EAAP 2018

69th Annual Meeting of the European Federation of Animal Science

Dubrovnik, Croatia, 27th to 31st August 2018

SRUC

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BALANCE
PRODUCTION / CONSUMPTION
Animal farming for Humans' wellbeing and Planetary health

Leading the way in Agriculture and Rural Research, Education and Consulting

Vocalization: a key indicator of health and welfare in future PLF systems for poultry

Malcolm Mitchell and Jessica Martin

Leading the way in Agriculture and Rural Research, Education and Consulting

Meat Poultry Production

Livestock Species	European Union	World
Broilers	6.9 billion	59.8 billion
Turkeys	203 million	660 million

Meat Poultry Production

- Broiler Chickens are produced globally in intensive systems

- Sheds may contain 50,000 birds

Meat Poultry Production

- Birds are grown to 32-70+ days before slaughter dependent on required bird size and breed

- Environments, nutrition, bedding/litter and production processes are precisely defined and frequently controlled

Meat Poultry Production

- Present scales of production require increasing levels of automated monitoring and control

- Key parameters include environmental variables, birds health and welfare and performance

Improving Management for Better Animal Productivity

Largest broiler farm in Europe (World?)

Ukraine:-

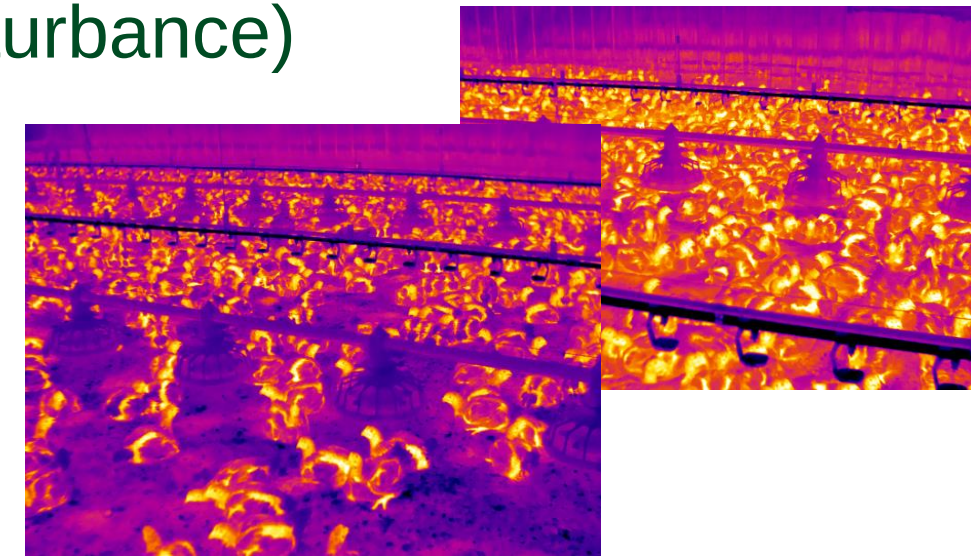
- 12 Growing areas – 38 sheds - 54,000 birds per shed
- Over 2 million birds on the ground
- 2 slaughterhouses, processing plants
- 4000 employees!
- Requires integrated and hi-tech monitoring and management

- Is this the future?

Meat Poultry Production

- Broiler chickens may be subjected to a range of potential stressors during intensive production

- These include infectious disease challenges, thermal stress, metabolic disease, physical stressors (e.g. litter quality), interactions with humans (threat and disturbance)



PLF Solutions

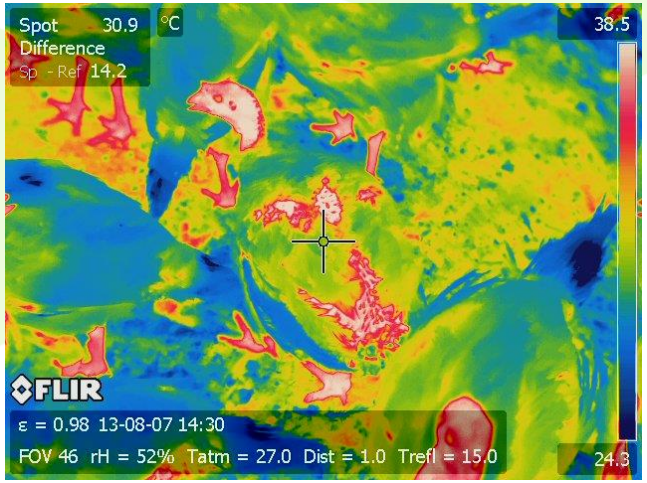
- Therefore the predicted expansion of intensive poultry production requires the development of PLF solutions supporting animal and environmental monitoring and control (e.g.Precision livestock farming: a ‘per animal’ approach using advanced monitoring technologies - Halachmi and Guarino (2016)

- Early warning of problems associated with animal health and welfare are key.

PLF Solutions

- Acoustic recording and analysis of vocalization may provide the basis for monitoring and early warning systems

- Vocalizations in poultry may reflect the birds' affective state and may change during exposure to stress or be associated with altered health or welfare status.



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- Based on frequencies and call duration - 91.2% of chicken vocalisations fall into 4 distinct categories(Marx et al., (2001)
  - distress calls
  - short peeps
  - Warbler
  - pleasure notes

- Based on social isolation tests:-
  - vocal pattern may be a reliable source of information to detect acute stressful situations aversive to the chick

