Risk-benefit analysis in ecological risks
生態学におけるリスク-便益分析

- 絶滅危惧植物(環境庁RDB)
  - Japanese Redlist in vascular plants
- 愛知万博環境影響評価
  - Environmental Impact Assessment for EXPO2005 in Japan
- 中池見LNG基地の多様性損失-便益評価
  - expected loss of biodiversity” (ELB) and benefit for LNG plant in Nakaikemi wetland

Survey of vascular plants

- 400 taxonomists
- 4400 1/25000
  - –4400grids of 1:25000 map
- 7000
  - –7000 native (sub)species

絶滅危惧植物(環境庁RDB)
Japanese Redlist in vascular plants

個体数規模別頻度分布

Frequency of the population sizes in grids.

Population size class	<10	<100	<1000	>1000	Extinct	Unknown
Number of grids	12	60	15	8	13	23

減少率別頻度分布

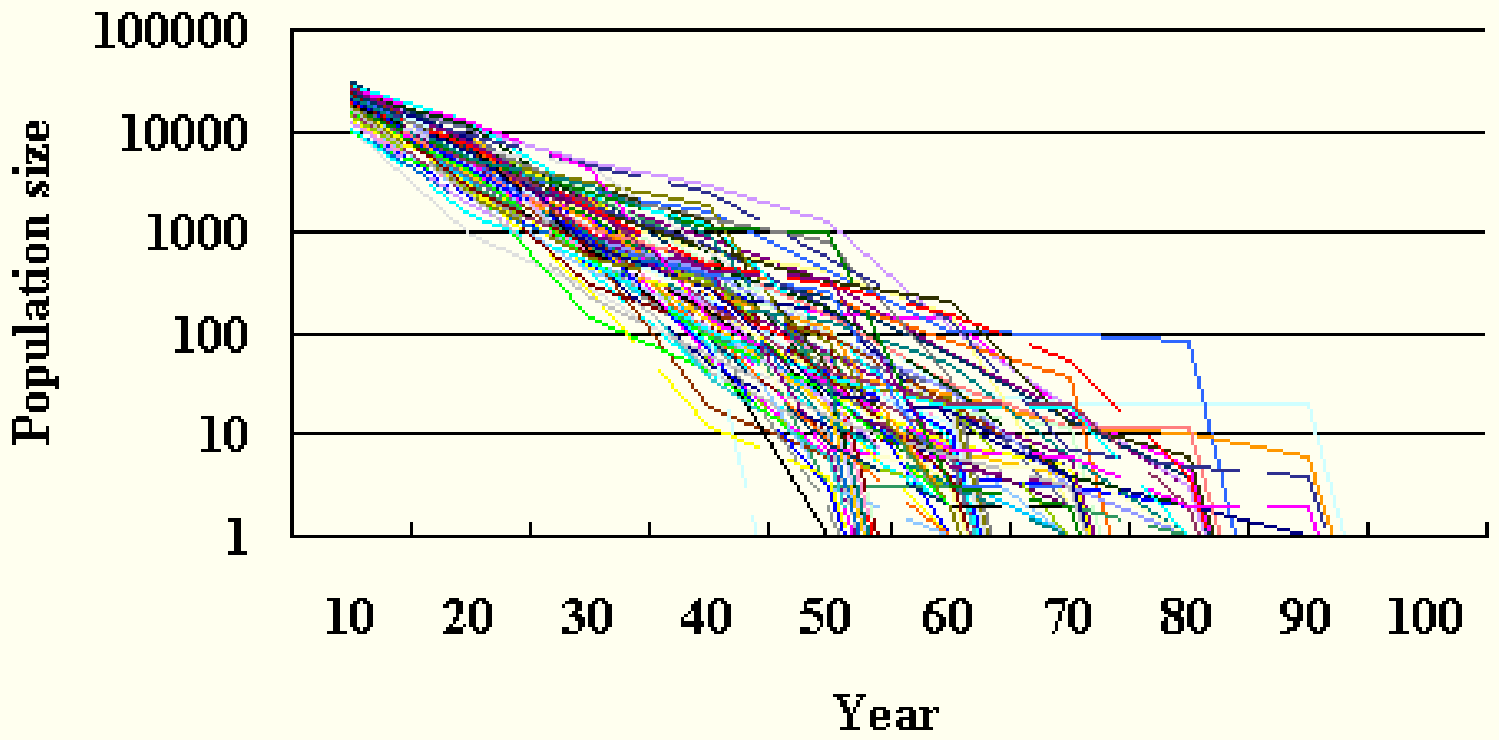
Frequency of the decline in grids.

