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Husbandry and Health Program Survey Synopsis

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Introduction

As part of this special issue of *Zebrafish* on husbandry and health, we invited 19 facilities across the world to participate in a survey of husbandry and health practices. Considering that there are more than 1000 laboratories listed in ZFIN, these 19 surveys provide only a snapshot of the methods employed by facilities around the world. However, we hope that this information will enable the community to begin to build a picture of the commonality and diversity of zebrafish facilities, information that is crucial if we hope to establish common, scalable, community standards. We thank all of the facilities that participated in this first iteration of the survey.

What was Covered in the Survey

We asked facilities to provide a basic description including the number of rooms, number of tanks, and the type of water system. We asked for information about the water system, including monitoring, filtration, and UV sterilization. We asked questions about husbandry, including food types, feeding schedules, housing densities, and animal tracking. Finally, we asked about health monitoring, including pathogen sampling, diagnostic tests, and personnel protection.

Table 1. Housing Density Ranges

	Average	*SD*	n/*19 reporting*
Nursery			
Embryos/L	65.6	90.0	16
Early larvae/L	28.7	24.8	
Juveniles/L	12.3	8.0	
Adults			
Tank size 1 (L)	1.7	1.3	16
Tank size 2 (L)	3.6	2.1	
Tank size 3 (L)	7.8	2.6	
Fish density 1 (fish/L)	4.9	2.7	18
Fish density 2 (fish/L)	7.9	6.2	
Fish density 3 (fish/L)	12.6	18.8	

Nursery: fish density is reduced stepwise in most facilities as fish grow and mature. Adults: fish density is further reduced, except for the largest tank volumes. In most facilities, three tank sizes are used to accommodate different family sizes.

What we Learned

It will not come as a surprise to anyone that the sizes of facilities varied widely within the survey group. Interestingly, we learned that fish housing density varies considerably among facilities, as shown in Table 1. Feeding schedules and feed types also varied, but less so, as shown in Table 2.

Most facilities carry out some type of water quality monitoring, as shown in Figure 1A, and in these facilities water quality parameters are within the published ranges zebrafish tolerate. Although all 19 facilities monitor water temperature, pH, and conductivity, monitoring and reporting were more variable for the buffering capacity of water (hardness) and water pollutant equilibrium (ammonia, nitrite, and nitrates).

Most of the participating facilities use recirculating water systems in their main fish housing area. However, the rate of water exchanges is highly variable, ranging from 1% to 20%, and one of the surveyed facilities relies entirely on a water flow-through system, due to the nature of its scientific program.

Most facilities report that they quarantine imported fish. However, quarantine space varies from a single rack within a facility to a dedicated room either within the facility or in another location. Despite the common use of quarantine, fewer than half of the facilities surveyed specifically request a health status report when importing fish into their facility.

Table 2. Average Number of Feedings and Quantity of Food per Fish per Day

	Average	*SD*	n
Feedings per day	2.8	1.3	16/19
Food (g)/fish per day	0.0526	0.0653	

On average, fish are fed three times a day. The average facility feeds both live and dry (flake) food. The average amount of food per fish and per day is ~10% of body weight, assuming 500 mg adult body weight. Note that the survey asked for the amount of food fed, not the amount of food actually consumed.