PLF Solutions

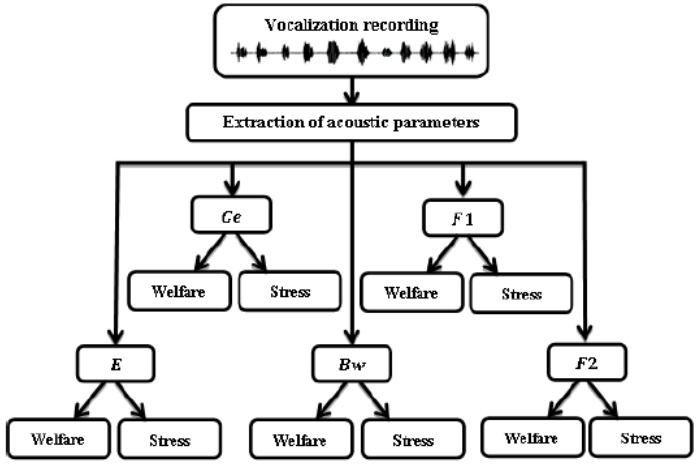
IDENTIFICATION OF ACOUSTIC PARAMETERS FOR BROILER WELFARE ESTIMATE

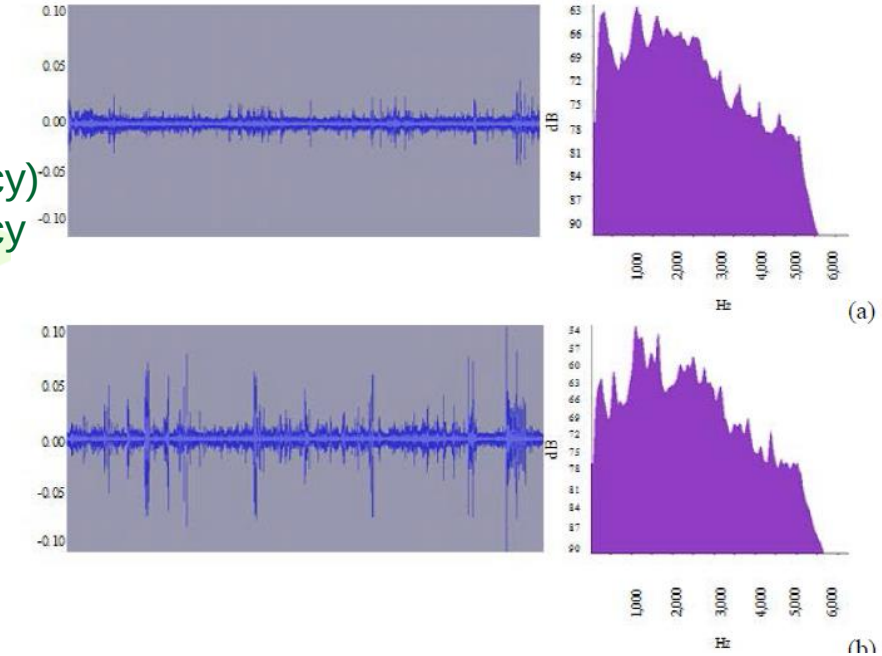
ERICA M. PEREIRA[1], IRENILZA DE A. NÄÄS[2], RODRIGO G. GARCIA[3]

Eng. Agríc., Jaboticabal, v.34, n.3, p.413-421, maio/jun. 2014

Analysed broiler vocalisations

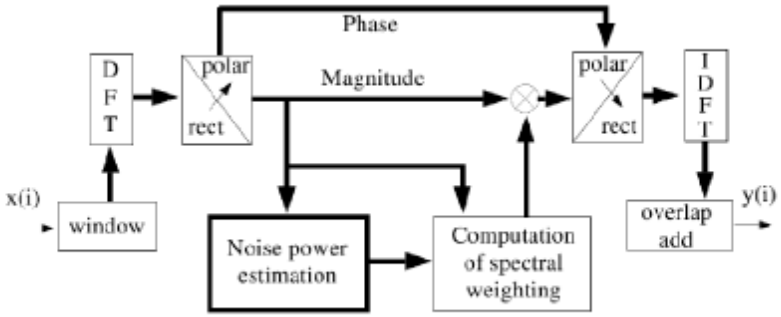
Derived E (energy)
BW (band width)
F1 (energy concentration at a specific frequency)
F2 (energy concentration at a specific frequency
Used to determine welfare status and stress

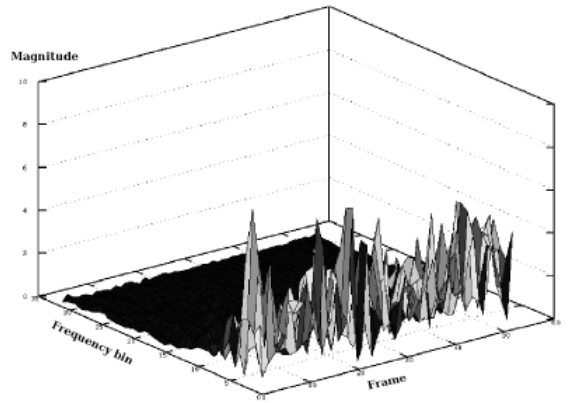




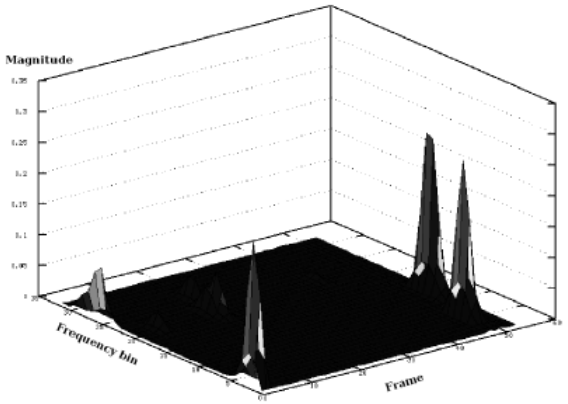
PLF Solutions

Curtin, Daley and Anderson (2014) Classifying broiler chicken condition using audio data





(a) Unmodified signal



(b) Noise removed with oversubtraction factor of 2.5

PLF Solutions

Curtin, Daley and Anderson (2014) Classifying broiler chicken condition using audio data

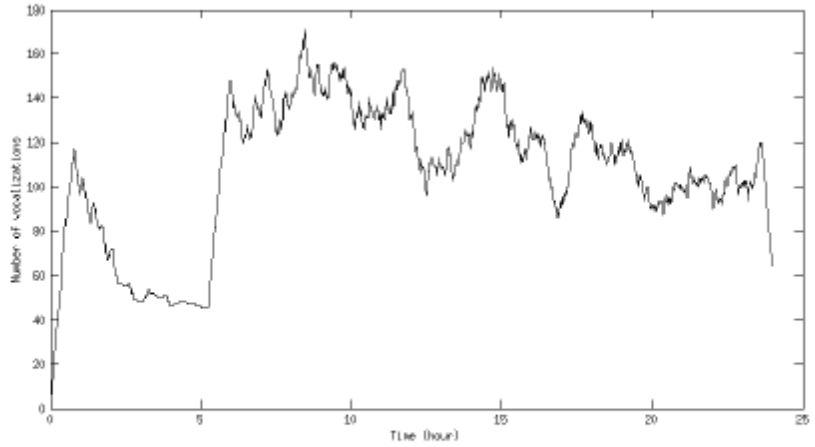


Fig. 3. Number of vocalizations per 45-minute period in an average day.