Class of decline rates	<0.01	<0.1	<0.5	<1	>1	Extinct	Unknown
Number of grids	8	23	24	12	6	13	45

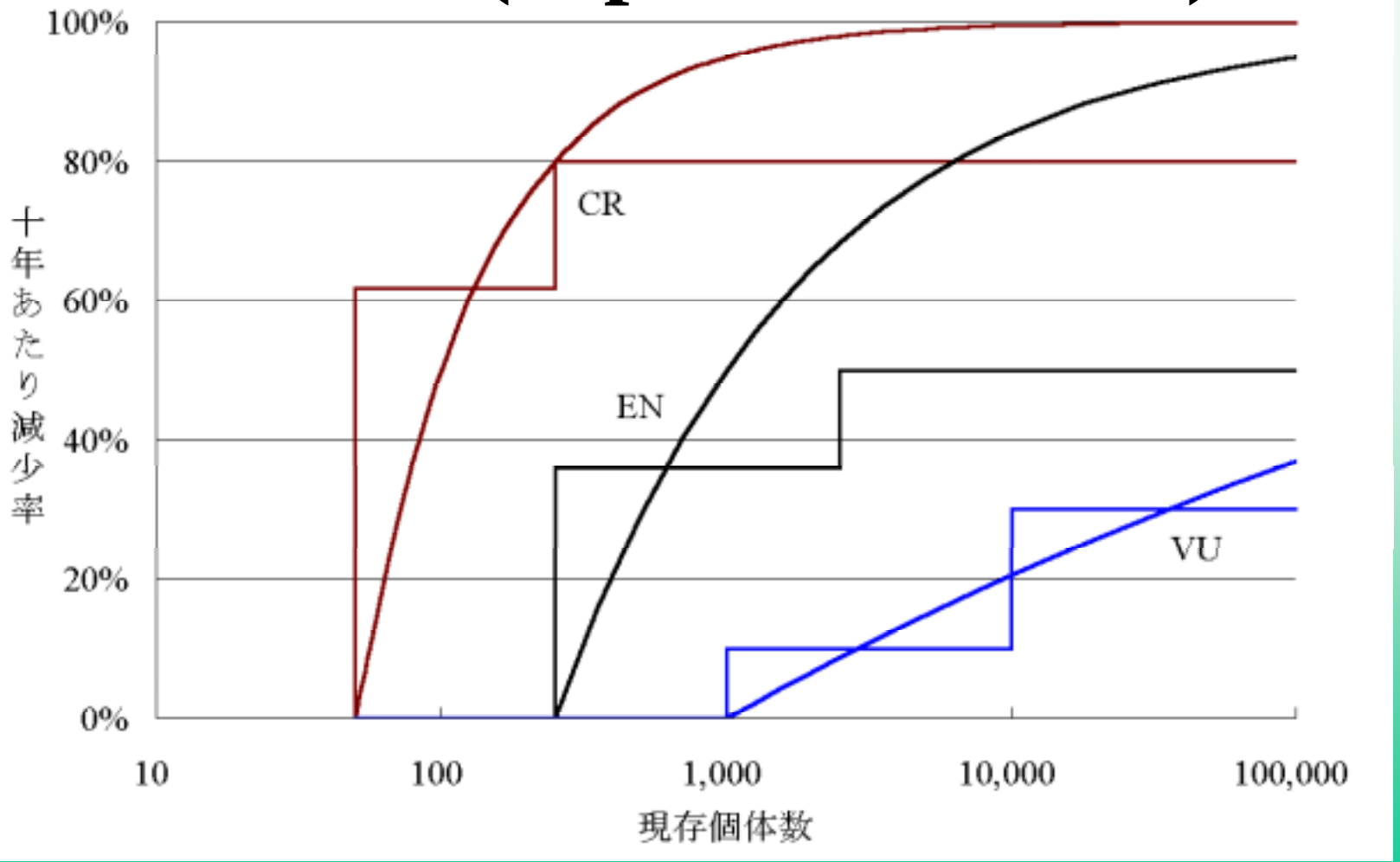
サクラソウの場合（The case of primula)

