## ABSTRACT

Northern river otters, very inquisitive and intelligent, enjoy playing intra-specifically and with their surrounding environment. Within captivity, opportunities to interact with enriching items maintain there physical and psychological well-being. Through a mixed methods study at the Peterborough Zoo, I observed their otter couple over two days, recording qualitative notes and quantitative tallies based on frequencies of varying behaviours. After a water bottle was introduced, a significant difference (chi-square; d.f. = 3, P = 8.57) was found in the frequency of social interaction between the otters after interacting with the bottle, comparative to the control day without new stimuli. This significance displays the importance of behavioural monitoring in zoos to ensure well-being and successful goals of zoo keepers, including reproductive success.


## INTRODUCTION

Is there a difference between the social interactions of Northern river otters (*Lontra canadensis*) in an exhibit at a zoo if something is added to their physical environment as stimulation, such as a play ball or driftwood? If there is a change to the Northern River Otters environment in a captive environment (a zoo exhibit), then there will be an increase in social communication between the paired otters within the exhibit. An increase in social communication between species at zoos increases the captive animal's physiological and psychological well-being, as well enhanced interest from visitors, as the animals positive and intriguing performances will create an enjoyable experience.

Northern river otters are one of the more social members of the weasel family, *Mustelidae*. Within their wild habitat, northern river otters have evolved to utilize a large expanse of environments, including rivers, lakes, freshwater marshes, esturaries and rocky sea coasts (Petrini *et al*. 2008). By 1990 the IUCN (International Union for the Conservation of Nature) Otter Specialist Group established the northern river otter a candidate for protection, as populations had decreased substantially from hunter's reports (Petrini *et al.* 2008). Due to their population decline from habitat destruction and overhunting, the Northern river otters became an important species for conserving in captive zoo and aquarium environments.

The social organization of the Northern river otter varies from wild to captivity, as wild males are solitary while females remain in groups with their offspring (Melquist and Dronkert, 1987 *IN* Petrini *et al.* 2008). Their general behaviour in the wild or captivity includes wrestling, nuzzling with their muzzles, social grooming, face pawing, diurnal resting and scent marking (Beckel, 1982 *IN* Petrini *et al.* 2008). Beckel (1982) has found wrestling not only a factor in play, but a measure of strength intra-specifically.

Previous hypotheses have determined play to strengthen social bonds between otters (Aldis 1975; Baldwin 1982; Byers 1984 *IN* Beckel 1991), as the frequency of wrestling has been observed previous to and during mating season. Muscle development was determined an important purpose for play (Browlee 1954 *IN* Bryers and Walker 1995), as benefits of play are immediate and persistent into adult hood, considering play occurs between animals of varying ages (Smith, 1982; Fagen 1981). Use of motor abilities and their effects have been demonstrated to have positive effects at any age (Fagen 1977, 1981 *IN* Bryers and Walker 1995). Transitory effects, or immediate benefits which may diminish if not continued, include physiological endurance and strength provided through vigorous and repeated activities. Play, in this sense, increases these physiological effects, as well as neurological effects (Bryers and Walker 1995).

With a reputation for intelligence, fast paced and playful mannerisms, Northern river otters spend much of their time exploring through manipulation of objects, and due to their active lifestyle and inquisitive "personality" they need to maintain these skills in order to prevent psychological boredom and decrease in health (Pike *et al.* 2008). Though the social networking of species interactions can be complex and unique (Lusseau 2003; Croft *et al.* 2004; McDonald 2007 *IN* Pike *et al.* 2008), interactions between social species has been studied to determine the individual differences between members of a group which reflect and affect the overall behaviour of the group. Often, the "behavioural phenotype" (Reale *et al.* 2007 *IN* Pike *et al.* 2008), or those behaviours we witness based on the structure and ecology of the otter, will affect interaction in the surrounding environment, including predators, foraging resources, social communication and sexual interactions (Reale *et al.* 2007 *IN* Pike *et al*. 2008). In the captivity of the Peterborough Zoo, these influences are altered, and management of the paired otter's captive environment plays a key role in what affects their behavioural phenotype. The

characteristics of social play, including frequency, sex differences and age relation change the social structure of any species (Bekoff 1977; Byers 1984; Fagen 1981; Meaney *et al.* 1985; Smith 1982 *IN* Pike *et al.* 2008). These influences will affect the Peterborough Zoo otters, as these characteristics apply to wild or captive animals.