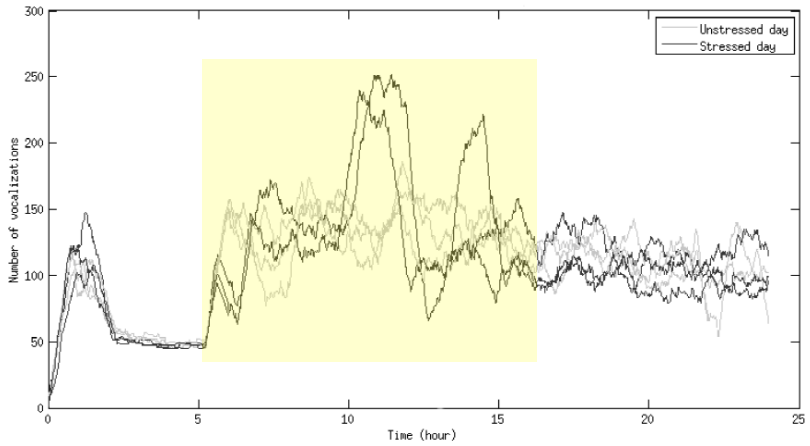


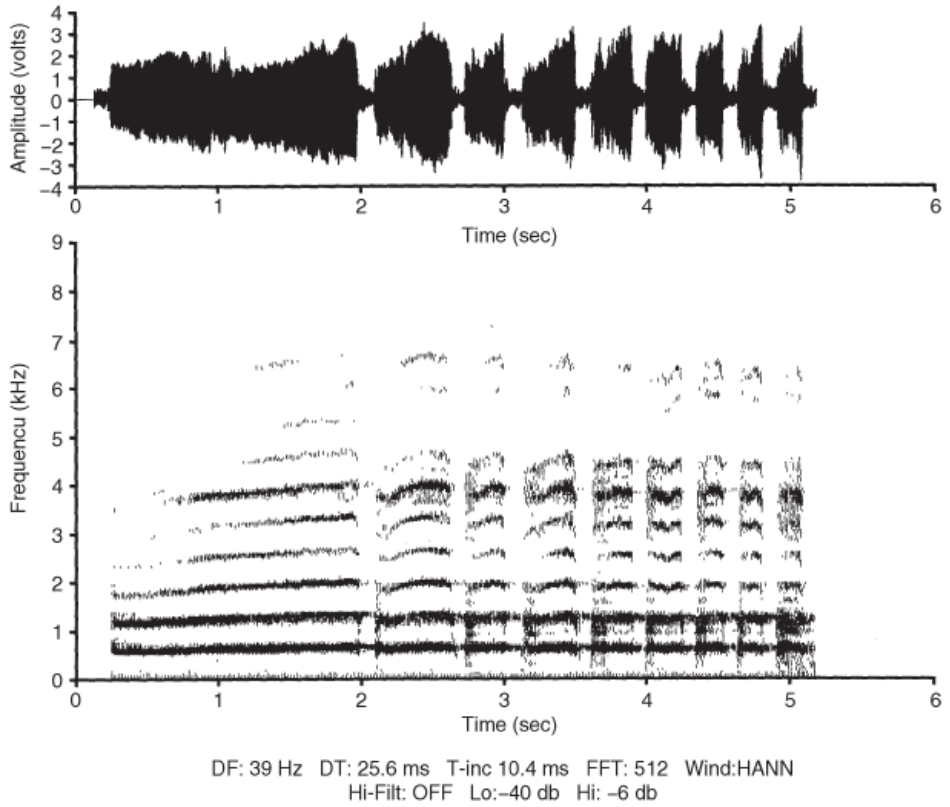
Fig. 4. Number of vocalizations for both stressed and unstressed days.

Number of vocalisations can be used to identify stress

Can be employed as a flock monitoring tool

PLF Solutions

The number of Gakel sounds is positively correlated with the degree of hunger……..digital sound analysis offers fascinating prospects for automated determination of the state of farm animals. Noldus and Jansen 2004



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Animal (2016), **10:9**, pp 1567–1574 © The Animal Consortium 2015
doi:10.1017/S1751731115001408

animal

Vocalisation sound pattern identification in young broiler chickens

I. Fontana[1], E. Tullo[1†], A. Scrase[2] and A. Butterworth[2]

[1]*Department of Health, Animal Science and Food Safety, Università degli Studi di Milano, Milan, 20133 Italy;* [2]*Department of Clinical Veterinary Science, University of Bristol, Langford, North Somerset BS49 5DL, UK*

Figure 1. Screenshot of the Adobe® Audition ™ software showing the spectrograms and the frequency analysis window relative to a specific vocalisation.

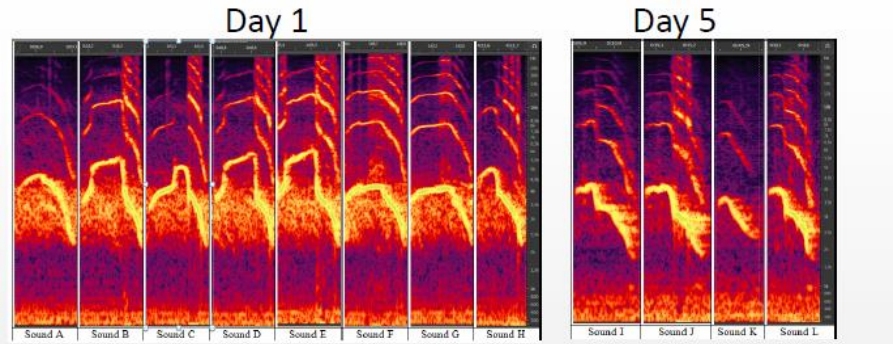
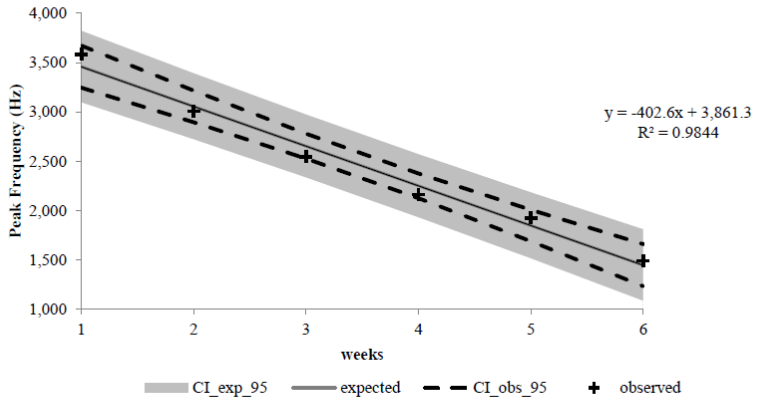


Figure 4. Linear regression of PF in relation to the age of the animals expressed in weeks. Confidence intervals of the mean are reported in dotted lines. Confidence intervals of the prediction are represented by the grey area.



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Key Findings:-

- Peak Frequency in inversely proportional to age and weight (significant correlation $p<0.001$
- May underpin the development of an automated tool based on vocalisation analysis to predict weight and growth trends
- Audio monitoring - Identification of specific frequencies may allow assessment of health and welfare status when characterised in relation to bird behaviours by comparison of recorded sounds with anticipated sounds

PLF Solutions


Contents lists available at ScienceDirect

Computers and Electronics in Agriculture

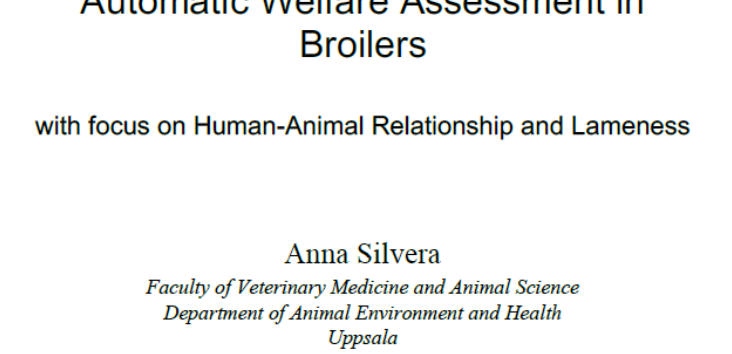
journal homepage: www.elsevier.com/locate/compag

