Table 2

Comparative Effects of Non-Harvesting and Sequential Optimal Harvesting under Base Case Scenarios

	PVNB	IRB	λ1	λ2	λ3	λ*1	λ*2	λ*3
Base Case								
biomass alone, no harvesting	$5,923.60	1.0000	60.89	73.58	43.00	65.66	69.49	71.21
biomass, herbivore no harvesting	$15,201.13	0.0670	64.48	73.58	43.00	65.66	69.49	71.21
all species no harvesting	$15,507.53	0.1817	64.26	73.58	43.00	65.66	69.49	71.21
biomass alone optimal harvest	$18,436.49	1.0000	65.66	50.47	43.00	65.66	69.49	71.21
biomass with herbivore optimal harvest	$17,530.98	0.1082	63.96	73.58	43.00	65.66	69.49	71.21
carnivore optimal harvest	$15,818.48	0.1859	64.35	73.58	43.00	65.66	69.49	71.21
biomass-herbivore optimal harvest	$19,705.43	0.0689	65.83	73.58	43.00	65.66	69.49	71.21
biomass-carnivore optimal harvest	$17,496.48	0.1715	65.93	73.58	43.00	65.66	69.49	71.21
herbivore-carnivore optimal harvest	$16,263.24	0.2024	63.67	73.58	43.00	65.66	69.49	71.21
all species optimal harvest	$18,026.86	0.1701	66.09	66.27	43.00	65.66	69.49	71.21

Base Case Parameters		**X1**	**X2**	**X3**
Net benefits 1st parameter	a =	70.00	70.00	70.00
Net benefits 2nd parameter	b =	1.00	1.00	1.00
Intrinsic growth rate	r =	0.0800	0.0800	0.0800
Carrying capacity	K=	300.00	99.99	10.00
Discount rate	δ =	0.0200	0.0200	0.0200
	X* = K(r-δ)/2r	112.50	37.50	3.75
	Y* = K(r²-δ²)/4r	5.63	1.87	0.19

herbivore grass cons.rate, β =	0.0200
predation rate per carnivore, γ =	0.0100
herbivore to grass ratio, σ =	0.3333
predator/herb.support ratio, h =	0.1000
n =	30.00

Table 3

Comparative Effects of Initial Excess and Deficient Sustainable Stocks

	PVNB	IRB	λ1	λ2	λ3	λ*1	λ*2	λ*3
Excess Minimum Initial Stocks								
biomass alone, no harvesting	$11,009.66	1.0000	63.71	73.58	43.00	65.66	69.49	71.21
biomass, herbivore no harvesting	$12,516.33	0.0670	66.64	73.58	43.00	65.66	69.49	71.21
all species no harvesting	$12,838.25	0.1701	66.64	73.58	43.00	65.66	69.49	71.21
biomass alone optimal harvest	$17,021.86	1.0000	65.67	50.66	43.00	65.66	69.49	71.21
biomass with herbivore optimal harvest	$14,450.32	0.1518	61.96	73.58	43.00	65.66	69.49	71.21
carnivore optimal harvest	$13,155.52	0.2088	62.00	73.58	43.00	65.66	69.49	71.21
biomass-herbivore optimal harvest	$21,814.80	0.0690	65.78	61.54	43.00	65.66	69.49	71.21
biomass-carnivore optimal harvest	$20,218.29	0.1222	65.78	61.54	43.00	65.66	69.49	71.21
herbivore-carnivore optimal harvest	$13,483.51	0.1595	61.85	73.58	43.00	65.66	69.49	71.21
all species optimal harvest	$21,261.96	0.1811	65.63	61.14	43.00	65.66	69.49	71.21
Deficient Minimum Initial Stocks								
biomass alone, no harvesting	$5,923.60	1.0000	60.89	73.58	43.00	65.66	69.49	71.21
biomass, herbivore no harvesting	$10,879.03	0.0670	61.69	73.58	43.00	65.66	69.49	71.21
all species no harvesting	$11,678.15	0.2094						
biomass alone optimal harvest								
biomass with herbivore optimal harvest								
carnivore optimal harvest								
biomass-herbivore optimal harvest								
biomass-carnivore optimal harvest								
herbivore-carnivore optimal harvest								
all species optimal harvest								

