Micro and macro environment in rodents animal facilities

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- Why do we monitor the environment of the animal facility?
- What can we monitor in terms of environment?
- How do we monitor the macro/micro environment?

Why do we monitor the environment of the animal facility?

- Because legislative requirements
- Because animal welfare
- Because staff protection

What can we monitor in terms of environment?

- Temperature, RH, Light, Noise, particles, microbiological contamination…at room level
- Temperature, RH, Light, Noise, NH_3,CO_2, O_2 at cage level.

Temperature and Relative Humidity

Facts!

Temperature

- Homeothermic mammals. Rodents not fully until 3-4 weeks of age. Core temperature around 37 °C.
- Hair-covered and non-sweating. Thermoregulation through alteration of metabolic rate.
- Changing in ambient temperatures, due to possible compensating responses, are potentially capable of interfering with or confounnding experimental results (G.Clough)

Temperature

- **Thermal Neutral Zone**

  That range of ambient temperatures within which an endotherm can control its temperature by passive measures and without elevating its metabolic rate.

  In laboratory mice 26 to 34 °C

  (Lab rodents are maintained at a temperature lower than the TNZ).

Effects…too many probably

Temperature

- Metabolism
- Cardiovascular
- Growth
- Organ weights
- Water and feed consumption
- Serological, haematological parameters
- Reproduction
- Behaviour
- More….

Guidelines and suggestions

- Overall room temperature 21 +/-3 °C
- For rats and mice: optimum field of variation is 20-26°C but 18-28°C is suitable for breeding and rearing (Yamauchi et al.1983).
- In IVC cages 20 to 24 °C.

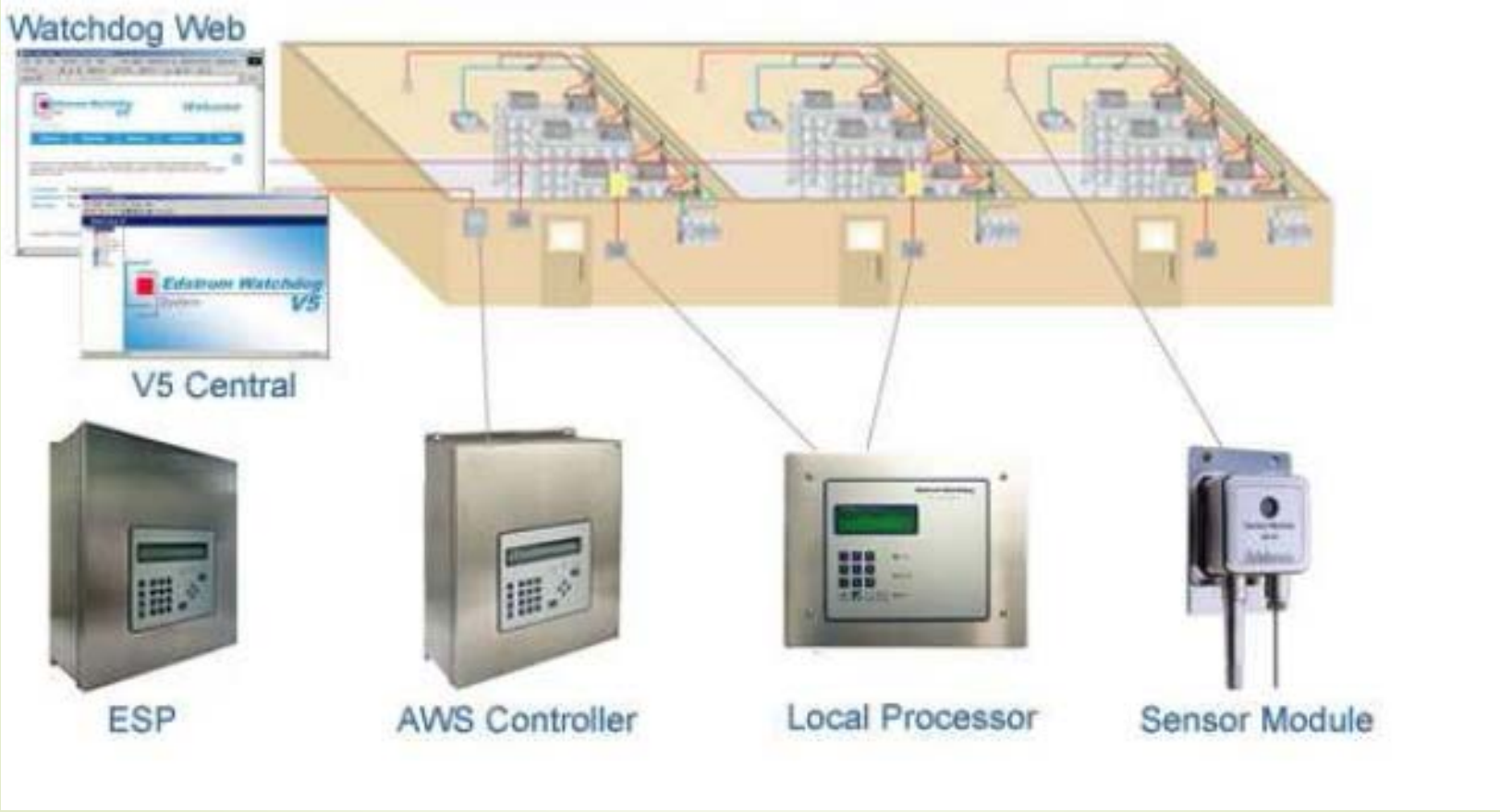
How many facts?

