Using **R** for the Analysis of Bird Demography on a Europe-wide Scale

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vogeltrekstation

NIOO

TABASCO
UNIVERSIDAD JUAREZ AUTONOMA
"ESTUDIO EN LA DUDA ACCION EN LA FE"

BTO
Looking out for birds

Bird populations are dynamic in space and time

Examples:

- decline of farmland birds

Bird populations are dynamic in space and time

Examples:

- decline of farmland birds
- decline of migratory passerines

Bird populations are dynamic in space and time

Examples:

- decline of farmland birds
- decline of migratory passerines
- increase of waterfowl

Population changes attributed to:

- climatic change (phenological shift, …)
- land use and land cover change
- conditions on staging and wintering grounds
- ...

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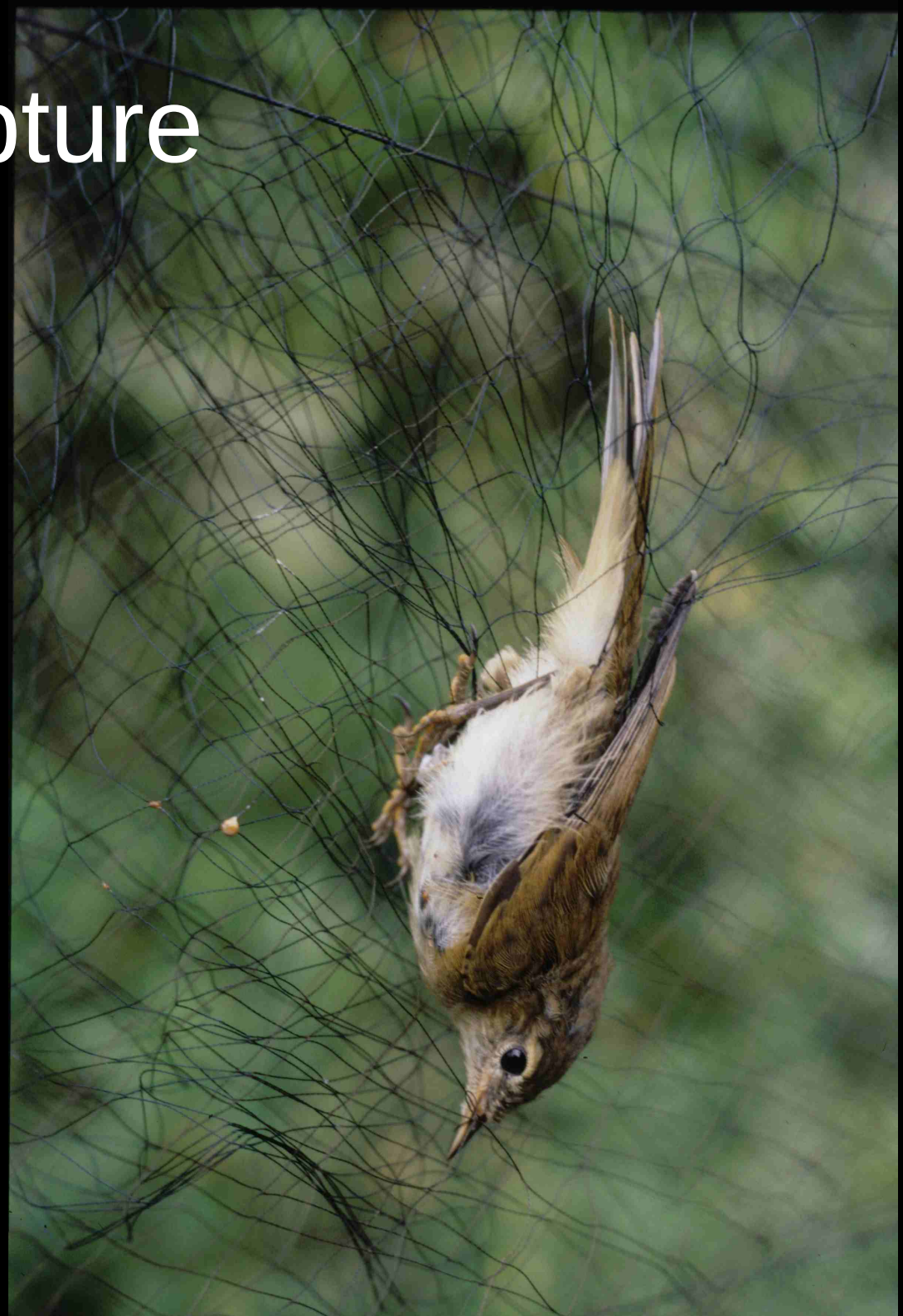
Proximate causes for abundance changes:

- reproductive success
- survival rate

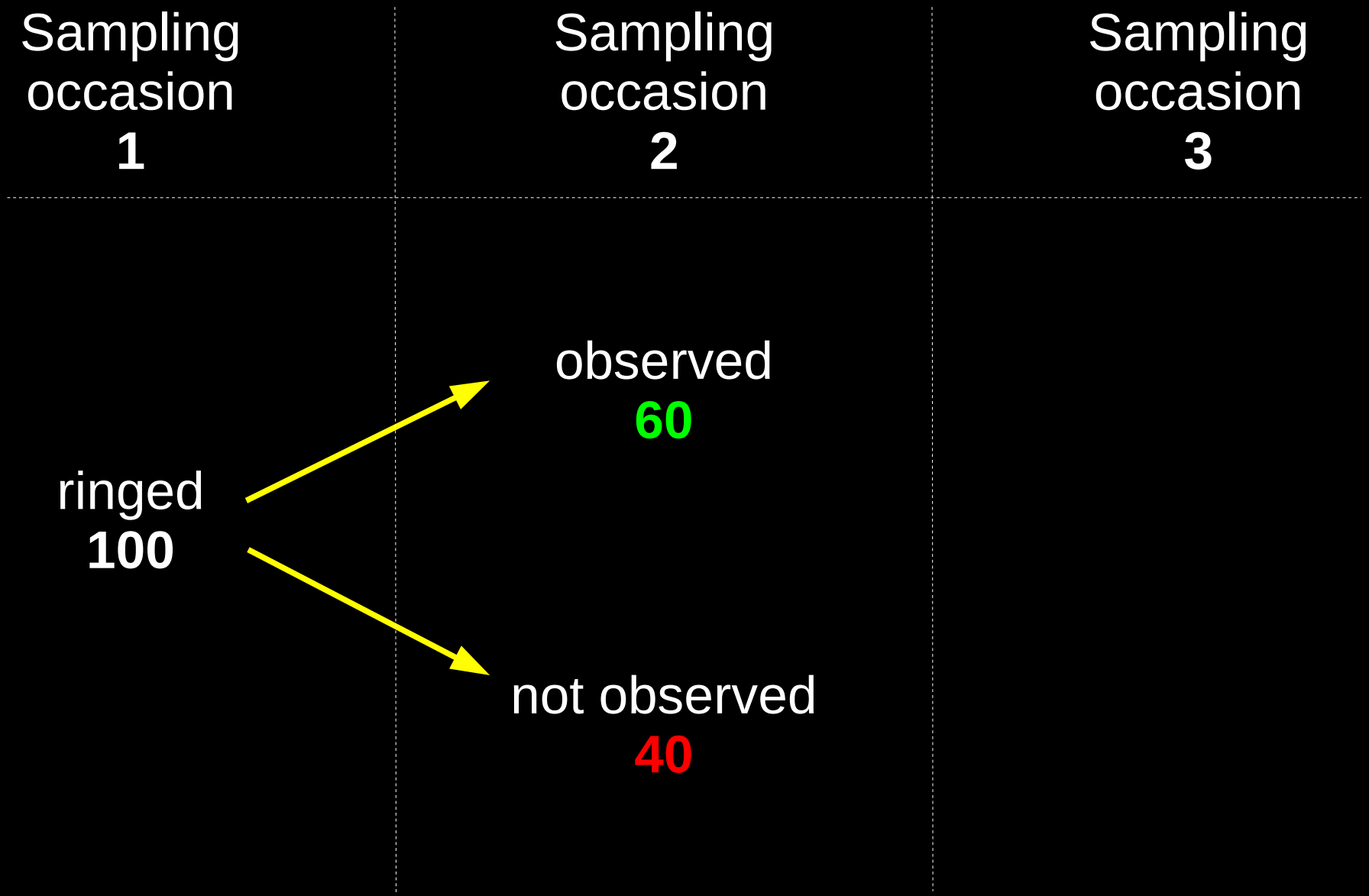

mist net

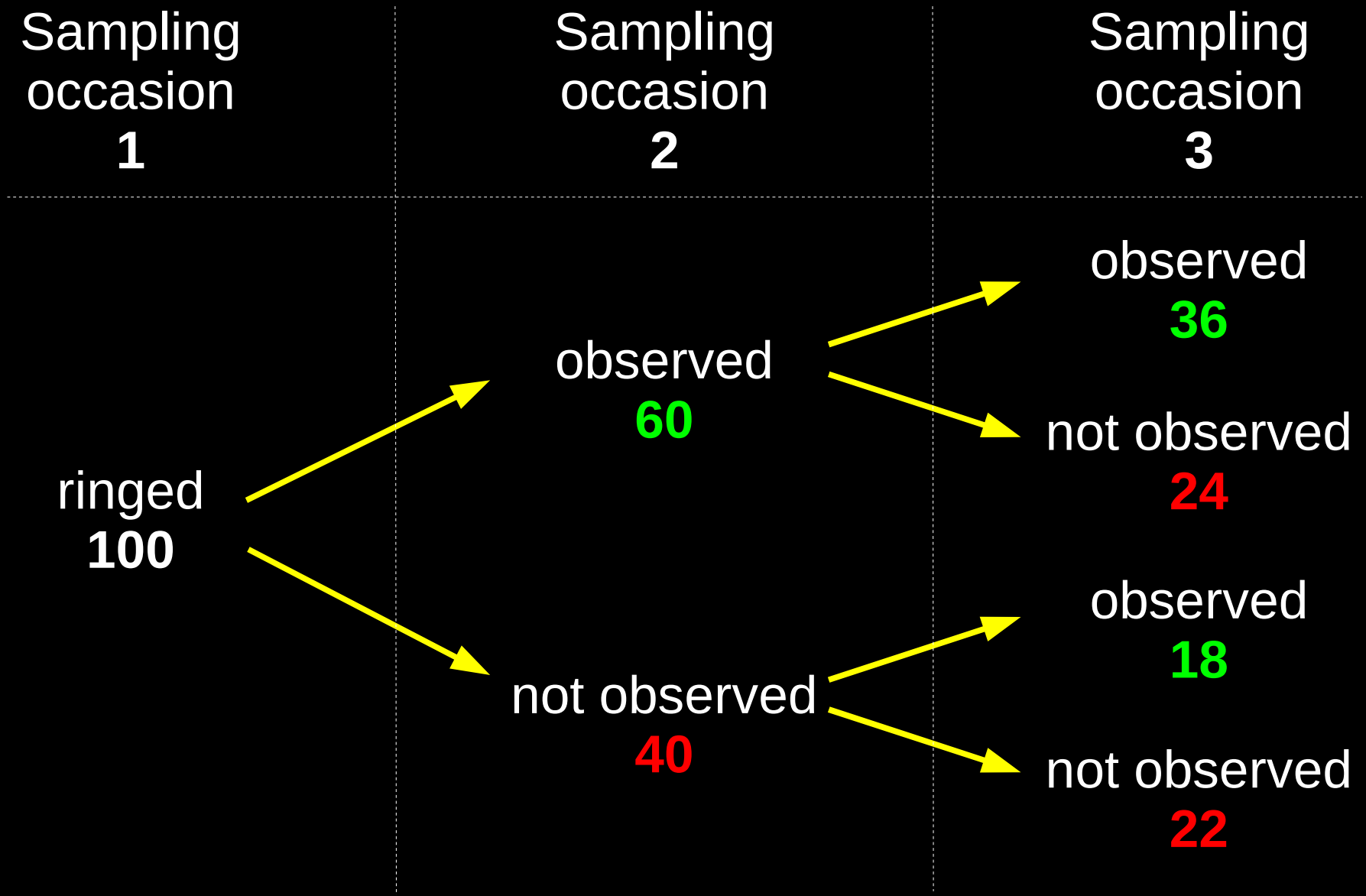
bird capture

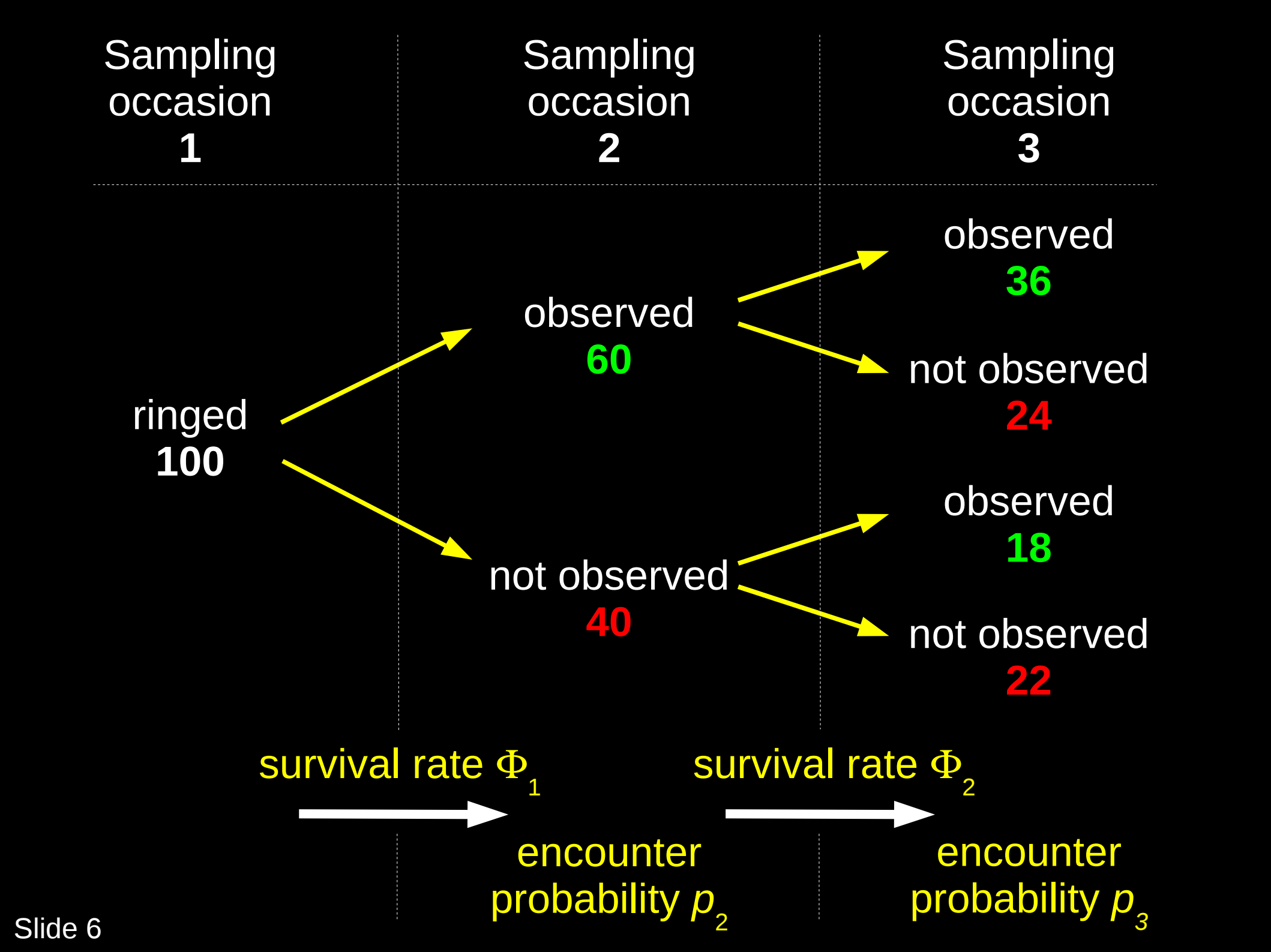


ring application

Sampling occasion **1**	Sampling occasion **2**	Sampling occasion **3**
ringed **100**		


Sampling occasion 1
Sampling occasion 2
Sampling occasion 3
ringed
100
observed
60
not observed
40


Sampling occasion 1
Sampling occasion 2
Sampling occasion 3
ringed 100
observed 60