Excess and Deficient Stock Parameters		**X1**	**X2**	**X3**
Net benefits 1st parameter	a =	70.00	70.00	70.00
Net benefits 2nd parameter	b =	1.00	1.00	1.00
Intrinsic growth rate	r =	0.0800	0.0800	0.0800
Carrying capacity	K=	300.00	99.99	10.00
Discount rate	δ =	0.0200	0.0200	0.0200
Base Case X* = K(r-δ)/2r		112.50	37.50	3.75
Base Case Y* = K(r²-δ²)/4r		5.63	1.87	0.19
Excess Initial Stock, X* = K(r-δ)/2r		80.00	26.66	2.67
Excess Initial Harvest, Y* = K(r²-δ²)/4r		5.63	1.87	0.19
Deficient Initial Stock, X* = K(r-δ)/2r		125.00	41.66	4.17
Deficient Initial Harvest, Y* = K(r²-δ²)/4r		5.63	1.87	0.19

herbivore grass cons.rate, β =	0.0200
predation rate per carnivore, γ =	0.0100
herbivore to grass ratio, σ =	0.3333
predator/herb.support ratio, h =	0.1000
n =	30.00

Table 4

Comparative Effects under Technical Change

	PVNB	IRB	λ1	λ2	λ3	λ*1	λ*2	λ*3
Embodied Technical Change (r=.10 versus .08 base case)								
biomass alone, no harvesting	$4,588.87	1.0000	57.71	74.36	36.27	64.06	68.95	71.16
biomass, herbivore no harvesting	$10,084.86	0.0670	58.57	74.36	36.27	64.06	68.95	71.16
all species no harvesting	$11,936.57	0.2072	58.29	74.36	36.27	64.06	68.95	71.16
biomass alone optimal harvest	$23,051.76	1.0000	64.06	38.07	36.27	64.06	68.95	71.16
biomass with herbivore optimal harvest	$14,327.71	0.1611	58.22	74.36	36.27	64.06	68.95	71.16
carnivore optimal harvest	$12,315.00	0.2107	58.31	74.36	36.27	64.06	68.95	71.16
biomass-herbivore optimal harvest	$29,916.24	0.0678	64.12	50.37	36.27	64.06	68.95	71.16

biomass-carnivore optimal harvest	$27,396.27	0.1717	64.18	50.37	36.27	64.06	68.95	71.16
herbivore-carnivore optimal harvest	$13,075.24	0.2239	58.15	74.36	36.27	64.06	68.95	71.16
all species optimal harvest	$28,978.52	0.1748	64.09	50.37	36.27	64.06	68.95	71.16
Disembodied Technical Change (K=10% over base; r = .08)								
biomass alone, no harvesting	$5,321.02	1.0000	60.69	73.58	43.00	65.66	69.49	71.21
biomass, herbivore no harvesting	$10,255.64	0.0670	61.49	73.58	43.00	65.66	69.49	71.21
all species no harvesting	$11,148.01	0.2103	61.23	73.58	43.00	65.66	69.49	71.21
biomass alone optimal harvest	$19,109.58	1.0000	65.66	50.39	43.00	65.66	69.49	71.21
biomass with herbivore optimal harvest	$13,329.18	0.1613	61.17	73.58	43.00	65.66	69.49	71.21
carnivore optimal harvest	$11,530.39	0.2143	61.25	73.58	43.00	65.66	69.49	71.21
biomass-herbivore optimal harvest	$21,669.99	0.0670	65.78	61.31	43.00	65.66	69.49	71.21
biomass-carnivore optimal harvest	$14,081.04	0.2091	61.13	71.15	51.01	65.09	69.09	71.15
herbivore-carnivore optimal harvest	$14,381.01	0.2212	61.02	73.15	51.01	65.09	69.09	71.15
all species optimal harvest	$24,357.64	0.1744	65.14	61.86	51.01	65.09	69.09	71.15