Original papers

Using sound technology to automatically detect the short-term feeding behaviours of broiler chickens

A. Aydin [a,*], D. Berckmans [b]

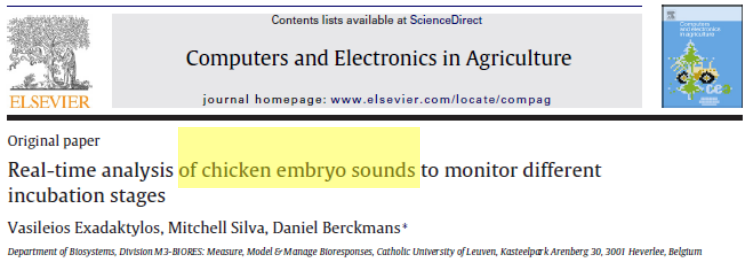
[a] Department of Agricultural Machineries and Technologies Engineering, Faculty of Agriculture, Canakkale Onsekiz Mart University, 17020 Canakkale, Turkey
[b] Division Measure, Model & Manage Bioresponses, KU Leuven, Kasteelpark Arenberg 30, B-3001 Heverlee, Belgium


Automatic Welfare Assessment in Broilers

with focus on Human-Animal Relationship and Lameness

Anna Silvera

Faculty of Veterinary Medicine and Animal Science
Department of Animal Environment and Health
Uppsala


Contents lists available at ScienceDirect

Computers and Electronics in Agriculture

journal homepage: www.elsevier.com/locate/compag

Original paper

Real-time analysis of chicken embryo sounds to monitor different incubation stages

Vasileios Exadaktylos, Mitchell Silva, Daniel Berckmans*

Department of Biosystems, Division M3-BIORES: Measure, Model & Manage Bioresponses, Catholic University of Leuven, Kasteelpark Arenberg 30, 3001 Heverlee, Belgium


Animal (2016), **10:9**, pp 1567–1574 © The Animal Consortium 2015
doi:10.1017/S1751731115001408

animal

Vocalisation sound pattern identification in young broiler chickens

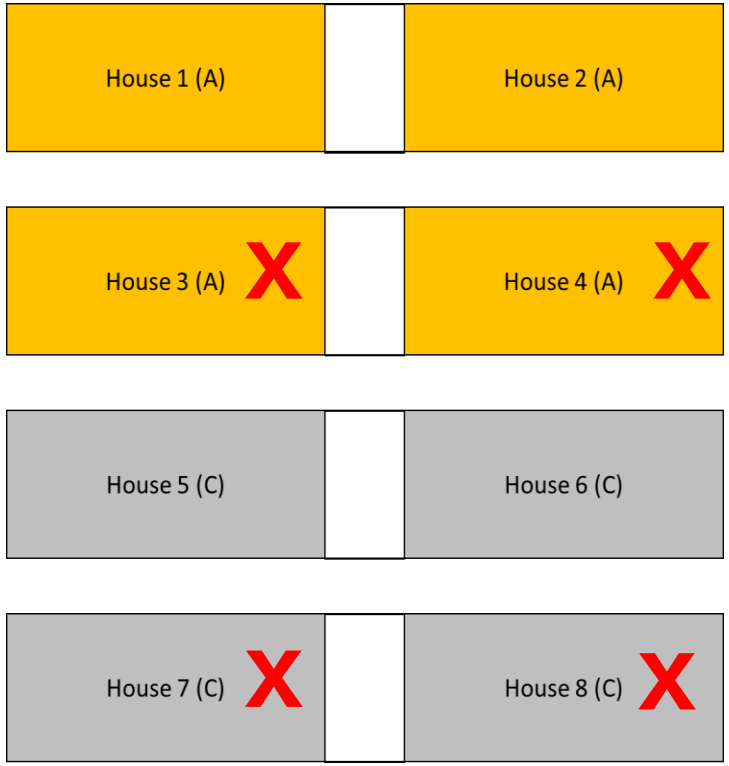
I. Fontana[1], E. Tullo[1†], A. Scrase[2] and A. Butterworth[2]

[1]Department of Health, Animal Science and Food Safety, Università degli Studi di Milano, Milan, 20133 Italy; [2]Department of Clinical Veterinary Science, University of Bristol, Langford, North Somerset BS49 5DL, UK

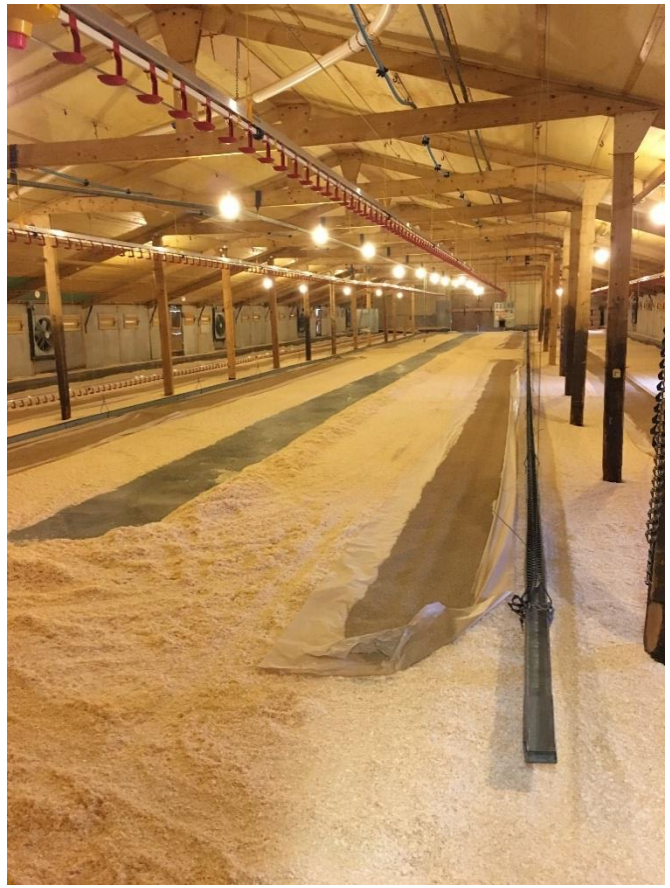
Herborn, Wilson, Mitchell, McElligott and Asher (2018); Individual distress calls as a flock-level welfare indicator. Congress of the ISAE; Ethology for Health and Welfare, July 30th to August 3rd 2018, University of Prince Edward Island, Charlottetown, Prince Edward Island, Canada