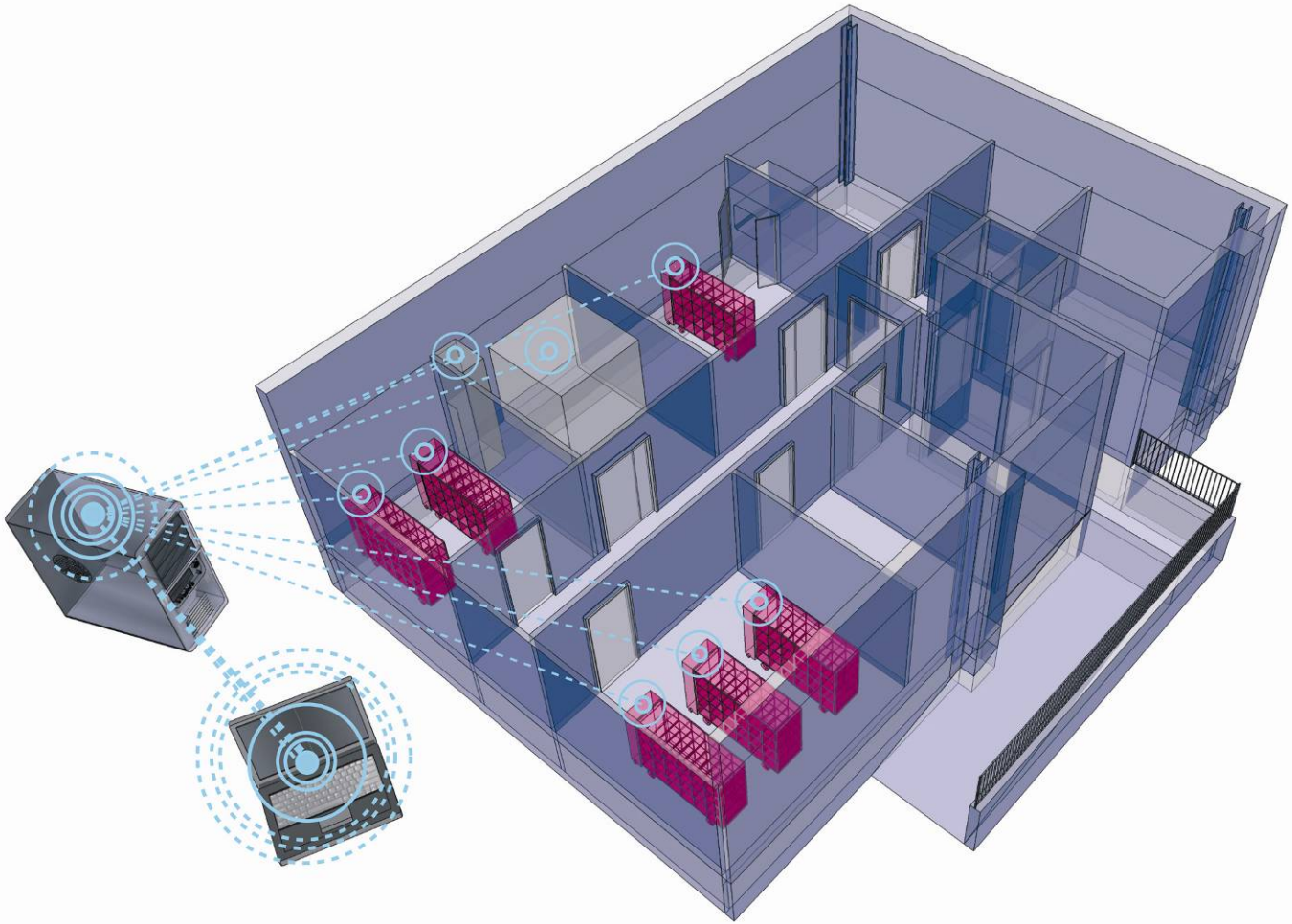
Relative humidity

- Not sweating mammals
- Consequence: To compensate the extra heat loss at 35% RH vs 75% RH (both groups at 21°C) rats eat 5% more (Weihe et al.1961).
- Absorption rate of substances applied directly to skin can be affected due to change in viscosityof the substance.
- Ringtail (< 40% RH)

How do we monitor the macro/micro environment?