サクラソウの個体数減少見通し

Projected population decline of Primura



IUCN (criteria)
RDB (Japanese criteria)



20%

20% of native species are threatened

- ACD 100 1
  - Criterion ACD: $N(1-R)^{10}<10000$

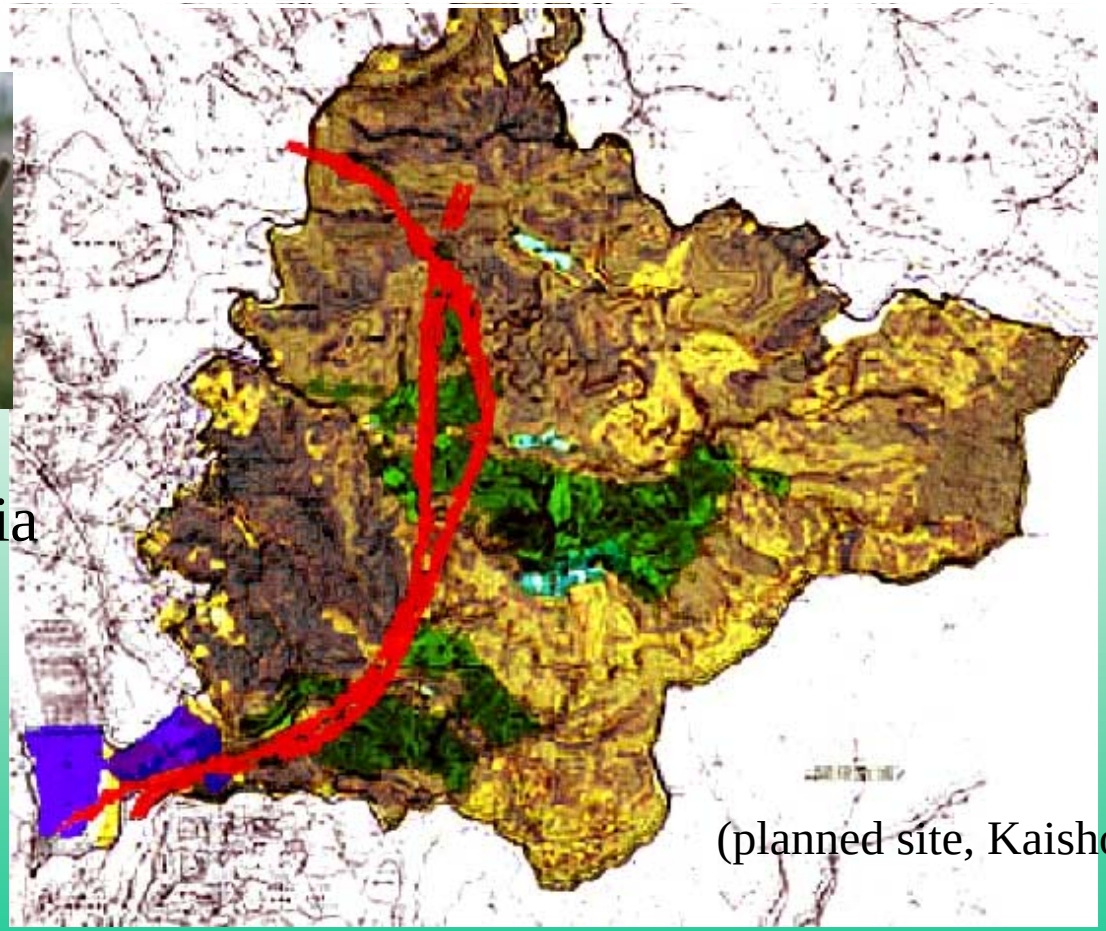
or

- E : 100 10
  - Criterion E: $P_{100}>10\%$

II (Vulnerable)

