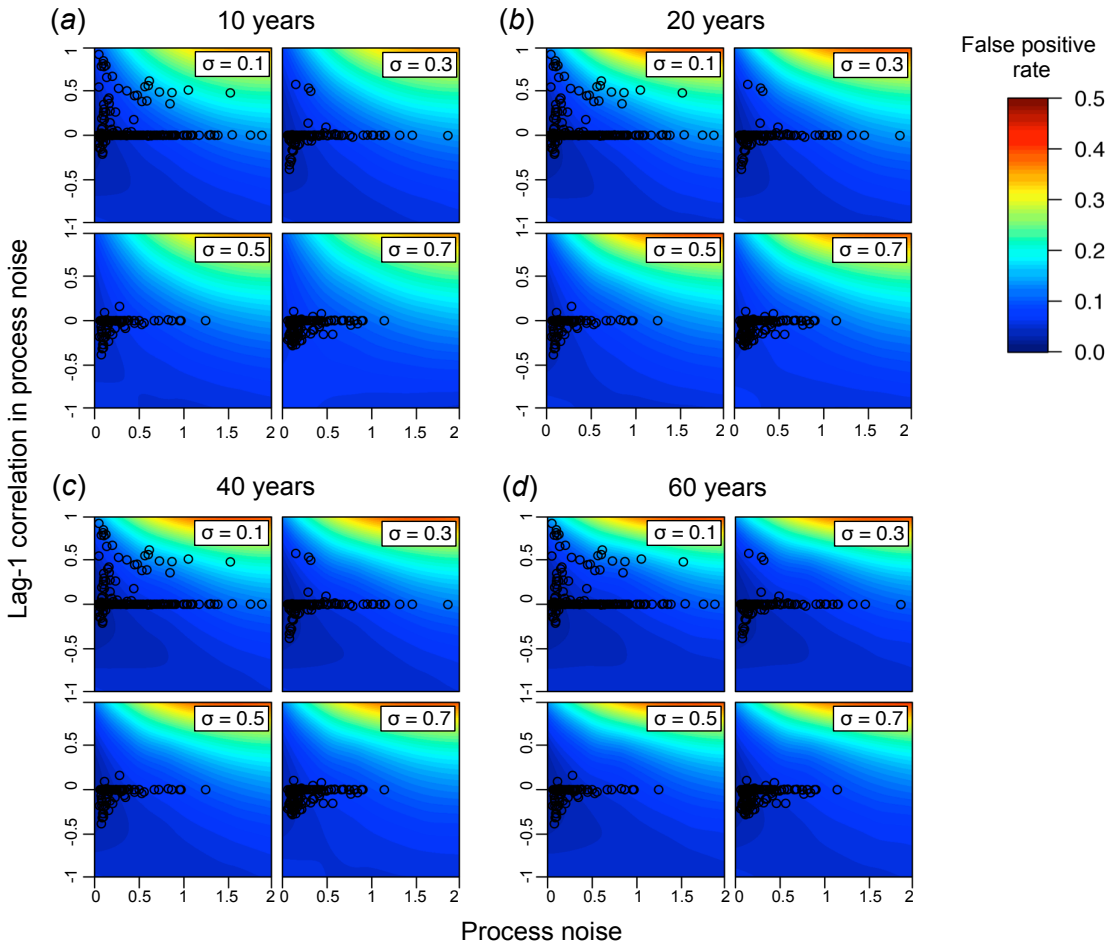


Figure S3. (a) False positive rates based on simulated time series without density dependence (b = 1) and a population growth rate equal to 0 (see equation 1) across a range of observation windows (time series length). Panels b and c are for the same conditions as panel a, except they are for a 50% or 80% decline threshold, respectively. All panels are based on simulations with observation error equal to 0.1