not observed 40
observed 36
not observed 24
observed 18
not observed 22


Sampling occasion 1
Sampling occasion 2
Sampling occasion 3
ringed 100
observed 60
not observed 40
observed 36
not observed 24
observed 18
not observed 22
survival rate Φ_1
survival rate Φ_2
encounter probability p_2
encounter probability p_3

encounter history	frequency	probability
111	36	$\Phi_1 p_2 \Phi_2 p_3$
110	24	$\Phi_1 p_2 (1 - \Phi_2 p_3)$
101	18	$\Phi_1 (1 - p_2) \Phi_2 p_3$
100	22	$1 - \Phi_1 p_2 - \Phi_1 (1 - p_2) \Phi_2 p_3$

$$\ln L(\Phi_1, p_2, \Phi_2, p_3) = 36 \ln(\Phi_1 p_2 \Phi_2 p_3) + 24 \ln(\Phi_1 p_2 (1 - \Phi_2 p_3)) + 18 \ln(\Phi_1 (1 - p_2) \Phi_2 p_3) + 22 \ln(1 - \Phi_1 p_2 - \Phi_1 (1 - p_2) \Phi_2 p_3)$$

110100100010
100101101000
100000000000
111000000000
100110010100
101001001011
100001000000
100010010010
010100110100
011010110000
010000000000
010000000000
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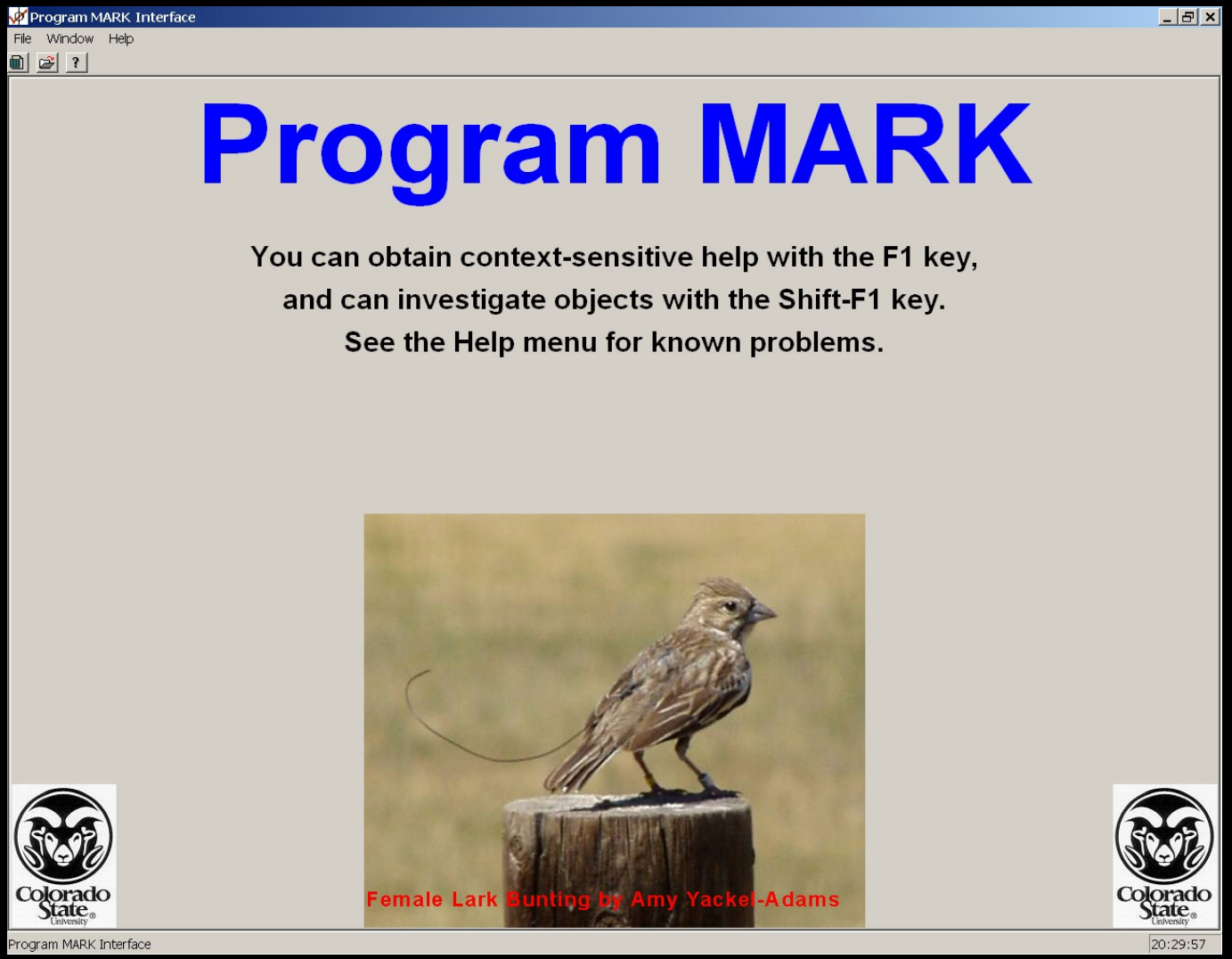

