Power to Detect Trends in a Low-Capture-Probability Population

K. Alexandra Curtis,

Jeffrey E. Moore, Erin A. Falcone, Gregory S. Schorr,

Jay Barlow, David J. Moretti, and Erin Keene

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SWFSC MMTD

Outline

- Mark-recapture for monitoring
- Motivating case
- Power analysis I: What *do* we know?
- Power analysis II: Sampling design
- Conclusions

Mark-recapture for monitoring

CMR methods allow estimation of valuable population information for management
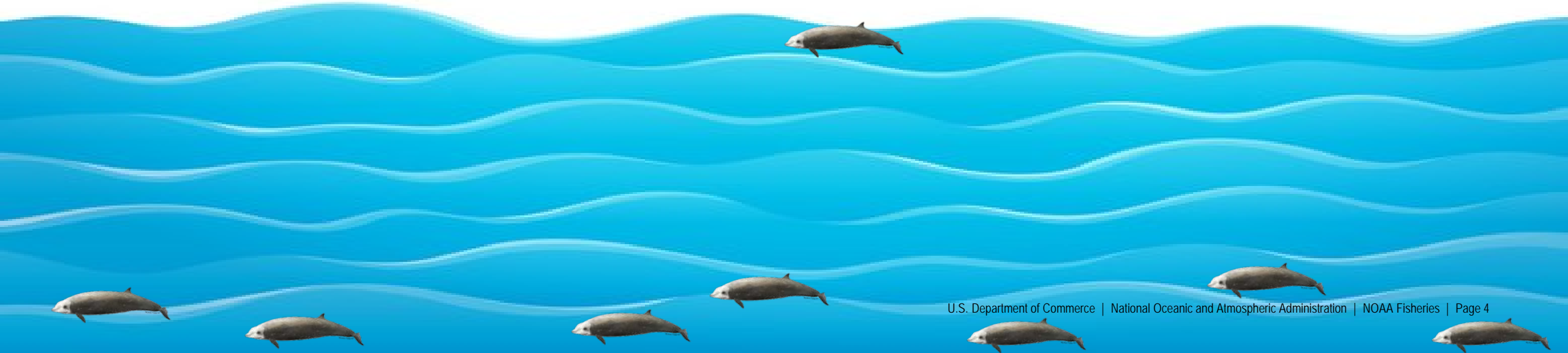
- vital rates

- abundance

- trends

ADFG

NMFS Permit #1603

NOAA Fisheries
Teach-at-Sea Ellen O'Donnell

Mark-recapture for monitoring

Sampling design challenges

- Low capture probability

➡ low precision

➡ low power to detect trends

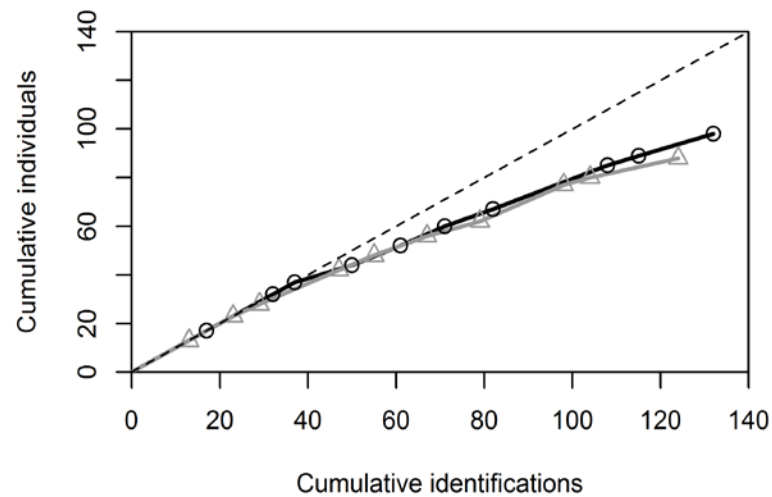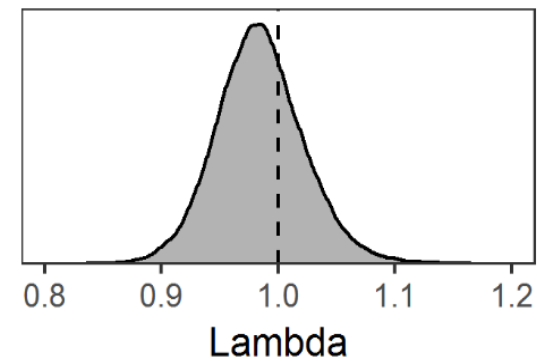How allocate effort to improve power?