As northern river otters are flexible and hardy they are very suitable to zoos and aquariums for exhibits. Due to the behavioural phenotype of the northern river otter, it is crucial that both physiological and behavioural requirements are met. With a comfortable environment, including adequate food and known security in their habitat, captive otters may indulge in playful acts more often than wild otters due to the availability of resources and security, (Melquist and Dronkert 1987 *IN* Petrini *et al.* 2008).

The welfare of animals has been used throughout biological studies at zoos and aquariums though it does not have a particular definition, and therefore is not consistent (Broom and Johnson 2000 *IN* Hill and Broom 2009). Within Hill and Broom's (2009) study, the ability for an animal to 'cope' with their captive environment is considered, based on their individuality. Pools of fresh, clean, deep water for swimming, diving and playing increase the 'welfare', or well-being of Northern river otters, as well as sufficient land area for exploration and dry, clean shelters with clean, dry bedding are essential for their minimal well-being (Crandall 1964 *IN* Petrini *et al.* 2008).

Environmental enrichment and husbandry training are utilized to enhance the lifestyle quality of captive animals (Mellen and Ellis 1996 *IN* Mellen and MacPhee 2001). The aspect of enriching the physical and social environment of a captive animal has been practiced since the early 1900's (Yerks 1925; Hedgier 1905 & 1969 *IN* Mellen and MacPhee 2001), however, enrichment has often been a reactive approach; a method of adding new entities to an exhibit and assuming it will motivate the individuals in the exhibit. Enrichment requires a holistic approach by developing a proactive program using the animal's natural and individual histories in accordance to their specific exhibit. As each animal will have a unique background its previous experiences will influence its reactions to physical and psychological enrichment. The tolerance and flexibility of northern river otters is quite high (Broom and Fraser 2007 *IN* Hill and Broom 2009), as both its evolutionary influences (genotype) and its natural habitat have majorly influenced its behavioural phenotype, and its motivation (Sachser 2001 *IN* Hill and

Broom 2009). Necessities of an individual Northern river otter in an captive exhibit must be met with appropriate conditions, as the response of efforts to improve its 'welfare', important opportunities for change in living conditions, ability to socialize intra-specifically in sex and varying ages, and strategy by which they respond to enrichment must be observed and recorded in behavioural monitoring. Animal 'welfare', aims to relieve captive animals from known stressors, and through behavioural monitoring, specific hypothesis, predictions and goals can be made for useful enrichment.

The goals of managers for exhibits, including the Peterborough Zoo, may change over time, pending the goals, deduced by preceding observations by zoo keepers. The otter pair at the Peterborough Zoo is a breeding pair; however, they have not produced progeny, so goals include identifying potentially stressful situations for either otter. By creating the appropriately enriched environment, successful breeding may occur. By reducing any stress and promoting active behaviour will also gain interest from visitors (Hutchins *et al.* 1984; Kreger *et al.* 1998 *IN* Hutchins and Thompson 2008) another goal of the zoo keepers to maintain.

Ranges of disciplines studies within zoo environments have included behaviour, nutrition, genetics, reproductive physiology, pathology, veterinary medicine, autecology, wildlife management and landscape ecology (Hardy 1996; Hutchins and Conway 1995; Hutchins *et al.* 1996; AZA 1995-2005 *IN* Hutchins and Thompson 2008). Majority of studies have used the "ad hoc" approach with independent research at one institution (including this river otter study at the Peterborough Zoo), with broad mixtures of applied research. However, in order to appropriately execute applied research on captive animals, basic research on the fundamental questions concerning each animal's physical and psychological health must be addressed over time in order to have accurate controls (Hutchins 2001 *IN* Hutchins and Thompson 2008). Though my study in fact carried on without specific goals deduced from previous knowledge of the otter's background information, this information was gathered and will be utilized in discussing how my experiment affected the outcome of my study. The individual otters, Splish and Splash, were introduced to the Peterborough Zoo in 2007. Splish (male) was purchased from British Columbia, and Splash (female) from Winnipeg, so their backgrounds differentiate. Both were wild born, though both original sites are unknown.

The water bottle used for stimulation was one of many choices offered by studies (Petrini *et al*. 2008; Mellen and MacPhee 2001; Gabbert 1999; Heap *et al.* 2008) for their physical environment. Other forms of stimulation have included food or occupational enrichment, which are referred in the appendix. The water bottle provided a simple, inexpensive and effective item that could be easily observed within the exhibit viewing area. Wells (2009) has suggested olfactory and auditory enrichment, though this was non-optional in a limited time span.