Gary White (Colorado State University)

The MARK Parameter Index Matrix (PIM)

	ϕ_1	ϕ_2	ϕ_3	ϕ_4	ϕ_5
birds ringed at t = 1:	1	2	3	4	5
2:		6	7	8	9
3:			10	11	12
4:				13	14
5:					15

each column corresponds to a year

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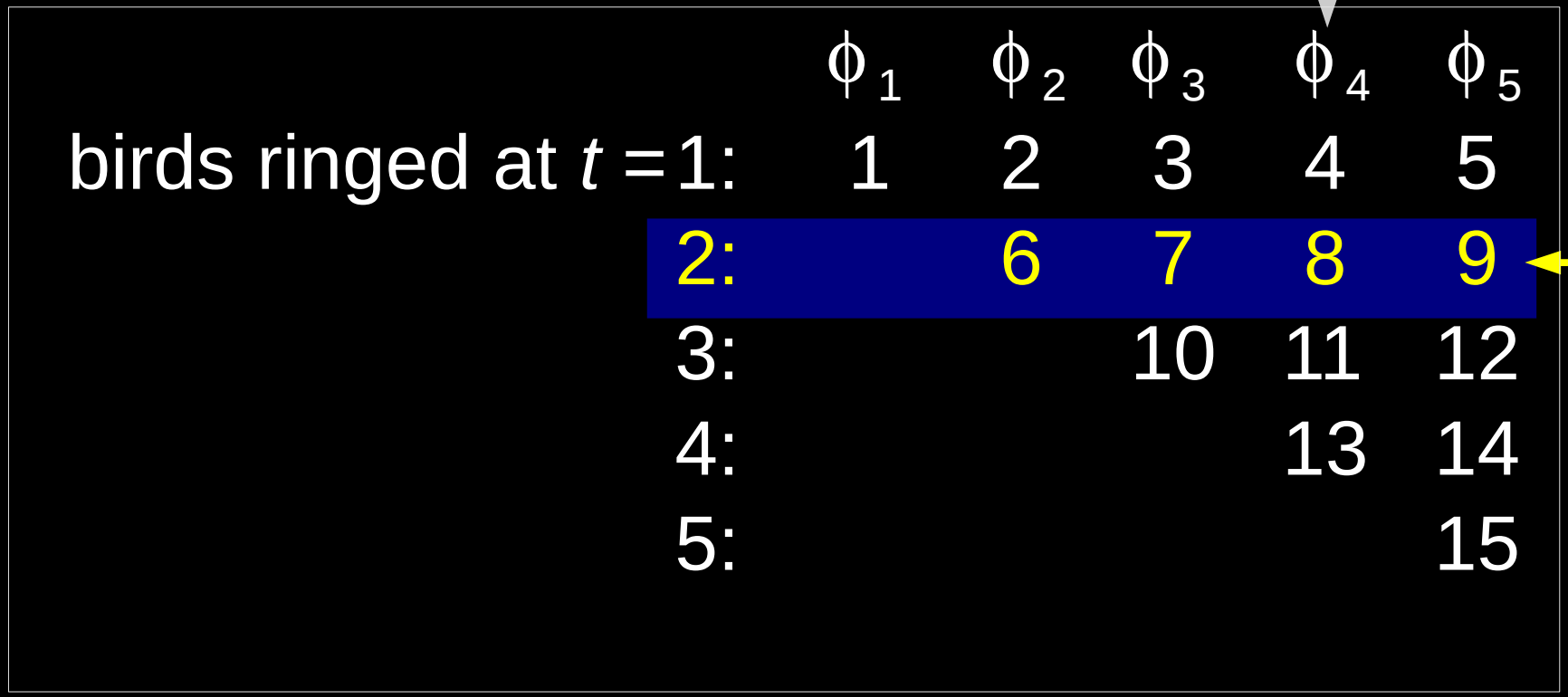