Technical Change Parameters		**X1**	**X2**	**X3**
Net benefits 1st parameter	a =	70.00	70.00	70.00
Net benefits 2nd parameter	b =	1.00	1.00	1.00
Intrinsic growth rate	r =	0.0800	0.0800	0.0800
Embodied Technical Change growth rate	r'=	**0.1000**	**0.1000**	**0.1000**
Carrying capacity	K=	300.00	99.99	10.00
Disembodied Technical carrying capacity	K'=	**330.00**	**109.99**	**11.00**
Discount rate	δ =	0.0200	0.0200	0.0200
$X^* = K(r-\delta)/2r$		112.50	37.50	3.75
$Y^* = K(r^2-\delta^2)/4r$		5.63	1.87	0.19
Disembodied Optimal Stock, $X^* = K(r-\delta)/2r$		123.75	45.37	4.99
Disembodied Optimal Harvest, $Y^* = K(r^2-\delta^2)/4r$		6.19	2.27	0.25

herbivore grass cons.rate, β =	0.0200
predation rate per carnivore, γ =	0.0100
herbivore to grass ratio, σ =	0.3333
predator/herb.support ratio, h =	0.1000
n =	30.00

Table 5

Comparative Effects under Alternative Discount Rates

	PVNB	**IRB**	λ1	λ2	λ3	λ*1	λ*2	λ*3
Increase in discount rate (δ = 5% vs. 2% base)								
biomass alone, no harvesting	$1,022.26	1.0000	62.75	74.28	43.04	69.66	72.22	73.37
biomass, herbivore no harvesting	$1,877.44	0.0670	63.58	74.28	43.04	69.66	72.22	73.37
all species no harvesting	$2,015.34	0.2094	63.32	74.28	43.04	69.66	72.22	73.37
biomass alone optimal harvest	$8,061.23	1.0000	69.65	67.41	43.04	69.66	72.22	73.37
biomass with herbivore optimal harvest	$3,946.90	0.2438	63.04	74.28	43.04	69.66	72.22	73.37
carnivore optimal harvest	$2,260.54	0.2322	63.46	74.28	43.04	69.66	72.22	73.37
biomass-herbivore optimal harvest	$8,902.54	0.0670	68.11	65.00	43.04	69.66	72.22	73.37
biomass-carnivore optimal harvest	$7,499.27	0.1701	68.11	65.84	43.04	69.66	72.22	73.37
herbivore-carnivore optimal harvest	$2,841.92	0.2257	63.22	74.28	43.04	69.66	72.22	73.37
all species optimal harvest	$6,927.46	0.2043	65.78	71.34	43.04	69.66	72.22	73.37
Decrease in discount rate (δ = 0% vs. 2% base)								
biomass alone, no harvesting	$204,377.12	1.0000	60.54	73.44	42.99	64.06	68.07	69.87
biomass, herbivore no harvesting	$375,350.45	0.0670	61.33	73.44	42.99	64.06	68.07	69.87
all species no harvesting	$402,921.75	0.2094	61.08	73.44	42.99	64.06	68.07	69.87
biomass alone optimal harvest	$399,004.89	1.0000	64.06	3.13	42.99	64.06	68.07	69.87
biomass with herbivore optimal harvest	$401,733.37	0.1217	61.16	73.44	42.99	64.06	68.07	69.87
carnivore optimal harvest	$407,601.18	0.2050	61.11	73.44	42.99	64.06	68.07	69.87
biomass-herbivore optimal harvest	$534,197.95	0.0678	64.11	52.31	42.99	64.06	68.07	69.87
biomass-carnivore optimal harvest	$544,730.73	0.1734	64.11	52.31	42.99	64.06	68.07	69.87
herbivore-carnivore optimal harvest	$410,327.70	0.2018	61.13	73.44	42.99	64.06	68.07	69.87
all species optimal harvest	$410,342.71	0.2018	61.13	73.44	42.99	64.06	68.07	69.87

Alternative Discount Parameters		**X1**	**X2**	**X3**
Net benefits 1st parameter	a =	70.00	70.00	70.00
Net benefits 2nd parameter	b =	1.00	1.00	1.00
Intrinsic growth rate	r =	0.0800	0.0800	0.0800
Carrying capacity	K=	300.00	99.99	10.00
Base case discount rate	δ =	0.0200	0.0200	0.0200
Alternative discount rate 1	δ' =	**0.0500**	**0.0500**	**0.0500**
Alternative discount rate 2	δ' =	**0.0000**	**0.0000**	**0.0000**
$X^* = K(r-\delta)/2r$		112.50	37.50	3.75
$Y^* = K(r^2-\delta^2)/4r$		5.63	1.87	0.19
Optimal Stock, $X^* = K(r-\delta)/2r$		123.75	45.37	4.99
Optimal Harvest, $Y^* = K(r^2-\delta^2)/4r$		6.19	2.27	0.25

herbivore grass cons.rate, β =	0.0200
predation rate per carnivore, γ =	0.0100
herbivore to grass ratio, σ =	0.3333
predator/herb.support ratio, h =	0.1000
n =	30.00