Total control??





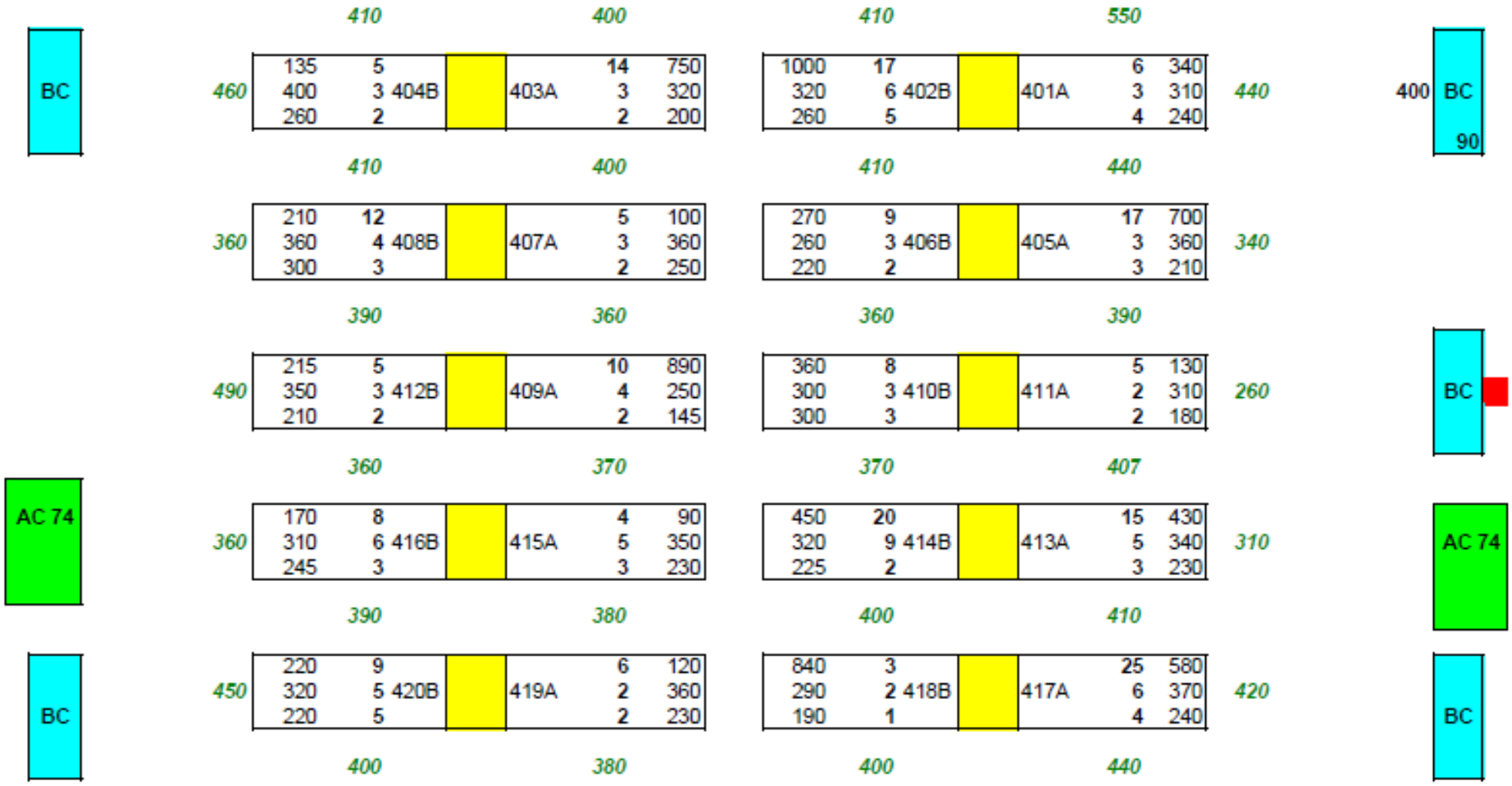
Light Intensity monitoring.

- A Luxmeter ALMEMO 2290-4, probe LUX FLA613VL was used to record either the background room and the intra-cage light intensity. The instrument was moved by the operator in 34 positions in the room at 1 m from the floor.

- The second position used for recording the light intensity, was the outside of the cages selected for the test. The probe was positioned on the vertical surface of the top front area.

- The Luxmeter probe was then positioned inside a pre-assembled 1284L cage on each rack. The cage was filled with bedding, diet, and a bottle (full of water), the card holder was present as well. Sixty values were recorded.