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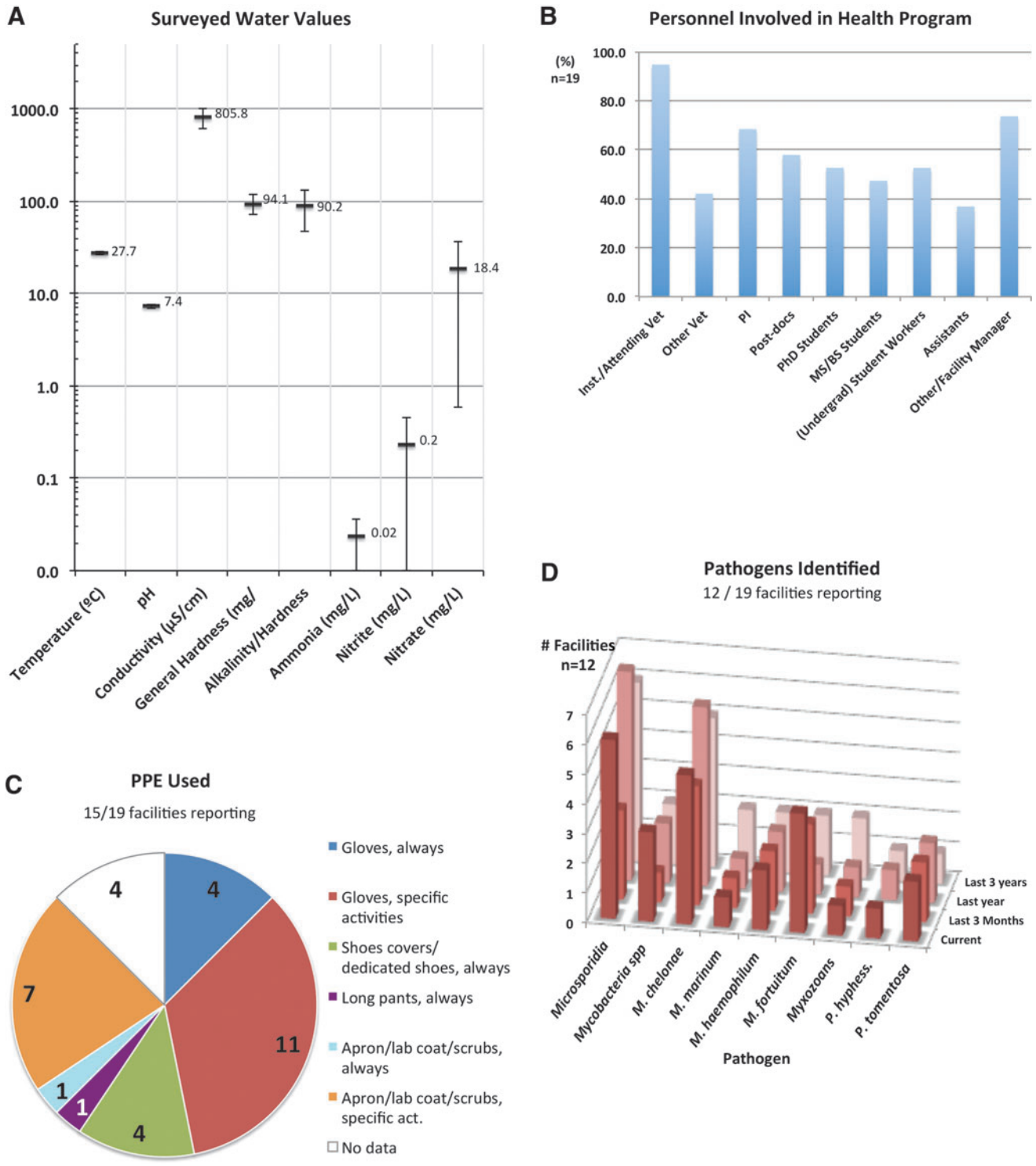

FIG. 1. Summary of husbandry and health-monitoring program elements. **(A)** Average water quality values, with upper and lower range. Temperature, pH, and water conductivity were monitored in all 19 facilities [100% in **(A)**]. The *lines* indicate average values, the *upper bar* delineates the average upper range, and the *lower bar* the average lower range. Temperature ($n=19$): 27.7°C (average), 26.5°C (lower range), and (28.8°C upper range); pH ($n=19$): 7.4 (average), 7.0 (lower), and 7.8 (upper range); conductivity ($n=19$): 805.8, 604.7, and 1006.8 µS/cm; general water hardness ($n=14$): 94.1, 71.3, and 116.9 mg/L (concentration of divalent metal ions, e.g., Ca^{2+}, Mg^{2+}); total hardness/alkalinity ($n=5$): 90.2, 47.3, and 133.1 mg/L $CaCO_3$; ammonia ($n=17$): 0.0232, 0, and 0.0463 mg/L; nitrites ($n=16$): 0.2, 0, 0.5 mg/L; nitrates ($n=16$): 18.4, 0.6, and 36.2 mg/L. **(B)** A range of institutional and laboratory personnel is involved in zebrafish care. The chart shows the percentage of the surveyed facilities reporting participation of various institutional and laboratory personnel in animal health. **(C)** PPE worn. *Numbers* in the pie indicate how many surveys reported the use of a particular PPE. We distinguished all activities and specific activities as indicated by the *colors* in the pie chart legend. **(D)** The number of surveys reporting one or several pathogens in their facility at present, during the past 3 months, during the past year, and during the past 3 years. The microsporidian *Pseudoloma neurophilia* and *Mycobacterium chelonae* are most frequently reported. PPE, personal protective equipment.

More than half of the facility surveys reported that they perform sampling for pathogens, although the number of times per year, which fish are sampled, the types of diagnostics used, and the pathogen control and mitigation strategies are highly variable among facilities.

How fish and equipment are monitored for biosafety also varied considerably among facilities. Most facilities surveyed use UV sterilization of their water, but the strength of the UV source and the manner and how often it is monitored are highly variable.

Most facilities have personnel specifically designated to their health program, as shown in Figure 1B. Use of personal protective equipment varies considerably among facilities (Fig. 1C), perhaps, in part, because of differences in screening and identification of pathogens within facilities (Fig. 1D).

Next Steps

If the information gleaned from this survey does prove useful after further analysis, then we hope to find a way to expand the survey in the future, and to make as much of the data as possible available to the community.

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