Body Condition Scoring System for Laboratory Zebrafish

Carole Wilson
UCL Zebrafish Facility, Division of Biosciences

Aim: To implement a standarised body condition scoring system (BCS) of laboratory zebrafish.

Introduction

Zebrafish are a rapidly expanding model in biomedical research. Currently there are no standardised methods for health monitoring of zebrafish. In this poster, we describe how we have developed and deployed a non-invasive tank-side body condition scoring system that can be performed at the same time as the daily checks required by The Animal (Scientific Procedures) Act 1986.

The 'Traffic Light' System

Current health monitoring systems used for laboratory zebrafish include sentinels, water quality and biofilm screening. Unlike mammals, monitoring zebrafish health and welfare using body condition scoring is rare and not well developed or utilised.

We have developed a scoring system, called the 'traffic light system', (Fig. 1) comprised of 4 stages; each grades various aspects of fish behaviour and general body condition that may be observed in a general population. of zebrafish.

Body Condition Score	Traffic light colour	Meaning of traffic light colour	General appearance	General movement / swimming	Body, scale and fin	Bone formation
BCS1	Black	Immediate disposal	Dying	Little sign of life/movement	Not relevant	Not relevant
BSC2	Red	Priority to remove from system Possible signs of contagious disease Investigate	General emaciation Wasted body to head ratio General body deformities General dropsy/protruding scale	Swimming/orientation reversed Swimming on side Sitting on bottom of tank but will move in response to stimuli	Tumors or body ulcers Decayed fins/missing caudal fin Scale loss and/or patchy loss of pigment Protruding or defective eyes	Scoliosis/lordosis
BSC3	Amber I	Monitor for decline	Under conditioned Thin	Listing Gasping[1]	Missing operculum Partial missing dorsal/pectoral fins	Mild signs of scoliosis/ lordosis
	Amber II		Over conditioned Obese		Egg bound (not tumours)	
BSC4	Green	Good Health	Well conditioned Sleek body conformation	Swimming normal, not erratic, no signs of distress	Consistent pattern/colour Sexes may be physically witnessed	No signs of bone malformation

[1] Gasping in large numbers of fish is serious as it indicates a water problem and should be acted upon immediately

Fig. 1: Body Conditioning Scores and corresponding colour and action. Each score/colour has specific descriptions to aid in health identificaiton

Methods

The system was tested with 45 volunteers, categorised by previous fish and animal husbandry experience (Fig. 2). Six fish from the UCL Facility general population, representing at least one of each stage, were transfered to five individual tanks; one group tank with 8-10 fish (all 'green' stage with one from stages red to black). Scoring included a single score for the individual tanks and the lowest possible score for the group tank. Each participant scored twice: first, using their own experience, and then again after receiving training (5- 10 minutes) with a traffic light scoring sheet.

	Category 1	Category 2	Category 3	Category 4
Experience	Experienced animal (zebrafish) technicians	Familiarity with zebrafish appearance, but no working knowledge of animal husbandry	Experienced animal (mammalian) technicians	No knowledge of zebrafish nor of animal husbandry

Fig. 2: Categories based on experience and knowledge

Results

For the purpose of statistical analysis, we combined categories 2-4 to give us two groups (Fig. 3). Using the two groups (Fig. 4), we found that 64% of Group 1 were able to correctly score the fish before training and 74% were then able to correctly score fish after training. Group 2 were able to correctly score fish in 53% of all cases prior to training and increased to 63% after training.

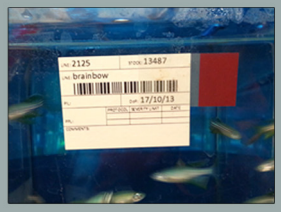
Fig. 3: Combined categories

Group 1	Group 2
familiar and working with Zebrafish in a research setting (n=21)	not familiar with Zebrafish in a research setting (n= 24)

Fig. 4: Showing correct scoring within groups before and after training

Implementation

In the UCL Facility, we have implemented our BCS system by changing the daily health screening protocol. Previously, these were done during feeding, with the feeder removing any sick or dead; now, we use a two-tiered system, with the feeder scoring tanks in accordance to the BCS and is later checked by a senior technician who makes the final decision and removes any fish. We use coloured labels that are placed on the top corner of a tank's label. Yellow flags are dated with the date of discovery.



Discussion

Overall, we found this system to be effective. The change in protocol has produced more accurate records of illness and deaths. Preliminary data shows that there was a 21.08% increase in identifying sick fish due to scoring tanks (Fig. 5). Additionally, the increase in identifying fish in both early and later stages of illness indicates that we are reducing the numbers of fish reaching or exceeding the severity limits. This data is currently stored in a database and can be used to monitor and identify any health issues and patterns that may arise.

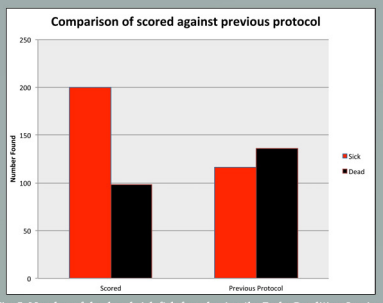


Fig. 5: Number of dead and sick fish found using the Body Condition Scoring System and number found using previous protocol. The time period covers 42 days in both instances

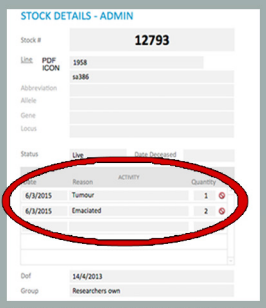


Fig. 6: A portion of the database with a searchable death and illness section

We found that flagging black stage fish to be detrimental; dead fish are consumed by others, posing a health hazard, and need to be removed immediately. Therefore, we only flag tanks that contain fish at either the red or yellow stages, and all black stages are immediately removed upon discovery. Additionally, we have found that the flags can be difficult to see given the large size of our facility; we addressed this by standardising the flag position.

Yellow flags are dated to indicate length of illness, which aids in decision-making. Due to our facility size, we have found that this system requires more staff and man-hours than our previous protocol; however, we see this as a refinement to protocols, as it has resulted in more fish being removed and accurate records.

References:
Wilson, C, K. Dunford, C. Nichols, H. Callaway, J. Hakkesteeg, M. Wicks. 2013. 'Body Condition Scoring for Laboratory Zebrafish' in Animal Technology and Welfare. 12(1). pp 1-7

Acknowledgements:
Many thanks to the UCL Fish Facility staff, including Karen Dunford, Heather Callaway, and Matthew Wicks for implementing the system.