Motivating case

Ziphius cavirostris in SOCAL Offshore Anti-Submarine Warfare Range (SOAR)

- High density
- Site fidelity

California Coastal Commission 2018

Jeff Foster
Cascadia Research Collective

Schorr et al., 2014

Motivating case

Sparse capture histories

n	x	1	2	3	4	5	6
104	1.49	71	19	12	1	--	1

Trend?

x	s	P_5	P_{25}	P_{75}	P_{95}
0.984	0.038	0.925	0.959	1.008	1.049

(Curtis et al., in prep)

Power analysis I: What *do* we know?

Approach

Estimated population parameters
(N=170, σ_{tFE}^2 =0.15, σ_{tRE}^2 = 0.1, σ_{iRE}^2 = 0.25, p=0.07)

Simulate 1000
capture histories each

λ = 1 λ = 0.966 λ = 0.933 λ = 0.87

Fit Bayesian Pradel-lambda models (tFE, tRE)

Type I error rates
(λ = 1, but "detect" decline)

Type II error rates
(λ < 1, but don't "detect" decline)
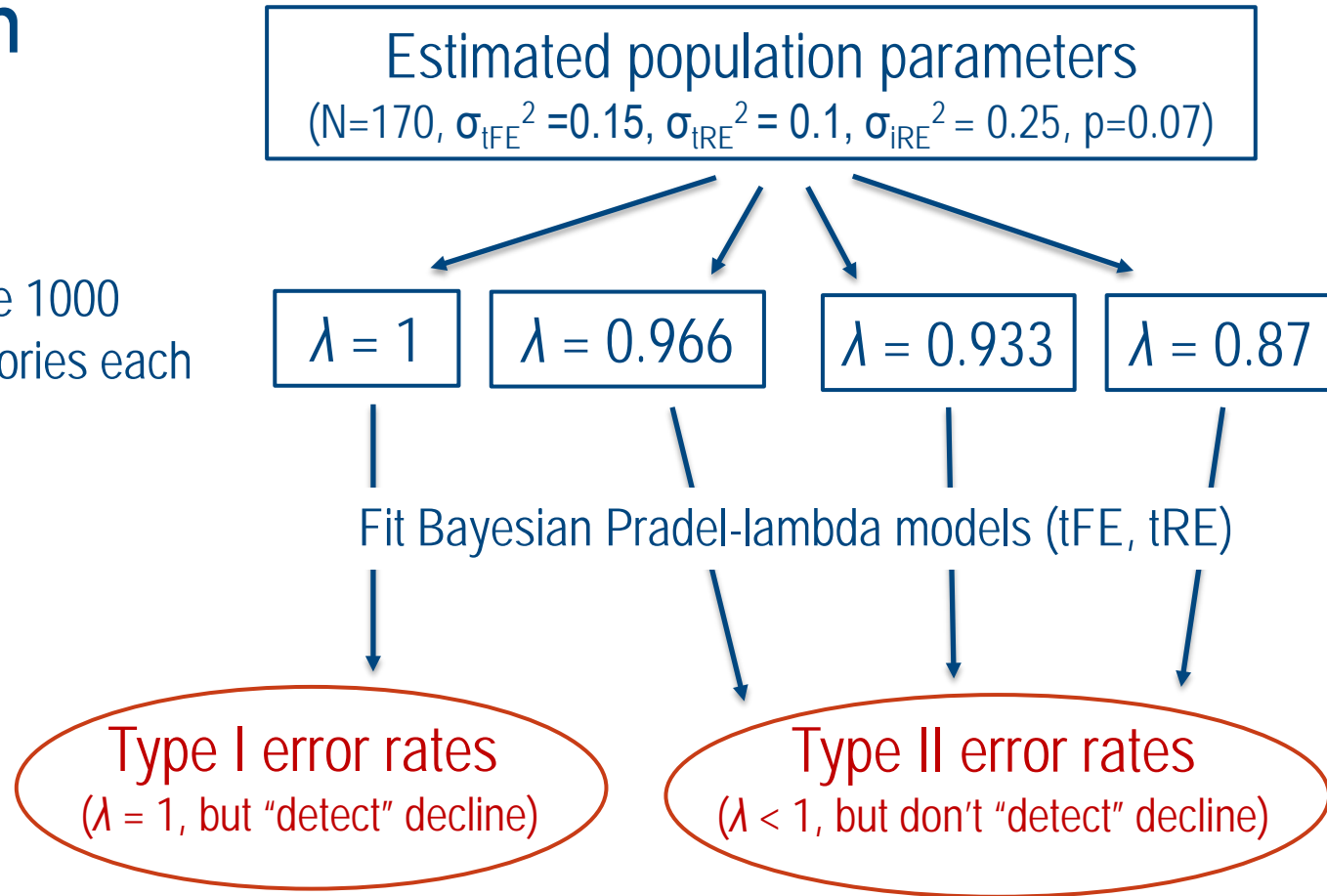
Power analysis I: What *do* we know?