A formal protocol has been created called "Methods for Behavioural Assessment" (Carlstead and Kleiman 1998; Carlstead 2000; Shepherdson and Carlstead 2001 *IN* Watters *et al.* 2009); a recommendation to read before proceeding with another study such as this. Without consistency and objectivity of goals in behavioural hypothesis credibility is lost. My study maintained credibility by understanding the definitions of the behaviours to look for however, the hypothesis undertaken was rather broad due to unknowing specific tendencies of each otter. The importance of my qualitative analysis displays the importance of recoding anecdotal observation, which may interpret changes in behaviour.

My investigative variables included wrestling, grooming, resting, playing in designated areas within their exhibit, and playing with their available toys on land and in water. Considering authors including Beckel (1991) have found Northern river otters to increase their socialization subsequent to interacting with new items in their environment, the introduction of a new item to the otter exhibit here in Peterborough should produce similar results. For scientific research to play important roles in zoo and aquarium animal care and conservation, it must rely on accurate and consistent quantitative evidence which can address particular issues, or have the ability to yield immediate results for managerial actions for either the specific animals at the institution, or on a larger and more useful scale, across institutions (Thompson 1993; Hutchins 2003 *IN* Hutchins and Thompson 2008).

## METHODS

Using a mixed method, qualitative notes were made regarding behaviours when separate in the exhibit (individually), when interacting together but reacting in different manners (paired up) and displaying the same behaviours when interacting with each other

(together). For quantitative analysis, I designed a table where the frequencies of specific behaviours were tallied, based on the associating description of the behaviour.

This study took place over two days. The first day, October 26th, qualitative notes were recorded concerning the two river otters' general behaviour. These remarks included overall behaviours noticed throughout the duration of observation, and were subjective in the sense that repetitive behaviours were most often acknowledged. These acknowledged behaviours became the study control as routine behaviours. Pending on the behaviour observed, start and end times for resting (napping), and looking out the windows prior to feeding time, indicative of typical behaviour, were recorded.

Their behaviours were tallied based on their frequency. Each time an otter displayed this behaviour, it was tallied once, regardless of sex. If the female otter jumped off of a rock into the water, a jump was tallied once. If she glided across the pool using her hind legs for propulsion, began undulating using her hind legs then switched back to gliding using her forelimbs, undulation and use of forelimbs were tallied once, while the act of gliding and using her hind legs for propulsion were tallied twice. Please refer to the appendix for the data tables utilized and records taken.

On October 27th, 2010, the same analytical procedure was done, though prior to the otters released after breakfast the zoo keeper threw the circular water bottle, purchased from Water Depot, chained to an 8" cinder block into their main pool area. For the first ½ hour of observations, I made mental records of behavioural frequencies due to the multitude of changes in qualitative observations due to the water bottle's presence.

Qualitative and quantitative data recorded the first day served as controls. Controlled variables during the mixed methods approach included the time of day and duration the otters were observed. This included one hour in the morning (8:15 am to 9:15 am) when released after breakfast, and three hours in the afternoon (12:30 pm to 3:30 pm), which included one hour before lunch and two hours thereafter. Other control variables included the item (water bottle), its location for viewing the otters activity (direct access from the viewing area), the size of the otter's exhibit, it's land to water ratio, levels of habitat and other items available for play. To maintain consistent observations, I remained on the main floor of the otter's exhibit while my partner Tyler

observed the top level of the exhibit so behaviour was consistently monitored. These tallies were based on five broad behavioural categories (Table 1).

This data was collected in a multinominal fashion, known as a "goodness of fit" test, where only one variable (the behaviour of both otters) is being tested against a variety of categories, of which the frequency of the behaviours observed assumes a uniform distribution. If the data were collected based on gender, it would have been a contingency experiment.

**Table 1**. Descriptions of the different behavioural categories observed during this experiment.

| BEHAVIOUR CATEGORY | DESCRIPTION |
|---|---|
| General Positive | Grooming, main location of grooming, touching noses, rubbing bodies, face pawing, general interaction, playing in the water, playing on land, wrestling, rolling, playing with toys, marking, anogential sniffing |
| General Negative | Grooming attempt rejected, mounting rejected, fighting, screeching |
| Swimming | Undulation, paddling, diving, tight maneuvers, sliding, gliding, climbing, use of vibrissa, playing in the top pool |
| Vocalization | Chirping, laughing, purring, coughing or grunting |
| Feeding | Location, capture technique, playing with food, diet for day, use of vibrissa |

## RESULTS

I described the qualitative, noted activities observed in water, as well as on land, during both days of this mixed method study based on those frequented behaviours tallied (*Table 2*).