Methods

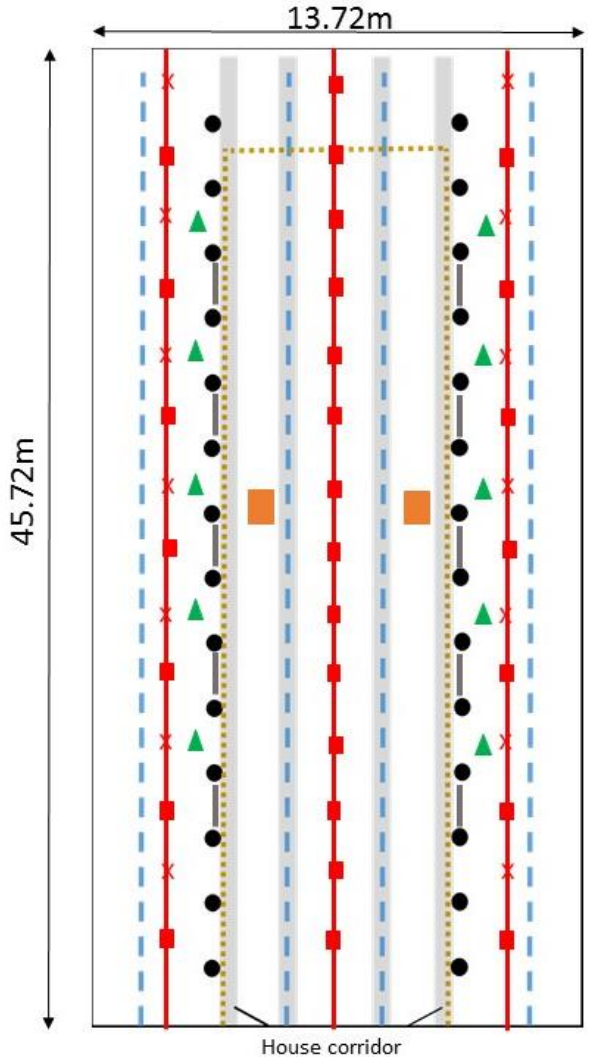
Number of birds per shed at placement was 12,100

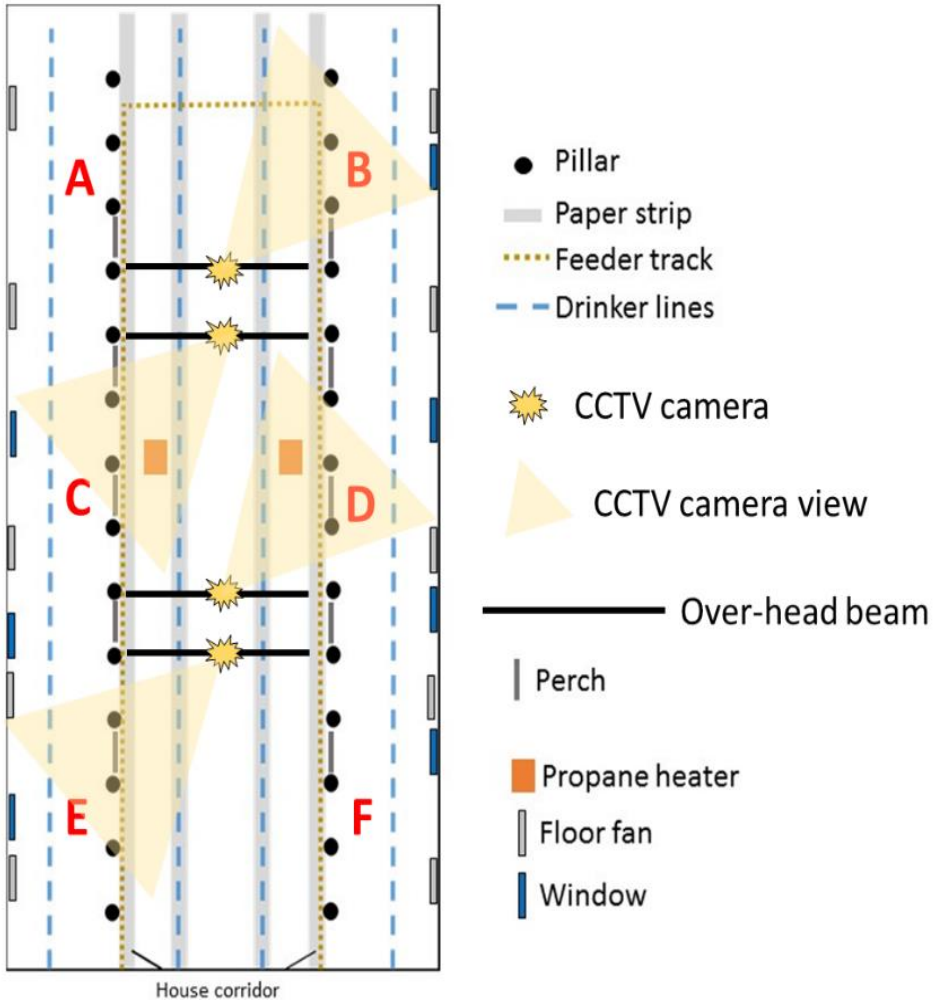


Methods



Methods


13.72m
45.72m
House corridor


A
B
C
D
E
F
House corridor
Pillar
Paper strip
Feeder track
Drinker lines
CCTV camera
CCTV camera view
Over-head beam
Perch
Propane heater
Floor fan
Window

Methods

- The present study characterized the changes in broiler vocalizations associated with imposition of a typical stress through disturbances of the flock
- Video and sound recordings were made from two commercial broiler flocks
- Broiler behaviour was digitally video recorded from four CCTV cameras in two houses
- Vocalisations were recorded along with digital behavioural footage by a Canon Legria camcorder with 64GB SD card

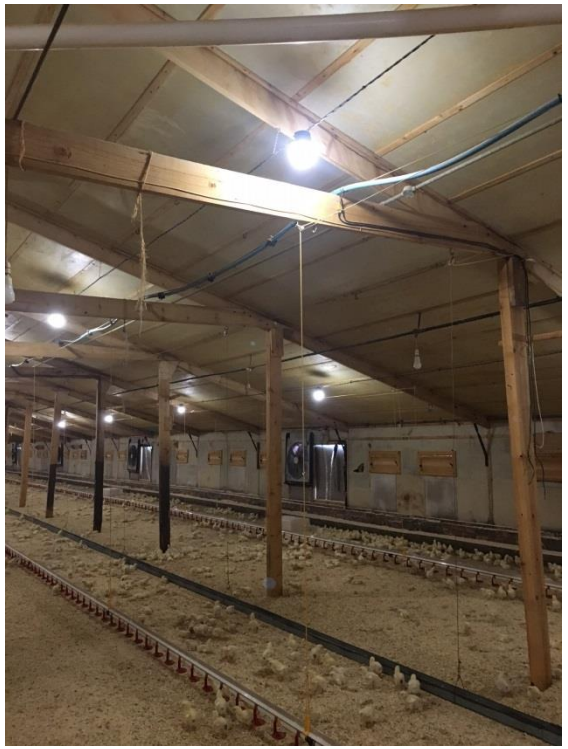
Methods

- House vocalisations were recorded over 3hr intervals
  - morning (09:00-12:00)
  - afternoon (13:00-16:00)
- Same four houses in which behavioural data were recorded
- Audio recordings were conducted on sample days (16d, 22d, 38d)