Results
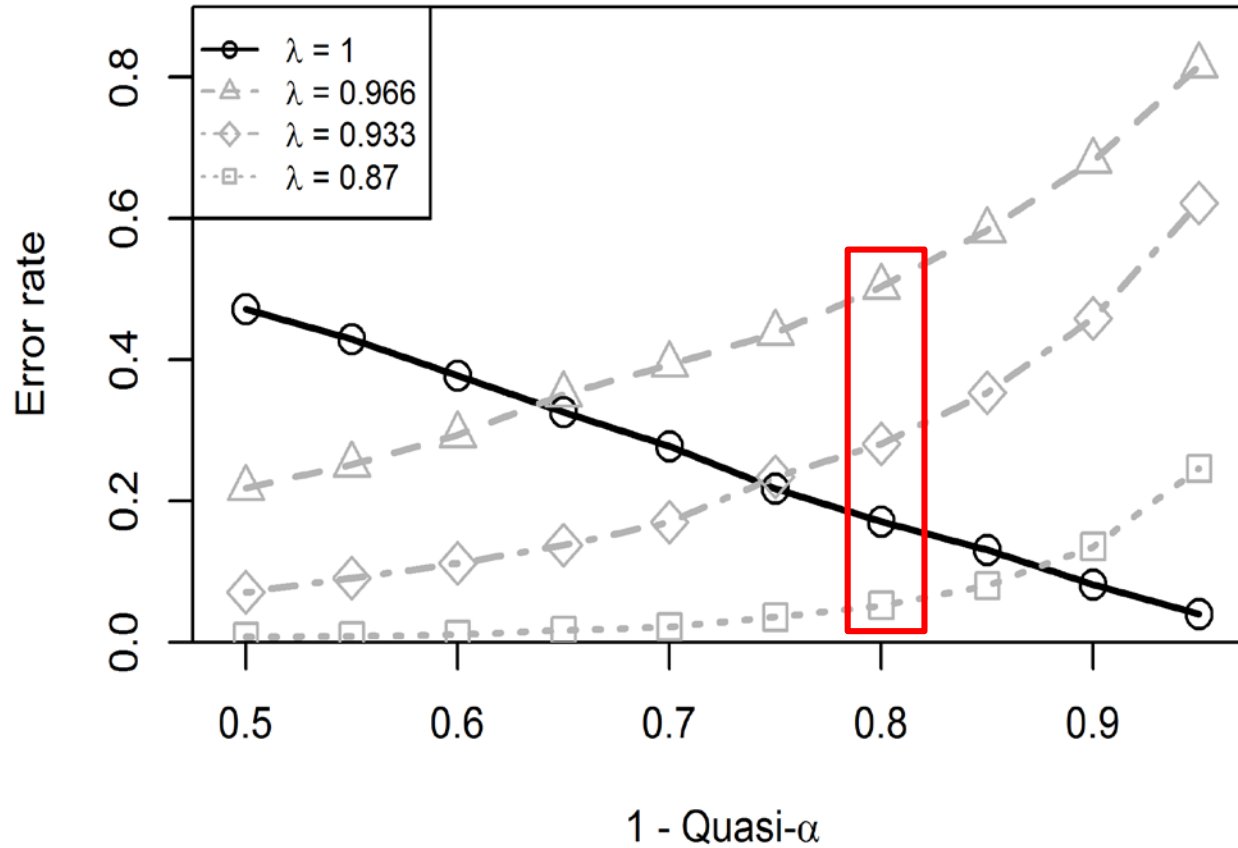
(Curtis et al., in prep)