**Table 2.** Full description of all behaviours analyzed.

| LOCATION | INTERACTION LEVEL | ACTION | DESCRIPTION |
|---|---|---|---|
| **Activities In Water (Swimming)** | In Water with Each Other | Playing with toys in water | Mouthing, biting, pushing and pulling available toys which included dog throw ball, play rope, swimming ring, box on land, tennis ball and floating driftwood |
| | | Wrestling-chasing by gliding | Chasing each other by gliding; included some physicality |
| | | Wrestling- full interaction | Gripping each other, mouthing, clawing, rolling around each other |
| | | Playing- awaiting meal time | Jumping off their rock wall, gliding faster and peering out the windows awaiting their |

| | | | |
|---|---|---|---|
| | | | known meal time (began at least 1 hour previous to lunch time) |
| | | Paddling on the surface | Using their hind legs with their head above the water, their tail slightly elevated |
| | | Playing – top pool | Playing with the large quantity of driftwood laying and floating in the top pool; would occasionally wrestle in full interaction in the pool |
| | Own Time in Water | Foraging on bottom of tank | Using their hind legs to move around bottom of main level pool, as well as undulation as described by Fish (1994) moved cobble and boulders using their muzzles |
| | | Paddling on the surface | Using their hind legs with their head above the water, their tail slightly elevated |
| | | Playing with toys in water | Mouthing, biting, pushing and pulling available toys which included dog throw ball, play rope, swimming ring, box on land, tennis ball and floating driftwood |
| | | Catching food | Catching their smelt lunch with their mouths, followed by Splash (male) climbing on the floating driftwood to eat and Splish (female) climbing upon a different piece of land to eat |
| | | Playing in the Top Pool | Playing with the large quantity of driftwood laying and floating in the top pool; would occasionally wrestle in full interaction in the pool |
| | Interactions With Visitors | Playing due to visitor's presence | Making tight maneouvers, pushing their muzzle and nose against the viewing glass, gliding faster and undulating more frequently when glass is tapped by young children |
| | | Playing- awaiting meal time | Jumping off their rock wall, gliding faster and peering out the windows awaiting their known meal time (began at least 1 hour previous to lunch time) |
| **Activities on Land** | Interactions on Land | Resting- making rest area | Both otters resting together in den below eastern white cedar bush towards back of exhibit near driftwood |
| | Own Time On Land | Using their latrine | Urinating in the same spot with tail elevated substantially while sweeping their feet |
| | | Eating- Munching down on solid surface | Each otter eating during lunch time, eating on their own in their own location |
| | | Time separated by own activities | Foraging on land for insects, etc<br>Observing the surrounding area<br>Grooming on driftwood |