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birds ringed at t = 1:	1	2	3	4	5
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3:			10	11	12
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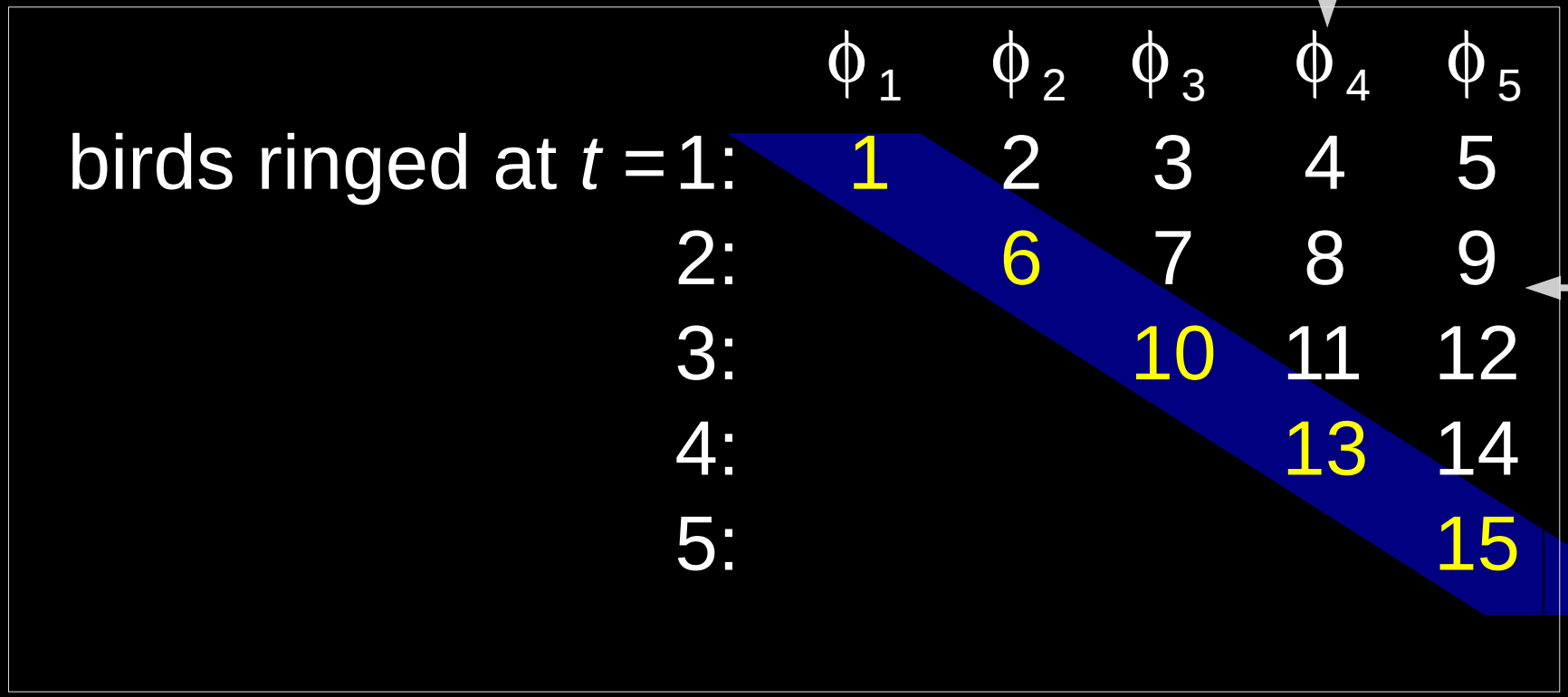
5:					15

each row corresponds to a cohort

each column corresponds to a year



each diagonal corresponds to an age class

each row corresponds to a cohort

Time-specific model

ϕ_1	ϕ_2	ϕ_3	ϕ_4	ϕ_5
1	2	3	4	5
	2	3	4	5
		3	4	5
			4	5
				5

Time-specific model

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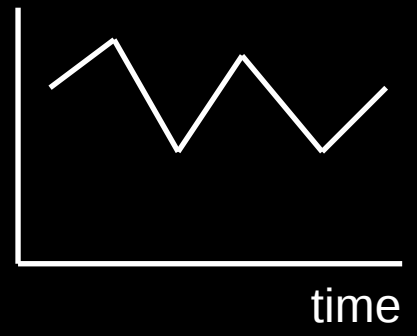
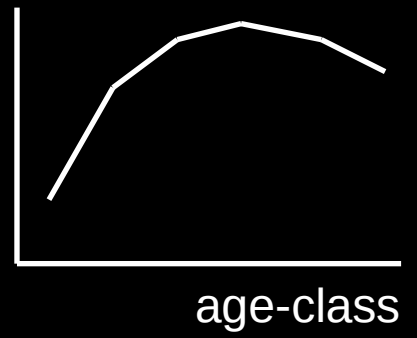
1	2	3	4	5
	2	3	4	5
		3	4	5
			4	5
				5