Intracage monitoring...


410
400
410
550
BC
460
135 5
400 3 404B
260 2
403A
14 750
3 320
2 200
1000 17
320 6 402B
260 5
401A
6 340
3 310
4 240
440
400 BC 90
410
400
410
440
360
210 12
360 4 408B
300 3
407A
5 100
3 360
2 250
270 9
260 3 406B
220 2
405A
17 700
3 360
3 210
340
390
360
360
390
490
215 5
350 3 412B
210 2
409A
10 890
4 250
2 145
360 8
300 3 410B
300 3
411A
5 130
2 310
2 180
260
BC
360
370
370
407
AC 74
360
170 8
310 6 416B
245 3
415A
4 90
5 350
3 230
450 20
320 9 414B
225 2
413A
15 430
5 340
3 230
310
AC 74
390
380
400
410
BC
450
220 9
320 5 420B
220 5
419A
6 120
2 360
2 230
840 3
290 2 418B
190 1
417A
25 580
6 370
4 240
420
BC
400
380
400
440

ANNEX 1

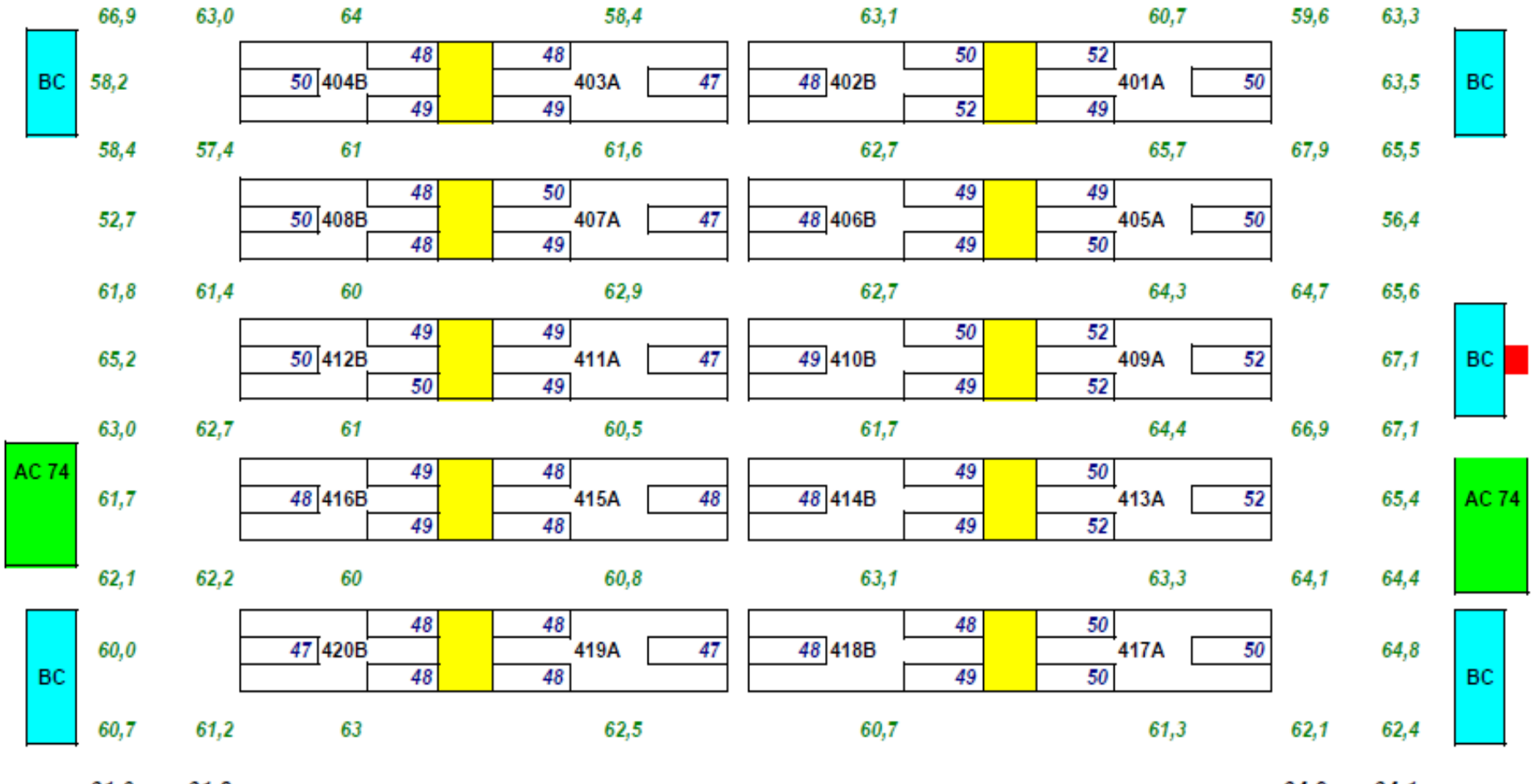
Results (Summary)

LIGHT INTENSITY (LUX)	Mean	Min	Max.	Range
ROOM	397,8	260	550	290
CAGE (OUTSIDE)	319	90	1000	910
CAGE (INSIDE)*	5,6	1	25	24

* Dark area inside the cage.