Table 6

Comparative Effects under Stochastic Behavior

	PVNB	**IRB**	λ1	λ2	λ3	λ*1	λ*2	λ*3
Increase in discount rate (δ = 5% vs. 2% base)								
biomass alone, no harvesting	$1,022.26	1.0000	62.75	74.28	43.04	69.66	72.22	73.37
biomass, herbivore no harvesting	$1,877.44	0.0670	63.58	74.28	43.04	69.66	72.22	73.37
all species no harvesting	$2,015.34	0.2094	63.32	74.28	43.04	69.66	72.22	73.37
biomass alone optimal harvest	$8,061.23	1.0000	69.65	67.41	43.04	69.66	72.22	73.37
biomass with herbivore optimal harvest	$3,946.90	0.2438	63.04	74.28	43.04	69.66	72.22	73.37

carnivore optimal harvest	$2,260.54	0.2322	63.46	74.28	43.04	69.66	72.22	73.37
biomass-herbivore optimal harvest	$8,902.54	0.0670	68.11	65.00	43.04	69.66	72.22	73.37
biomass-carnivore optimal harvest	$7,499.27	0.1701	68.11	65.84	43.04	69.66	72.22	73.37
herbivore-carnivore optimal harvest	$2,841.92	0.2257	63.22	74.28	43.04	69.66	72.22	73.37
all species optimal harvest	$6,927.46	0.2043	65.78	71.34	43.04	69.66	72.22	73.37
Decrease in discount rate (δ = 0% vs. 2% base)								
biomass alone, no harvesting	$204,377.12	1.0000	60.54	73.44	42.99	64.06	68.07	69.87
biomass, herbivore no harvesting	$375,350.45	0.0670	61.33	73.44	42.99	64.06	68.07	69.87
all species no harvesting	$402,921.75	0.2094	61.08	73.44	42.99	64.06	68.07	69.87
biomass alone optimal harvest	$399,004.89	1.0000	64.06	3.13	42.99	64.06	68.07	69.87
biomass with herbivore optimal harvest	$401,733.37	0.1217	61.16	73.44	42.99	64.06	68.07	69.87
carnivore optimal harvest	$407,601.18	0.2050	61.11	73.44	42.99	64.06	68.07	69.87
biomass-herbivore optimal harvest	$534,197.95	0.0678	64.11	52.31	42.99	64.06	68.07	69.87
biomass-carnivore optimal harvest	$544,730.73	0.1734	64.11	52.31	42.99	64.06	68.07	69.87
herbivore-carnivore optimal harvest	$410,327.70	0.2018	61.13	73.44	42.99	64.06	68.07	69.87
all species optimal harvest	$410,342.71	0.2018	61.13	73.44	42.99	64.06	68.07	69.87

Alternative Discount Parameters		**X1**	**X2**	**X3**
Net benefits 1st parameter	a =	70.00	70.00	70.00
Net benefits 2nd parameter	b =	1.00	1.00	1.00
Intrinsic growth rate	r =	0.0800	0.0800	0.0800
Carrying capacity	K=	300.00	99.99	10.00
Base case discount rate	δ =	0.0200	0.0200	0.0200
Alternative discount rate 1	δ' =	**0.0500**	**0.0500**	**0.0500**
Alternative discount rate 2	δ' =	**0.0000**	**0.0000**	**0.0000**
	$X^* = K(r-\delta)/2r$	112.50	37.50	3.75
	$Y^* = K(r^2-\delta^2)/4r$	5.63	1.87	0.19
Optimal Stock, $X^* = K(r-\delta)/2r$		123.75	45.37	4.99
Optimal Harvest, $Y^* = K(r^2-\delta^2)/4r$		6.19	2.27	0.25

herbivore grass cons.rate, β =	0.0200
predation rate per carnivore, γ =	0.0100
herbivore to grass ratio, σ =	0.3333
predator/herb.support ratio, h =	0.1000
n =	30.00