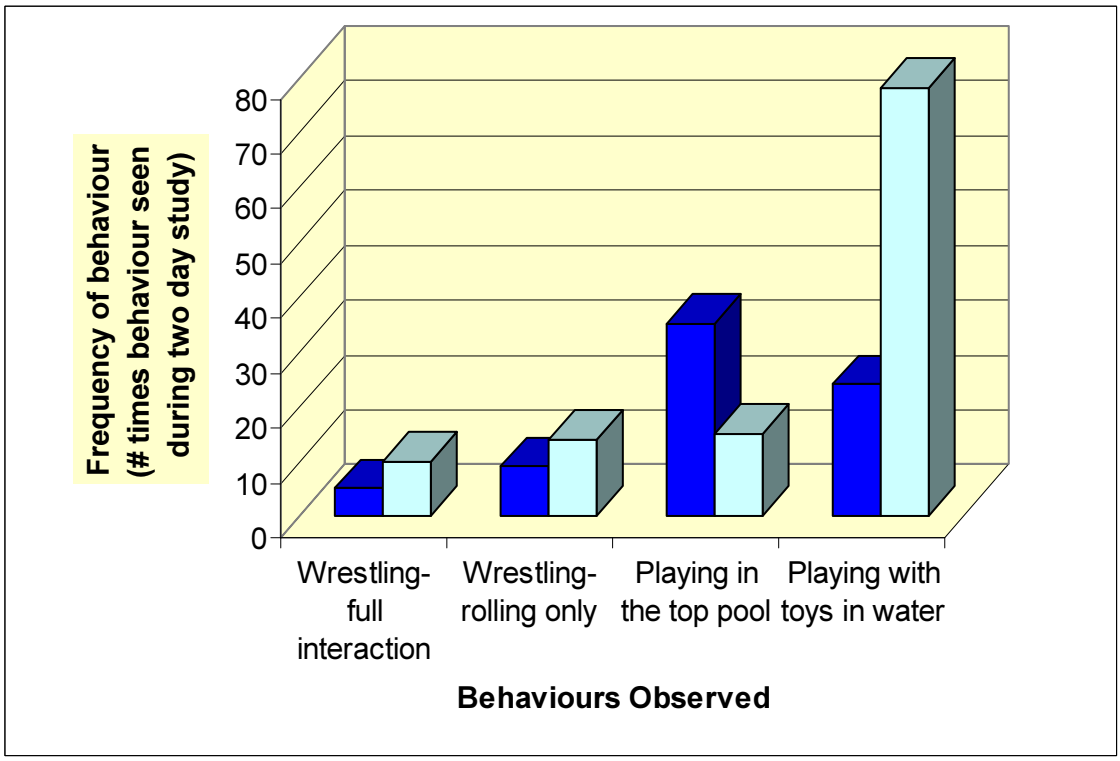


**Figure 1**. The frequency of the behaviours observed, including wrestling (full interaction and rolling only), playing in their top level pool and playing with toys in the water compared against the control day (dark blue) and experiment day (light blue).

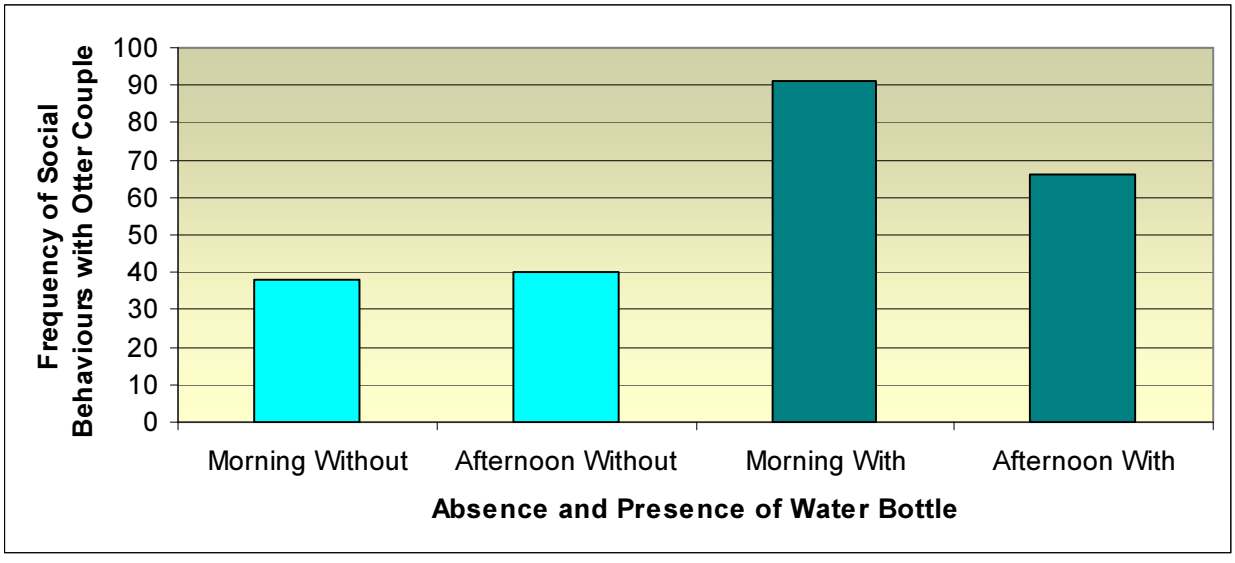


**Figure 2**. The frequency of the four broad social behaviours (both forms of wrestling, playing in the top pool and playing with toys) combined observed in the morning hour and three hour afternoon of the control day and experiment day.