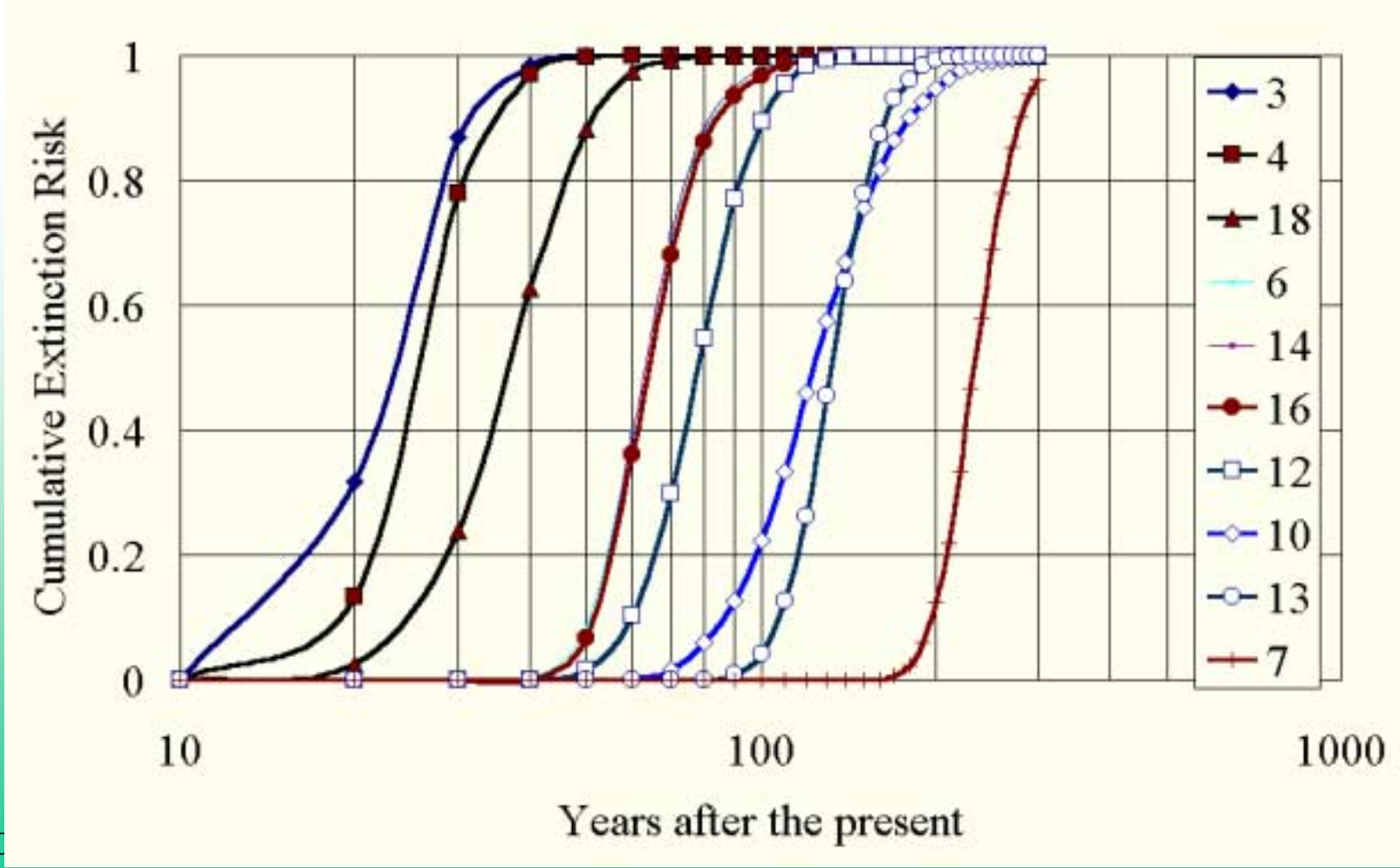
2005
World Exposition 2005, Japan

star magnolia



(planned site, Kaisho Forest)