Methods

- From video analysis a diary of disturbances was produced for all houses for weeks 3-6

- Identified disturbances included
  - stock person entry
  - distress calls



Methods

- Behavioural analysis:-
  - Instantaneous scan sampling was carried out at 30 second intervals for ten minutes before and after each recorded disturbance
  - Totaling 40 scans per disturbance.
  - These scans were recorded from 4 quadrants
  - 25 birds per quadrant, therefore 100 birds per scan
  - The number of birds in each quadrant were counted and the numbers of birds performing each behaviour in the ethogram was noted per scan
  - Behaviour was recorded using an established ethogram
  - The mean percentage of birds engaged in each behaviour for the 20 scans before and 20 after a disturbance were calculated and averaged

Methods

Martin et al 2016

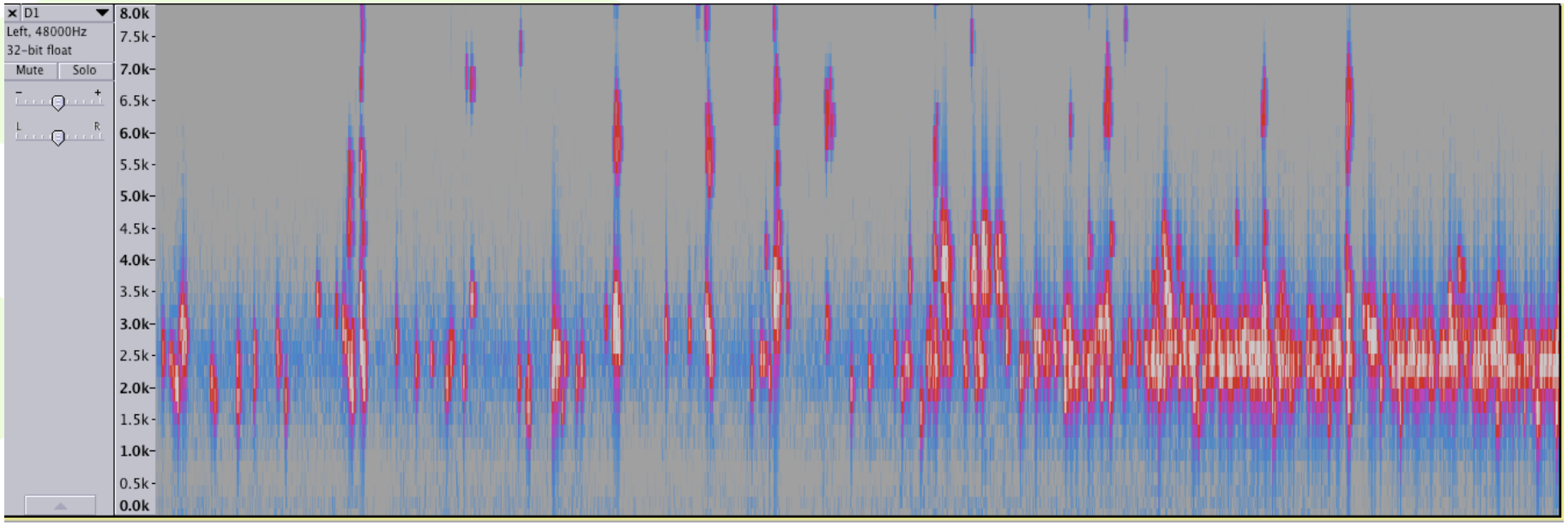
Behaviour	Description
Standing	Standing with no other behaviours noted
Sitting	Sitting on the ground with no other behaviours noted
Sleeping	Sitting on the ground with head laid on the floor and eyes closed or head under wing
Perching	
Feeding	
Drinking	
Walking	Walking around at a slow speed
Running	Walking at fast speed
Flying	Flapping wings while leaping into the air
Shuffling	Moving from side to side with some wing motion as if to get comfortable
Stretching	Limbs being stretched out straight while sitting or standing
Preening while standing	Moving beak through feathers or outstretched leg to clean while standing
Preening while sitting	Moving beak through feathers to clean while sitting down on the floor
Flapping while standing	Flapping wings while standing with no other behaviours noted
Flapping while walking	Flapping wings while walking at a slow speed
Dust-bathing	Beating wings into the substrate on the ground
Foraging	Pecking at the substrate while standing or sitting
Feather pecking	Pecking of another bird's feathers while sitting and relaxed
Aggressive peck	Forceful peck to head, neck or tail causing recipient to withdraw or retract

Methods

- Vocalisation analysis was carried out using Audacity 2.1.1
- Baseline frequencies were measured by stripping sound files from videos that contained no disturbances
- Noise reduction of background fans was applied using the sound editing software on Audacity

Methods

- Sound files were stripped from the video recordings that contained disturbances, converted to a.wav format and displayed as spectrographs



Methods

- Vocalization analysis was performed on 2s epochs of whole flock vocalisation noise analysed at 60 second intervals 10 minutes before and after each disturbance
- From the Spectrographs produced for each epoch using Audacity™ software maximum, minimum and peak frequencies were obtained
- Data were analyzed from 7 identified disturbances
- Paired t-tests or Wilcoxon Matched Pairs tests were used to compare behaviour and vocalization frequencies before and after disturbance

Methods

Disturbance (D) number	Week number	House number	Cause of Disturbance
D1	3	7	Stockperson entry
D2	3	8	Distress call
D3	3	8	Stockperson entry
D4	3	8	Distress call
D5	4	7	Stockperson entry
D6	6	7	Stockperson entry
D7	6	8	Stockperson entry

Table: Disturbances identified

Results

- After disturbance, the number of birds standing, walking and shuffling increased, while sleeping, stretching and dustbathing decreased
- There was a significant increase in range and peak frequency of vocalisations in disturbed birds
- The prevalence of some behaviours correlated with flock level vocalisation frequencies

Results

Table 1 *Mean/Median proportion of birds engaged in each behaviour before and after disturbance (N=7) and the outcome of paired t-test/Wilcoxon matched pairs comparison*

Behaviour	Mean/Median Before	Mean/Median After	P Value
Standing	2.74	5.70	0.022
Sleeping	15.79	4.95	0.022
Walking	2.45	6.67	0.022
Shuffling	6.07	7.96	0.022
Stretching	1.12	0.62	0.022
Dust-bathing	0.56	0.13	0.029