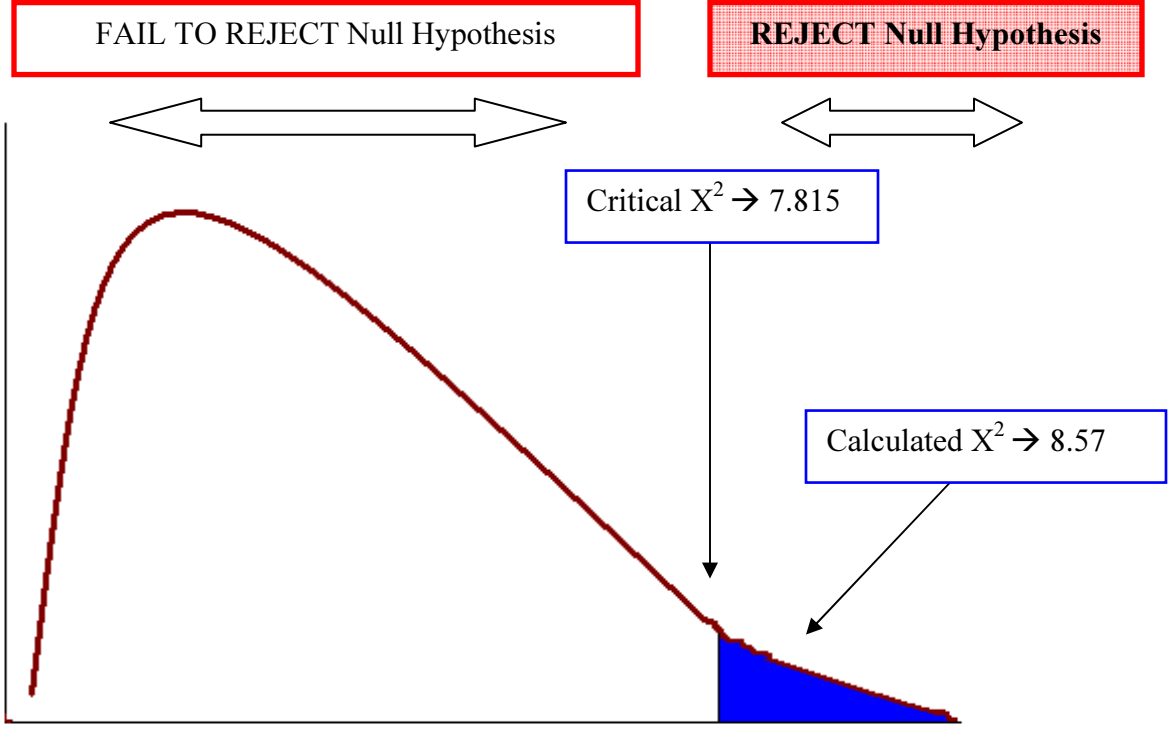


**Figure 3**. Diagram visually portraying the statistical significance of this experiment, with the $X^2$ value of 8.57 being greater than the critical value of 7.815. This indicated that the observed behaviours were found due to something more than just chance.

Descriptively, this study used nominal, count data. The otters played in the top pool 15 times; rolled together 14 times in the water and 10 times on land; played with their toys on both land and in the water 78 times during the observations day. Visually, and using a chi-squared to compare the frequencies tallied of the following behaviours (*Fig. 1*): wrestling (full interaction), wrestling (rolling only), playing in the top level pool, playing with available toys, gliding and undulation.

The rest of the categories, including gliding and undulation, were not considered social interaction, and were tallied inconsistently, and therefore not included. The frequency of the four, broad behaviours during the first day of observation (control) was compared to the expected (water bottle introduced). The frequency of wrestling (full interaction and rolling only), as well as playing with other toys available in the water, listed in the qualitative results, increased, while the frequency of times the otters visited their top level pool decreased. Both otters would visit the top pool simultaneously (together) (*Fig. 1*).

The frequency of the four broad social behaviours observed, when combined together were compared against the morning hour observed and the three hours during the afternoon. Both the morning and afternoon with the water bottle in the main level

pool display an increase in the combined social activity of Splish and Splash compared to the behaviours displayed during a typical day (*Fig. 2*).

Including gliding and undulation, there is no significant difference, statistically, with a 95% level of confidence. Symbolically, $0.05 > P > 0.025$ (d.f. = 3, $X^2 = 8.57$) (*Fig. 3*).

## DISCUSSION

The null hypothesis is rejected, and the alternate hypothesis stating that an increase in positive social interaction would be observed was found through statistical significance from a chi-square test.

Qualitatively, I observed the general daily frequency of behaviours, providing a baseline, though changes often occur. Wilson (1998 *IN* Bell 2007) found that individuals of different sex, age and differ often have various behavioural differences within a species. As these behaviours become a constant activity, like those observed with Splish and Splash, they become part of their behavioural syndrome, or personality (Sih *et al.* 2004 *IN* Bell 2007).These behaviours, known as covariates, are factors which can change, and will provide statistical differences if measured appropriately (Watters *et al.* 2009). These actions observed between the pair included consistent rolling of the female as she followed the male, as the two paddled around their main level exhibit, followed by hind leg propulsion and gliding by the viewing area. They would jump into the main pool together after foraging on vegetation, gliding, paddling and undulating. I would not consider these behaviours as those seen typically in zoos due to repetitious routine, as they patterns did not follow each other in a consistent order. Their exhibit overall reflects positive well-being with adequate food, shelter and watering. These behavioural events selected for this experiment may vary seasonally (fall, for this study), and temporally (two days) (Watters *et al.* 2009). The level of detail can fluctuation pending the researcher (rather detailed in my study), however, it does not allow for subtle changes to be detected.