Table 1

Noise: Instruments


66,9 63,0 64 58,4 63,1 60,7 59,6 63,3
BC
58,2
48 48
50 404B 403A 47
49 49
50 52
48 402B 401A 50
52 49
BC
63,5
58,4 57,4 61 61,6 62,7 65,7 67,9 65,5
52,7
48 50
50 408B 407A 47
48 49
49 49
48 406B 405A 50
49 50
56,4
61,8 61,4 60 62,9 62,7 64,3 64,7 65,6
65,2
49 49
50 412B 411A 47
50 49
50 52
49 410B 409A 52
49 52
BC
67,1
63,0 62,7 61 60,5 61,7 64,4 66,9 67,1
AC 74
61,7
49 48
48 416B 415A 48
49 48
49 50
48 414B 413A 52
49 52
65,4
AC 74
62,1 62,2 60 60,8 63,1 63,3 64,1 64,4
BC
60,0
48 48
47 420B 419A 47
48 48
48 50
48 418B 417A 50
49 50
64,8
BC
60,7 61,2 63 62,5 60,7 61,3 62,1 62,4
MEAN 61,0 61,3 64,2 64,1
MEAN dBA: ROOM 62,4
MEAN dBA: INTRA-CAGE 49,1

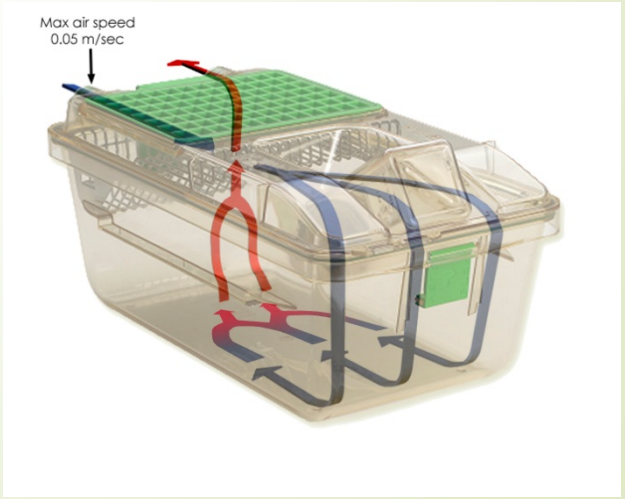
ANNEX 2

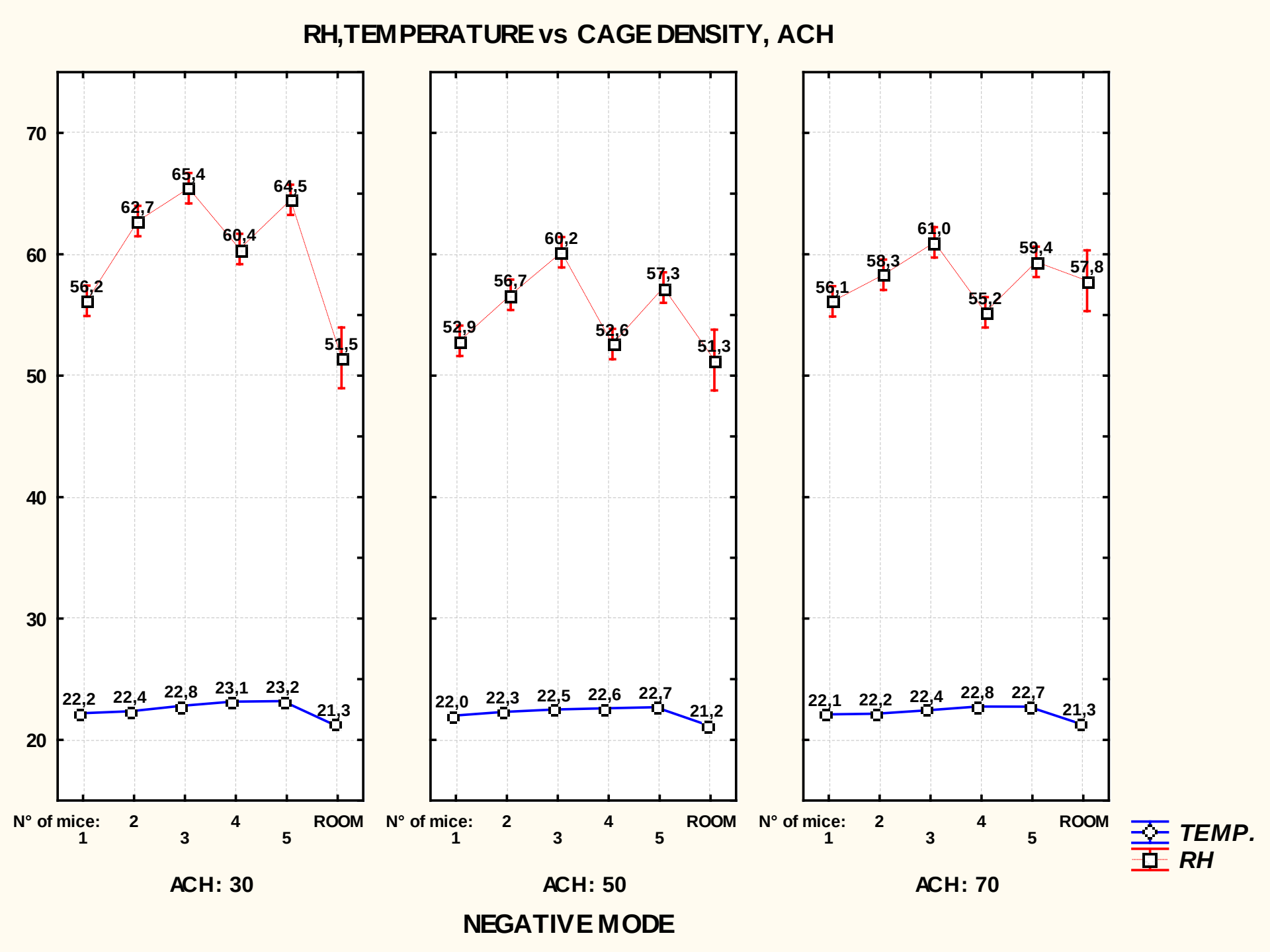
Noise level (dBA)	Mean	Min	Max.	Range
Room	62,4	52,7	67,9	15,2
Intra-cage	49,13	47	52	5

Table 2

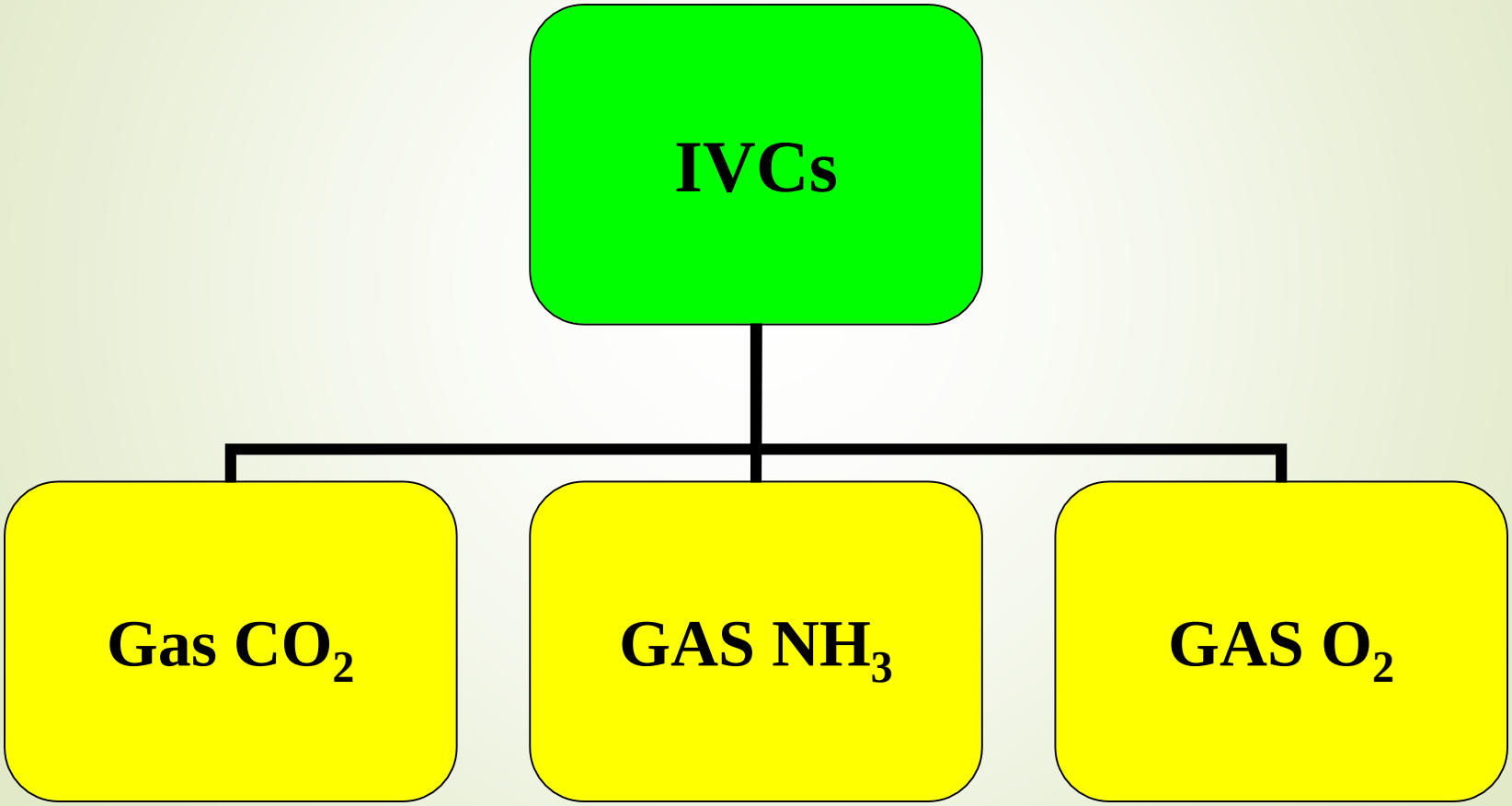
- Ultrasounds emission from a Change Station was verified at a distance of < 60 cm . An audible noise from the instrument was recorded as low, medium, high.
- 23-26 kHz (very) low
- 37-43 kHz medium
- 73-84 kHz high
- When the distance is over 60 cm ultrasounds disappear.
- No ultrasounds were detectable at bench level of the Change Station.
- Computer screen and AC74: No ultrasounds were detected from these two equipment.