Age-specific model

ϕ_1	ϕ_2	ϕ_3	ϕ_4	ϕ_5
1	2	3	4	5
	1	2	3	4
		1	2	3
			1	2
				1



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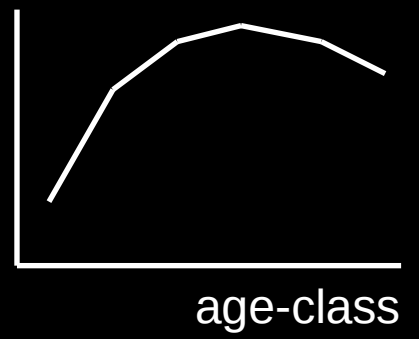
1	2	3	4	5
	2	3	4	5
		3	4	5
			4	5
				5

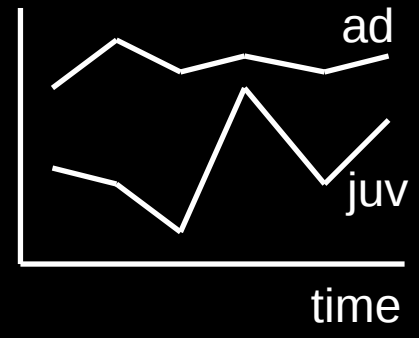
Age-specific model

ϕ_1	ϕ_2	ϕ_3	ϕ_4	ϕ_5
1	2	3	4	5
	1	2	3	4
		1	2	3
			1	2
				1



Time and two age-classes

ϕ_1	ϕ_2	ϕ_3	ϕ_4	ϕ_5
1	6	7	8	9
	2	7	8	9
		3	8	9
			4	9
				5



The MARK Design Matrix

Program MARK Interface (C:\Program Files\MARK\Examples\ed.DBF) - [Design Matrix Specification: Live Recaptures (CJS)]

File UnDo ReDo AddCol DelCol FillCol Appearance Run PIM Browse Window Help

Design Matrix Specification (B = Beta)

B1: Phi Int	B2: Phi g1	B3: Phi t1	B4: Phi t2	B5: Phi t3	B6: Phi g1*t1	B7: Phi g1*t2	B8: Phi g1*t3	Parm	B9: p Int	B10: p g1	B11: p t1	B12: p t2	B13: p t3	B14: p g1*t1	B15: p g1*t2	B16: p g1*t3
1	1	1	0	0	1	0	0	1:Phi	0	0	0	0	0	0	0	0
1	1	0	1	0	0	1	0	2:Phi	0	0	0	0	0	0	0	0
1	1	0	0	1	0	0	1	3:Phi	0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	0	4:Phi	0	0	0	0	0	0	0	0
1	0	1	0	0	0	0	0	5:Phi	0	0	0	0	0	0	0	0
1	0	0	1	0	0	0	0	6:Phi	0	0	0	0	0	0	0	0
1	0	0	0	1	0	0	0	7:Phi	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	8:Phi	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	9:p	1	1	1	0	0	1	0	0
0	0	0	0	0	0	0	0	10:p	1	1	0	1	0	0	1	0
0	0	0	0	0	0	0	0	11:p	1	1	0	0	1	0	0	1
0	0	0	0	0	0	0	0	12:p	1	1	0	0	0	0	0	0
0	0	0	0	0	0	0	0	13:p	1	0	1	0	0	0	0	0
0	0	0	0	0	0	0	0	14:p	1	0	0	1	0	0	0	0
0	0	0	0	0	0	0	0	15:p	1	0	0	0	1	0	0	0
0	0	0	0	0	0	0	0	16:p	1	0	0	0	0	0	0	0