These exploratory and aquatic actions are due to the plasticity of the Northern river otters (Bell 2007), however, the standard of the ‘natural’ behaviours will fluctuate pending the exhibit, and the background of the individuals. Particular features of the environment will motivate behaviours (Newberry 1995). The purpose of my study aimed

to quantify and qualitatively describe those 'natural' behaviours displayed by Splish and Splash, based on their particular exhibit. The behaviours I chose to tally were taken from a similar study done by Hansen *et al.* (2008), where behaviours were analyzed qualitatively to research the social networks between 15 captive otters. These behaviours were found as potentially important covariates for quantitative analysis (Watters *et al.* 2009). Not all behaviours were statistically analyzed due to inaccurate tallying.

Behavioural development through play is a growing field known as ethology, with key interests in sociobiology, evolutionary psychobiology and developmental behavioural ecology (Fagen 1981). Though play is often associated with immature individuals, the causation and motivation of play are important with age, sex, habitat, and species to describe their evolutionary strategies (Fagen 1981). The motivation of play depends on the context of the situation; whether the enrichment item will appropriately stimulate depending zoo keeper goals, and if social interactions observed will vary pending their experiences. This was evident between Splish and Splash. Play is based upon factors including frequency, duration, composition, sequences, intensity, variability, diversity, stability, simplicity, complexity, interactiveness, elaboratness, cooperativeness, reciprocity and intricacy of the social interactions (Fagen 1981). All of these variables are important, and should be investigated in future study. In error, they were not all considered within my study, due to time limitations, and not all the behaviours that were tallied were included due to inconsistent methods of tallying each behaviour.

Characteristics of Northern river otters, both genetically and behaviourally, provide a direction for quantifying social interactions, pending the frequencies and benefits of behaviours. Causal play is a difficult subject to quantify using multivariance analysis, which identifies one or more factors corresponding with play. This will depend on the sampled species, the technique used, the environment (exhibit) and assumption that a temporal correlation will dictate shared causal factors. Various activities are motivated in various sequences, and lack of motivation also biases behaviours. Similar age and size of animals will also bias mulitvariance analysis, as individuals have a greater probability than found by chance alone of playing together (Altmann 1962; Cheney 1978; Dnbar and Dunbar 1975; Fady 1969; Fagen 1974; Levy 1979; Owens 1975; Rasa 1977; Schaller 1972; Soczka 1974 and Symons 1978 *IN* Kubar 2006), as similar competency

and capabilities of each animals provides positive cost benefits in quality of play, degree of physical interaction, continuous play and amount of reciprocation. This was displayed between Splish and Splash as both initiated wrestling and tussling equal amounts, though it may have depended on different motivational circumstances causing my results to be biased, as the motivations of each animal were unknown.

Kuhar (2006) provides important discussion and detailed analysis of the statistical challenges for zoos and aquariums during research to successfully quantifying data based on very small sample sizes, and the tendency to pool data from various institutions. With enclosures and populations often consisting of pairs or families, it is difficult to maintain statistically consistency.

The independence between samples and/or observations, with no two samples more alike than the other is critical for successful hypothesis testing and the scientific method, as a component of random sampling (Todman and Dugard 2001 *IN* Kuhar 2006). Through meta-analysis of zoo related statistically research from 2000 to 2004, Kubar (2006) found inferential statistics including parametric ANOVA and t-tests, and non-parametric chi-square goodness of fit tests often used. This supports my chi-square test for a small sample size. Though many studies can not help violating independence and normal distribution due to small sample sizes, this can cause Type 1 errors where a significant difference is found, though it does not exist. This may have occurred within my study, due to an inconsistent method of tallying. Certain behaviours may have been observed due to human influence, skewing my data by tallying as natural behaviour. However, significance values are based on a combination effect by comparing the number of pooled information over time rather than each days worth, which my study utilized and successfully achieved a significant difference (Kubar 2006). Shyne (2006) also performed meta-analysis on 54 zoological studies, determining that proper enrichment significantly reduces ‘stereotypic’ behaviour, allowing increased growth of opportunities in varying behaviour in captivity.

40% of past studies pooled data through pseudoreplicaiton, and did not indicate the implications of gathering data from different sources, including difference in exhibit size, materials available to the otters, volume of visitors, and time spent with the otters by zoo keepers for health and enrichment purposes (Machlis 1985 *IN* Kuhar 2006). Only

26% provided degrees of freedom, indicating how many variables they looked at. Indicating implications that may cause varying environments between exhibits at different zoos must be acknowledged, as well as the degrees of freedom in future statistical analysis in zoo research. The Northern river otters at the Peterborough Zoo will share environmental characteristics influencing their behaviour based on their setting, however, they will not be similar to those at other zoos necessarily, and this must be taken into account. This is where a rapid assessment tool would be handy in order to gain consistent data across institutions.