Micro environment in IVCs




RH,TEMPERATURE vs CAGE DENSITY, ACH
70
60
50
40
30
20
56,2
62,7
65,4
60,4
64,5
51,5
22,2
22,4
22,8
23,1
23,2
21,3
52,9
56,7
60,2
52,6
57,3
51,3
22,0
22,3
22,5
22,6
22,7
21,2
56,1
58,3
61,0
55,2
59,4
57,8
22,1
22,2
22,4
22,8
22,7
21,3
N° of mice:
1
2
3
4
5
ROOM
ACH: 30
ACH: 50
ACH: 70
TEMP.
RH
NEGATIVE MODE

Still few words on the microenvironment



CO_2

- Interesting in IVCs
- Dynamic or static condition
- 8,8% LD_{50} in mice
- In Dynamic: max 0,5%
- In static: max 2,8%

NH_3

- Mainly because the activity of urease positive bacteria on urinary proteins
- Not defined treshold
- 20-25-50-100-200 ppm
- But for how long?
- Irritanting for the nasa

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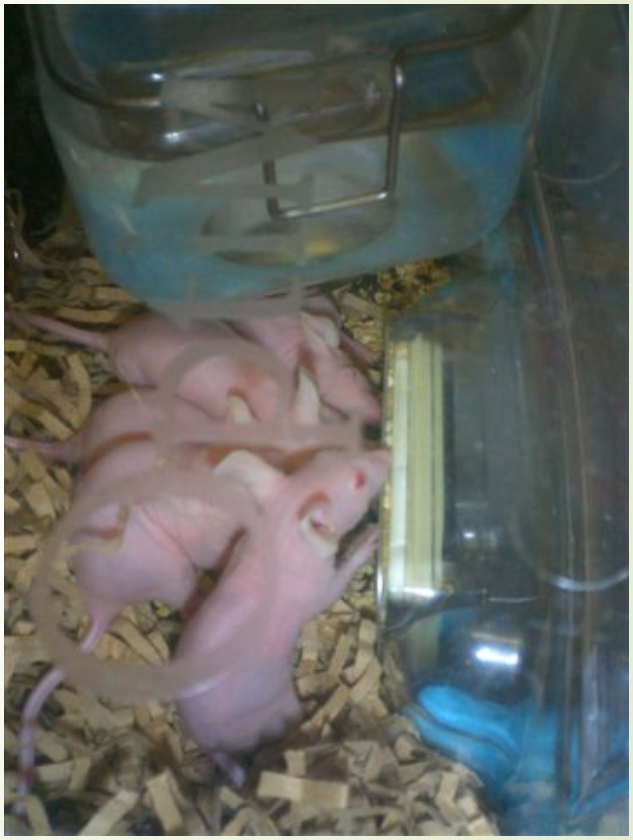
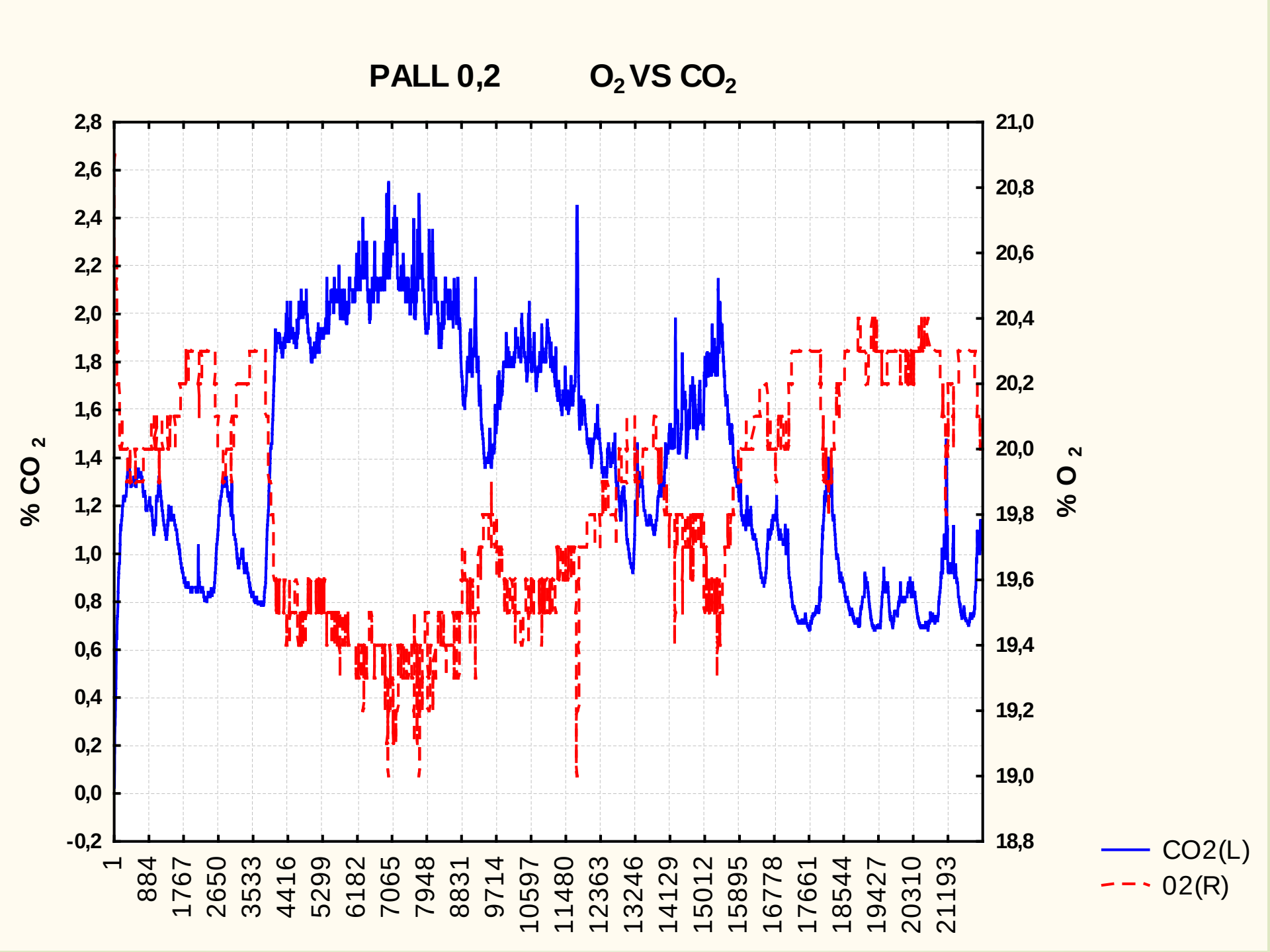
Effects of a 28-Day Cage-Change Interval on Intracage Ammonia Levels, Nasal Histology, and Perceived Welfare of CD1 Mice

Catherine M Vogelweid,[1,2] Kathleen A Zapien,[1] Matthew J Honigford,[1] Linghui Li,[1] Hua Li,[1] and Heather Marshall[1,*]

O_2

- 20,9% normal concentration in air
- Fluctuate as a consequence of CO_2 increase.
- Good quick indicator of air quality and ventilation efficiency




PALL 0,2
O2 VS CO2
% CO 2
% O 2
2,8
2,6
2,4
2,2
2,0
1,8
1,6
1,4
1,2
1,0
0,8
0,6
0,4
0,2
0,0
-0,2
21,0
20,8
20,6
20,4
20,2
20,0
19,8
19,6
19,4
19,2
19,0
18,8
1
884
1767
2650
3533
4416
5299
6182
7065
7948
8831
9714
10597
11480
12363
13246
14129
15012
15895
16778
17661
18544
19427
20310
21193
CO2(L)
02(R)

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Individually ventilated cages cause chronic low-grade hypoxia impacting mice hematologically and behaviorally ☆

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Thank you