Results

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BEFORE DISTURBANCE

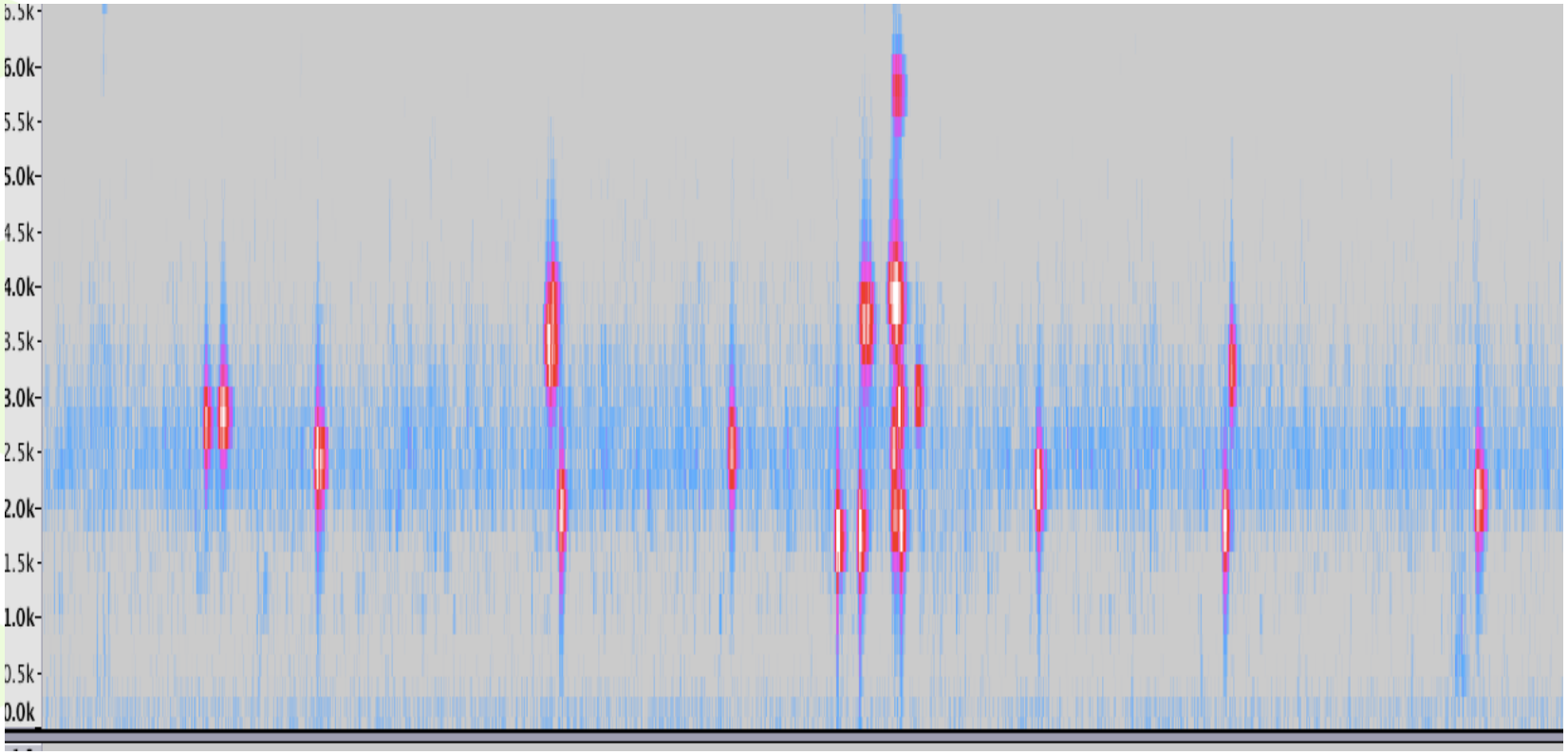


*Figure 1: Example spectrographs of flock vocalisation **before** and after a disturbance*

Results

AFTER DISTURBANCE

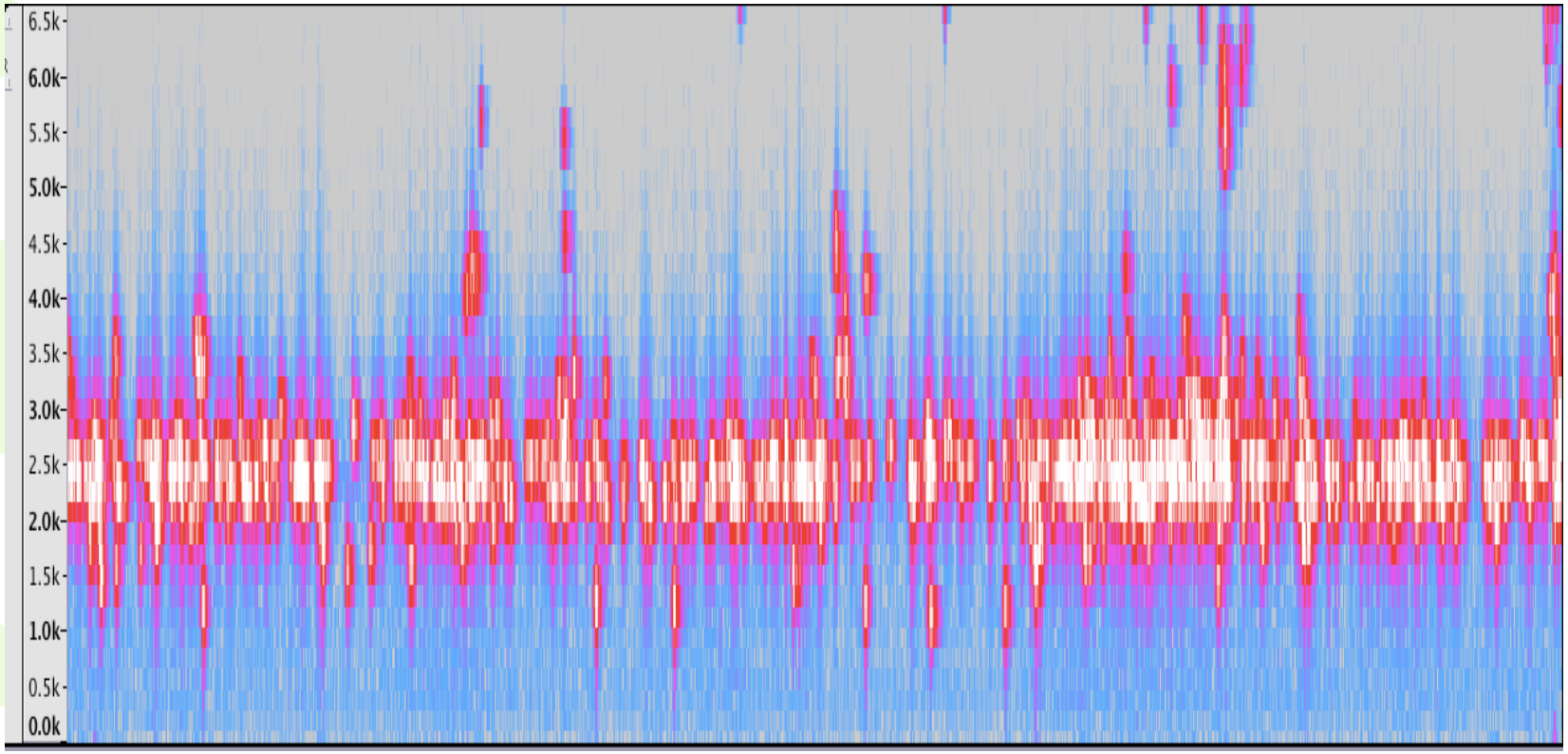


*Figure 1: Example spectrographs of flock vocalisation before and **after** a disturbance*