extinction risk



Mean time to extinction

- $T(N, R) = -10.1 - 8.9\log(N)/\log(1-R)$,
  - N:population size, R:decline rate
  - If N decreased to $N-N_2$, impact is $1/T(N,R)-1/T(N-N_2,R)$

impact on threatened species

Sp.	RDB	R	N_1	N_2	N_n	N_g	T_0	$\Delta(1/T)$	$\Delta \log T$
12	VU	0.59	4370	447	>1000	10	84	5×10^{-5}	0.004
13	VU	0.46	137	31	1000	40	128	2×10^{-6}	3×10^{-4}
19	VU	0.68	1721	108	7000	20	77	2×10^{-6}	2×10^{-4}
4	EN	0.84	31	18	2000	20	38	3×10^{-6}	1×10^{-4}
7	**VU**	**0.29**	**1554**	**140**	**10000**	**20**	**302**	$\mathbf{3\times10^{-7}}$	$\mathbf{9\times10^{-5}}$
25	nt	0.35	1888	681	100000	60	274	2×10^{-7}	4×10^{-5}
3	EN	0.85	13	9	4000	10	40	7×10^{-7}	3×10^{-5}
26	nt	0.48	64	41	10000	50	156	1×10^{-7}	2×10^{-5}
23	nt	0.38	711	88	30000	60	229	9×10^{-8}	2×10^{-5}
5	EN	0.74	2	1	2000	20	56	9×10^{-8}	5×10^{-6}
20	VU	0.62	2	1	3000	100	88	3×10^{-8}	3×10^{-6}
24	nt	0.31	127	33	60000	50	316	1×10^{-8}	4×10^{-6}

LNG plant project in Nakaikemi wetland

- LNG
  - LNG plant in hotspot of rare species
-
  - the secondary natural life that has been accidentally maintained by rice field

Expected loss of biodiversity

- ELB = $B\,\Delta(1/T)$

×

Contribution of biodiversity

× increment of extinction risk

B=loss of phylogenic tree

- 4
  - –vascular plants appeared 400million years ago
- **Σ** ELB=9200 years
  - –9200
  - –loss of 9200yrs history

2

2 extreme premises

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  - –Maintained by company’s effort
-
  - –Lost by LNG plant construction

9200
loss of 9200 years of history

Species name	rank	ΔN	log$N$	N_g	1-R	T	log$\Delta(1/T)$	log$B$	ELB
Eusteralis yatabeana	VU	>100	3.7	17	76%	36	−3.45	6.5	1214
Najas japonica	EN	?	3.3	29	80%	38	−3.81	7.1	1782
Trapa i nci sa	VU	>1000	3.6	50	55%	85	−3.85	7.1	1755
Monochoria korsakowii	VU	>1000	3.9	52	68%	56	−4.18	7.1	802
Marsilea quadrifolia	VU	>100	4.3	51	87%	32	−4.19	7.3	1254
Prenanthes tanakae	VU	>100	4.1	98	49%	120	−4.29	6.3	108
Persicaria foliosa	VU	>10	3.8	33	62%	54	−4.37	6.9	303
Azolla japonica	VU	>1000	4.8	80	75%	53	−4.39	7.5	1267
Sparganium japoinica	NT	<10	4.4	114	34%	202	−4.96	7.1	139
Isoetes japonica	VU	>100	4.4	149	58%	90	−5.05	7.5	261
Iris laevigata	VU	>100	4.4	81	54%	102	−5.20	6.8	40
Salvinia natans	VU	>100	4.7	104	77%	55	−5.24	7.5	161
Sagittaria aginashi	NT	>100	4.8	128	40%	162	−5.36	7.0	49
Sparganium erectum	NT	>100	4.6	148	38%	185	−5.72	7.1	24
Habenaria sagittifera	VU	>100	4.1	121	61%	82	−5.83	6.3	3

Economical benefit (v. Fukui Port plan)

- To need 75km longer pipelines;
- additional dredge the port

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=+91-100 billion yen(1000)

=4 billion yen/yr 40

cost for conservation area

- 10
  - 1 billion yen for initial investment
- 6000
  - 60 million yen/yr for running cost

120 million yen/yr

conclusion

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- We applied extinction risk versus economical benefit analysis to several environmental projects