Power analysis II: Sampling design
Approach

Estimated population parameters
($N=170$, $\sigma_{tFE}^2 = 0.15$, $\sigma_{tRE}^2 = 0.1$, $\sigma_{iRE}^2 = 0.25$)

Simulate 1000 capture histories each

λ: 0.966 0.933

effort: 1x (p=0.07) 2x (p=0.14)

yrs: 10 15 20

Fit Bayesian Pradel-lambda models (tFE, tRE)

Probability of detecting decline
(1 – Type II error rate)
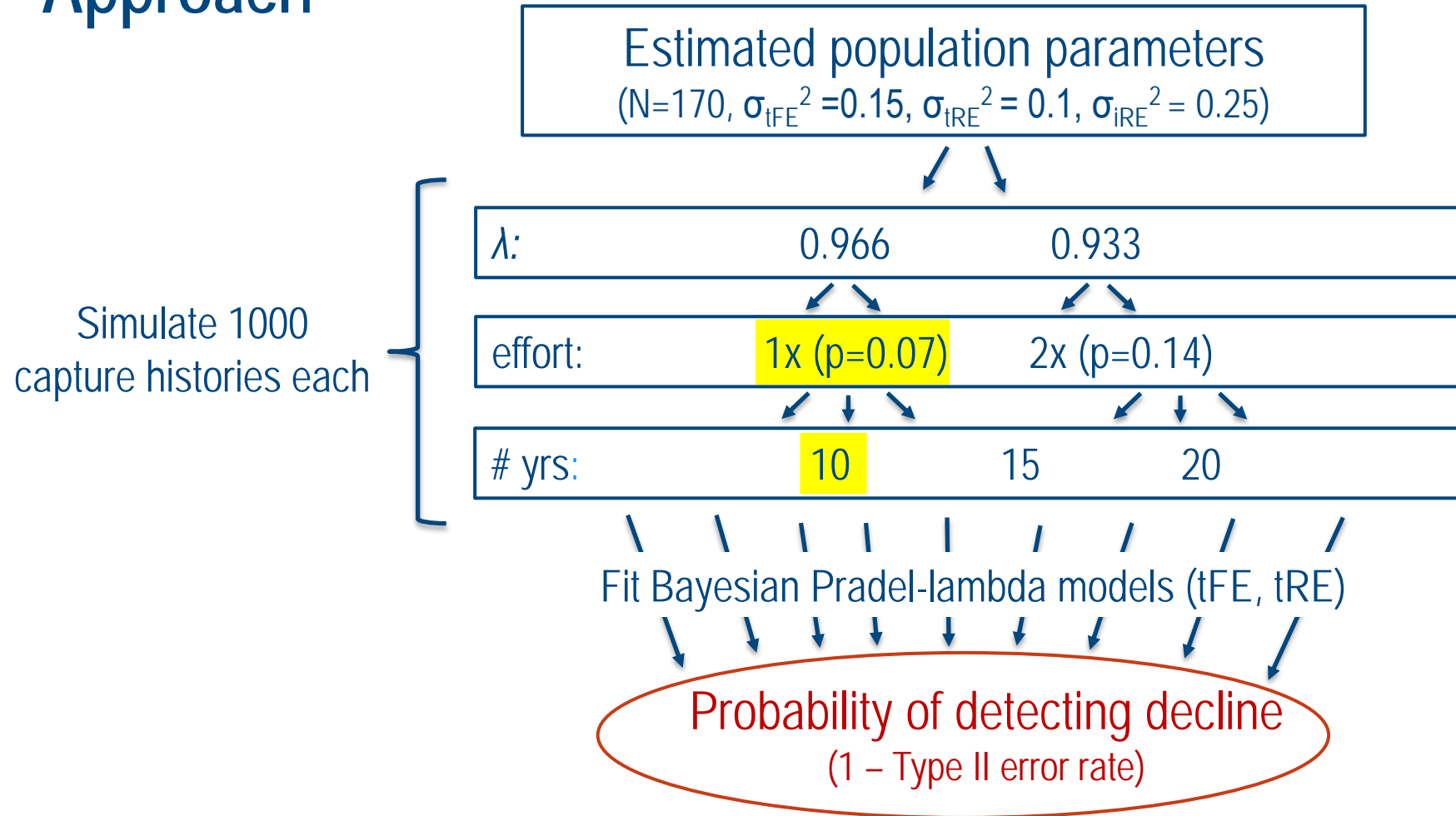
Power analysis II: Sampling design