Results

Table 2 *Mean/Median frequency of flock vocalisations before and after disturbance (N=7) and the outcome of paired t-test/Wilcoxon matched pairs comparison*

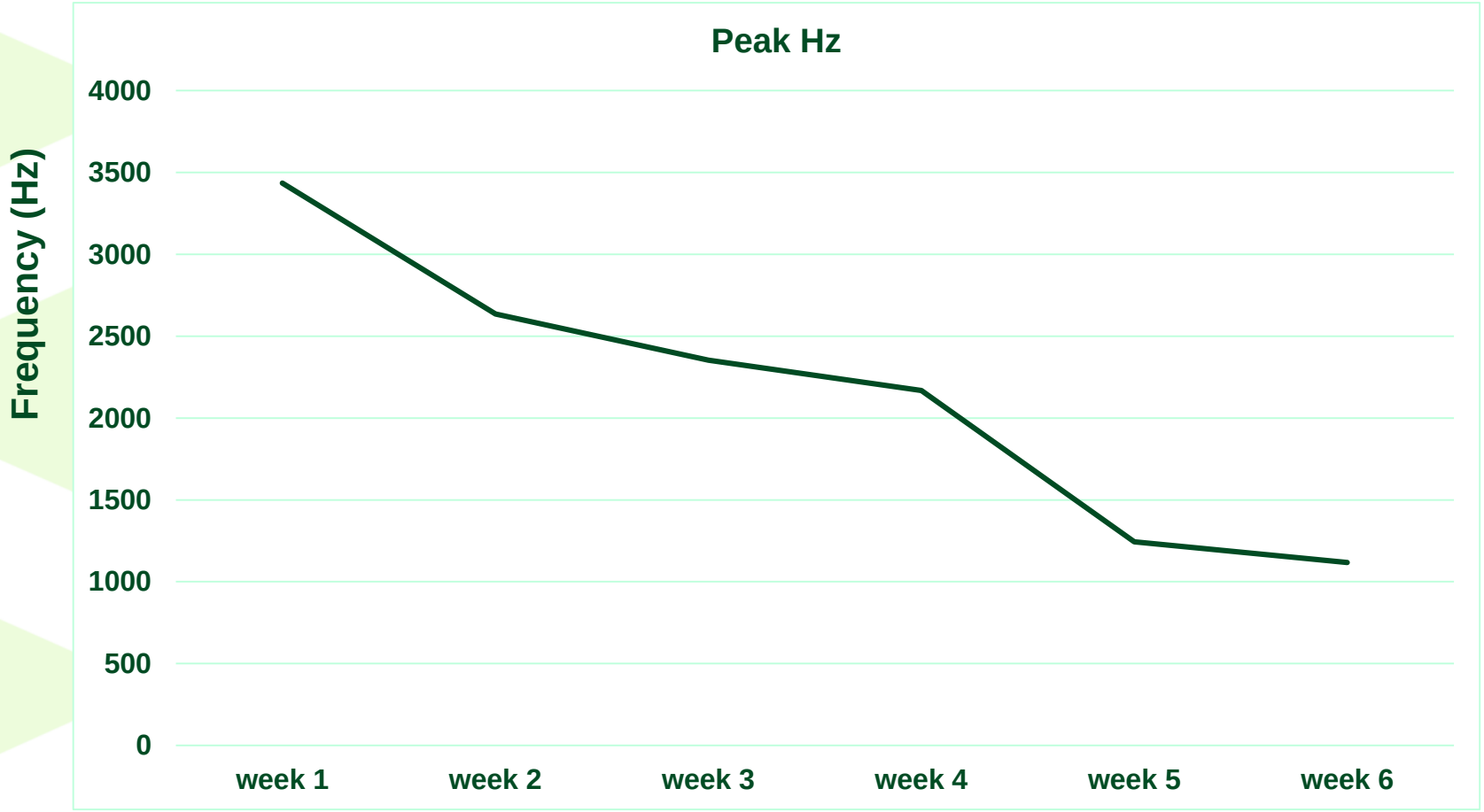
Vocalisation	Mean/Median Before	Mean/Median After	P Value
Mean Min Hz	420.20	263.80	0.023
Mean Max Hz	5057.00	5693.00	0.012
Mean Peak Hz	2100.00	2303.00	0.002

Results

- Across all data points, regardless of disturbance status, the peak frequency of vocalisation was
  - negatively correlated with sleeping (r=-0.758; p=0.002)
- Peak frequency was positively correlated with
  - flapping while walking (r=0.693; p=0.006)
  - with foraging (r=0.684; p=0.007)
  - with shuffling (r=0.657; p=0.011)
  - with walking (r=0.697; p=0.0060
  - and with feather pecking (r=0.533; p=0.05)
- Minimum frequency positively correlated with
  - shuffling (r=0.604; p=0.022)
  - with preening while sitting (r=0.596; p=0.025)
- No significant correlations between behaviour and maximum frequency were found.

Results

Mean baseline frequency values across both flocks (Hz) at different ages



Results

- The baseline (undisturbed) peak frequency decreased with age
- The peak frequency decreased from 3435.80 Hz to 1118.10 Hz over the 6 weeks of life
- Other vocalisation frequencies were not affected by age.

Discussion

- The maximum frequency after a disturbance had a mean of 5693Hz
- Vocalisations over 5.5kHz are known to be distress calls, according to the four categories defined by Marx et al (2001)
- This could indicate that more distress calls being generated in disturbed birds, leading to a higher maximum frequency at flock level.

Discussion

- A significant increase in range and peak frequency of calls therefore indicates disturbed birds and possible welfare compromise

- Using acoustic analysis to detect flock / group / bird distress in the absence of essential disturbance e.g. inspection walks /mortality check may be a useful indicator

- More vocalisations with the pitch frequency and main frequency modulation of ‘pleasure notes’ may indicate a “positive welfare state”.

Discussion

- It is suggested that acoustic recording and analysis of broiler vocalizations may be developed as a novel, non-invasive welfare measure for poultry for incorporation into whole house monitoring and control systems.

Discussion

- Flock based sound data monitoring, recording and analysis should be developed further as a non-invasive welfare measure in broiler chicken houses

- Acoustic monitoring and recording may be combined with other key technologies in PLF in to more comprehensive and integrated systems

Sensor networks – integrated systems – digital technology and telemedicine (IoT – IoL)

SRUC

The future

Meeting with Bill Gates and the Gates Foundation at SRUC/Roslin Institute

Thank you for your attention!