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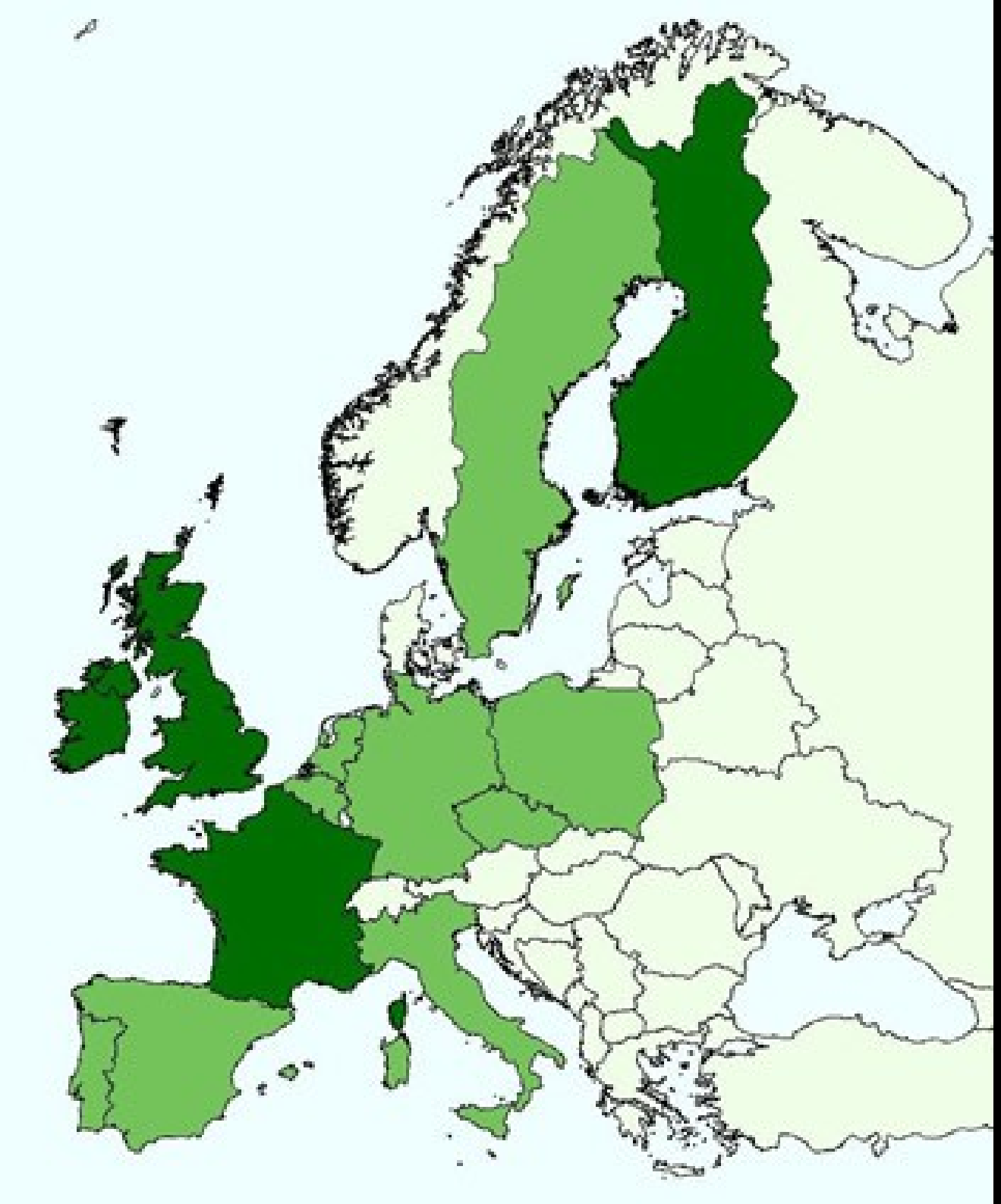
1	1	1	0	0	1	0	0	1:Phi	0	0	0	0	0	0	0	0
1	1	0	1	0	0	1	0	2:Phi	0	0	0	0	0	0	0	0
1	1	0	0	1	0	0	1	3:Phi	0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	0	4:Phi	0	0	0	0	0	0	0	0
1	0	1	0	0	0	0	0	5:Phi	0	0	0	0	0	0	0	0
1	0	0	1	0	0	0	0	6:Phi	0	0	0	0	0	0	0	0
1	0	0	0	1	0	0	0	7:Phi	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	8:Phi	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	9:p	1	1	1	0	0	1	0	0
0	0	0	0	0	0	0	0	10:p	1	1	0	1	0	0	1	0
0	0	0	0	0	0	0	0	11:p	1	1	0	0	1	0	0	1
0	0	0	0	0	0	0	0	12:p	1	1	0	0	0	0	0	0
0	0	0	0	0	0	0	0	13:p	1	0	1	0	0	0	0	0
0	0	0	0	0	0	0	0	14:p	1	0	0	1	0	0	0	0
0	0	0	0	0	0	0	0	15:p	1	0	0	0	1	0	0	0
0	0	0	0	0	0	0	0	16:p	1	0	0	0	0	0	0	0

Development of even moderately complex models is tedious and error-prone because the parameter structure and design matrix are created by hand.

Constant Effort Site schemes in Europe



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(Alaska Fisheries
Science Center)

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Further advantage for Europe-wide cooperation of CES network:

- Entire analyses can be written, documented and exchanged as scripts.

The use of RMark for survival analysis (and other **R** packages for reproduction analysis etc.)

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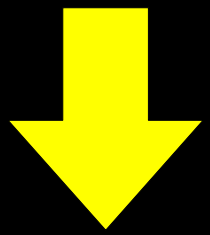

Euring

Co-ordinating bird ringing throughout Europe

Workshops on how to use R in the analysis of bird demography: demonstration and exchange of scripts, presentation of the prototype of an R package specifically designed for CES data,...


Thank
you
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