As behavioural monitoring is a useful tool for guiding husbandry and directing research, it's a baseline for understanding important influences of individuals in a zoo exhibit. Its significance has been confirmed in surveys conducted by Finlay and Maple (1965 *IN* Watters *et al.* 2009), and Stoinski *et al.* (1998 *IN* Watters *et al.* 2009) confirms that zoo based research has involved behavioural studies since the 1980's. By monitoring changes over time, important fluctuations can be detected.

Behavioural monitoring is not only limited to specific behaviours, but diet, enrichment practices and visitor attendance. The all fish diet provided for the otters, which is frozen, is similar to those of other institutions where appropriate minerals are substituted for lack of fresh fish (Petrini *et al.* 2008). As well, I observed the otters increase in activity with visitor presence due to their curious and playful nature.

Mellen and MacPhee (2001) provide context to rate behaviours as part of behavioural monitoring programs through direct and indirect evidence, enabling zoo keepers to make specific goals in which predictions can be clearly established due to the previous knowledge and information recorded. Determining the levels for each animal for each enrichment item determines, on a Likert scale, the achievement of the item. Directly, Splash was a Level 5 with repeated and sustained contact, while Splish moved from a Level 2, appearing to ignore the item, to Level 4, making brief contact with the water bottle far after the female as maintained contact. Indirectly, Splash made significant indirect contact, and Splish moderate interaction. As for the intended behavioural observations made based on my enrichment initiatives, I achieved a Level 4 with moderate reaction, as otters reacted immediately to object, keep reacting to water bottle, wrestle a few times after time as past by, stimulated to play with other toys nearby). Refer

to the appendix for this full Likert scale provided. Ideal for busy zoo keepers, however, as previously mentioned, it can only be used as a rapid assessment tool once a thorough assessment of the individuals basic behaviours have been analyzed (holistic approach). An issue concerning this method includes the fact that otters may not show distinct, continuous behaviours necessary for rapid assessment. However, if a detailed study was preformed across Ontario using scientific methodology, a rapid assessment tool may be plausible. Hoy *et al.* (2010) also provide information on enrichment practices and how they have improved over the past thirty years.

An important use of rapid assessment tools, in which my study recommends, enables specific goals of zoo keepers, and for the Peterborough Zoo, reproductive success. Cost benefits are important factors in reproductive success. Interestingly, the amount of time spent resting after interaction with the water bottle increased compared to the control, indicating an increase in energy necessary to interact with the item. However, it also increased the intensity and duration of wrestling between the pair. If play allows partners to maintain physical fitness and increased interaction in general, it may provide the necessary degree of body contact, in combination of dietary enrichment provided, to promote reproduction. As well, an increase in play has determined an increase in survivorship, and though in captivity, animals still wish to mate with strong mates to produce strong, healthy progeny. By promoting wide ranges of opportunities for this otter couple, through cardio, social interactions, and stimulation (King and Norwood 1989 *IN* Newberry 1995), they may reach reproductive success.

## CONCLUSION

Recent surges in concepts in behavioural management (Sih *et al.* 2004 *IN* Bell 2007) are working to produce analytical tools to compare individuals in a species in essence of evolutionary biology (Steppan *et al.* 2002 *IN* Bell 2007). Stable data is necessary to understand the influences on behavioural syndromes and frequencies observed within and across institutions (Bell and Stamps 2004 *IN* Bell 2007). Bell (2007) finds that differences between groups and individuals found using methods, like mine, find how boldness, aggressiveness and the relationship between these differences across groups in reaction to enrichment based on past individual experiences and their local

setting. These may provide appropriate null hypothesis's for behaviour's studied on '*a priori*' basis on behavioural independence (Melle and MacPhee 2001).

Future studies require qualitative monitoring on individual animals, followed by quantitative measurements through rapid assessments to describe theoretical factors contributing to individuals maintaining behavioural differences, which may be improved due to enrichment. Earnhardt et al. (2001) provide useful information for managing pairs and populations for genetic variability. For our otters at the Peterborough Zoo, it would be useful for the zoo keepers to increase behavioural monitoring in order to assess appropriate enrichment items, enabling reproductive success for Splish and Splash. The new item may even provide success for reproduction in early spring of 2011 (Liers, 1951).

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