Results
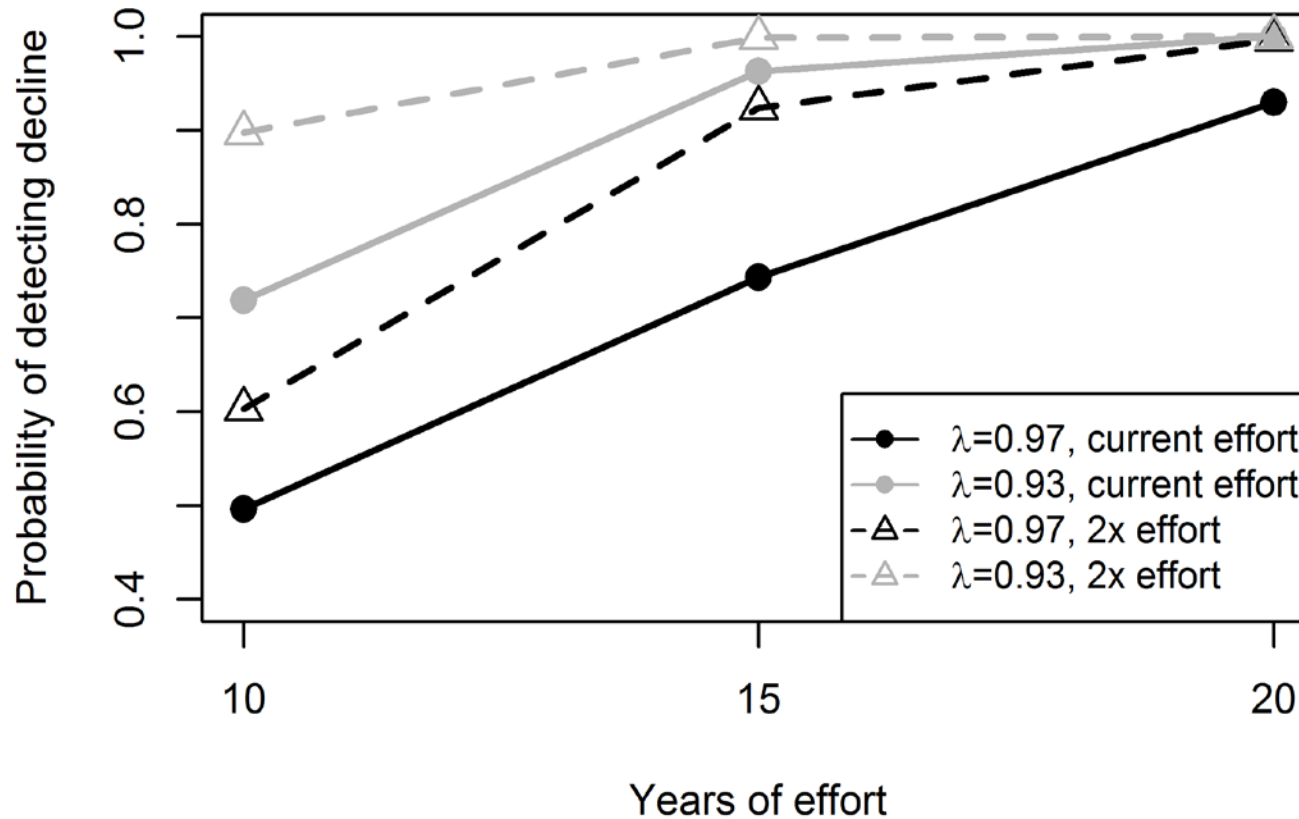
(Curtis et al., in prep)

Conclusions

- Power analyses can inform both inference and sampling design

- Increasing duration of monitoring buys more power per effort than within-year effort increase

- Tradeoff between efficiency (power per effort) and urgency (% decrease before detection)

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