EFFECTS OF INCREASED FEEDING FREQUENCY ON CAPTIVE NORTH AMERICAN RIVER OTTER (*LONTRA CANADENSIS*) BEHAVIOR

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ABSTRACT

EFFECTS OF INCREASED FEEDING FREQUENCY ON CAPTIVE NORTH AMERICAN RIVER OTTER (*LONTRA CANADENSIS*) BEHAVIOR

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Manipulating captive feedings to resemble natural conditions can be highly effective in promoting species-typical foraging behaviors and patterns, thereby improving welfare. Despite its potential importance and relative ease of implementation, meal frequency is rarely considered in captive management strategies. North American river otters (*Lontra canadensis*) are a common species in North American zoos and provide an excellent subject to investigate feeding frequency questions. Wild otters spend large amounts of time foraging and consuming numerous small meals daily. Higher activity levels might be associated with increased meal frequency and decreased resting behavior in captivity. In this study, behavioral responses to a number of factors were considered. While no behavioral responses to meal frequency were detected, other feeding-related variables could have obscured potential effects. Additional variables were found to significantly affect behavior. The time of day appeared to influence behavior *via* external factors, such as the zoo-going public which was associated with decreased resting and increased stereotypic behavior. Precipitation could provide unplanned, beneficial stimulation for amphibious animals such as otters. Finally, individual behavioral variation was used to aid interpretation and highlight the importance of accounting for animal individuality.

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I. INTRODUCTION

This study's objective was to determine whether increased feeding frequency beneficially affects captive river otter (*Lontra canadensis*) behavior, thereby improving welfare. Traditionally, scientific approaches assessing animal welfare have been classified into three main areas: physical health and functioning, affective state, and ability to live and behave in a species-typical fashion (Duncan and Fraser 1997, Fraser *et al.* 1997, Fraser 2009). This third area is often of particular interest to zoos and aquariums. Zoo animals displaying natural behaviors can aid in fulfilling the primary goals of modern zoos: research, conservation, education, and recreation. Simulating wild conditions in captivity is a common strategy used to stimulate natural behaviors.

Obtaining and consuming food is an important survival activity for all animals. Simulating natural conditions to promote species-typical foraging behavior could be a particularly effective strategy to improve welfare (Lindburg 1998). This has been accomplished through manipulating the presentation (Carlstead and Seidensticker 1991, Shepherdson *et al.* 1993), predictability (Hawke *et al.* 2000, Jenny and Schmid 2002, Kistler *et al.* 2009), and/or meal frequency (Shepherdson *et al.* 1993).

Meal frequency studies have reported a variety of findings. Increased feeding frequency has been associated with higher activity levels in chickens, though the authors noted this activity resembled stereotypic pacing (de Jong *et al.* 2004). Conversely, restricted feeding in mink is associated with increased stereotypic behavior (Bildsøe *et al.* 1991, Damgaard *et al.* 2004, Hansen and Møller 2008), while increased meal frequency resulted in decreased oral-related stereotypies and increased feeding-related behaviors in horses (Cooper *et al.* 2005).

Shepherdson *et al.* (1993) reported that increased meal frequency decreased stereotypic pacing and increased diversity of the behavioral repertoire in small felids. These results were not significant, however, until meals were hidden throughout the cats' enclosure. The diversity of findings warrants further investigation of similar questions for additional taxa held in zoo environments. Therefore, this study examined captive behavioral effects of increased feeding frequency for a close relative of the mink, the North American river otter (*Lontra canadensis*).

River otters are found in rivers, lakes, marshes, estuaries, and sea coasts throughout North America (Foster-Turley *et al.* 1990, Reed-Smith 2008). Their high natural activity levels and propensity for play behavior make them attractive additions to zoos (Beckel 1991, Stevens and Serfass 2005). The Association of Zoos and Aquarium's (AZA 2009) North American River Otter Population Management Plan records 245 individuals housed in 99 accredited facilities across North America. Though once threatened throughout their range, hunting bans and translocation projects have improved the river otter's status and the International Union for Conservation of Nature (IUCN) now lists them under Least Concern (Foster-Turley *et al.* 1990). To avoid stressing wild populations, zoos are attempting to sustain captive breeding populations, though low breeding success makes this difficult (Bateman *et al.* 2009). Better captive management could result in improved breeding for this species (Duplaix-Hall 1975, Carlstead and Shepherdson 1994).

North American river otters are primarily piscivorous, single-prey loaders, consuming each prey item as it is caught (Houston and McNamara 1985, Davis *et al.* 1992). Wild river otters spend a great proportion (41-62%) of their time foraging, eating many small meals daily (Duplaix-Hall 1975, Melquist and Hornocker 1983, Hoover and Tyler 1986). Compared to wild river otters, captives can be fed as few as two meals per day (pers. obs.), though the AZA's Small

Carnivore Taxon Advisory Group (TAG) recommends feeding at least three times per day and four to five times if possible.

This study was designed to evaluate the TAG recommendation by assessing behavioral effects of meal frequency. Pertinent literature on the topic was reviewed, before describing and presenting results of an original empirical study. Based on a common zoo practice of feeding two to five meals per day, a mixed effect regression model was developed. Higher meal frequency was similar to wild conditions. Therefore, higher activity levels were predicted to be associated with increased meal frequency and decreased resting and stereotypic behavior.

Additional variables with potentially important behavioral effects were considered. Visitor presence could be stressful and/or disruptive to river otters, decreasing resting and increasing stereotypic behaviors (Birke 2002, Carlstead and Brown 2005, Mallapur *et al.* 2005). Wild river otters are crepuscular and nocturnal (Melquist and Hornocker 1983). Thus, time of day could have important captive behavioral implications as zoo visitors and feeding times could disrupt natural sleep patterns. Finally, captive animals have limited control over microhabitat selection, making them especially prone to weather- and temperature-based disturbance (Chamove and Anderson 1989, Morgan and Tromborg 2007, Anderson and Williams 2010).

II. LITERATURE REVIEW

Animal welfare:

Welfare, in its broadest sense, refers to an animal's quality of life (Duncan and Fraser 1997). Welfare is not a purely scientific concept, and currently no one clear all-encompassing definition exists. Animal welfare involves both ethical concerns and subjective judgments (Duncan and Fraser 1997), meaning no two people are likely to fully agree on how it should be assessed, and how strongly certain features should be weighted. It can best be described as a continuum running from good to poor, encompassing a variety of approaches aimed at promoting well-being, most of which can be organized into three main areas (Duncan and Fraser 1997).

The first involves basic animal health and functioning. Broom and Kirkden (2004) define welfare as it relates to the animal's ability to cope with its environment. Disease, injury, starvation, social interactions, housing conditions, husbandry procedures, and veterinary care can all potentially challenge an animal's ability to successfully cope (Broom and Kirkden 2004). If the individual is unable to cope, or can only cope with difficulty, its welfare is compromised, as manifested by a variety of physiological and behavioral symptoms.

One such symptom is an increase in stress level, defined by Broom and Kirkden (2004) as "an environmental effect on an individual which over-taxes its control systems and reduces its fitness or seems likely to do so." When an animal perceives or experiences stimulation, glucocorticoids are released as part of the hypothalamic-pituitary-adrenal (HPA) response. Glucocorticoid levels in blood, feces, or saliva provide a useful quantitative measure of stress level experienced by an individual, though such data must be carefully interpreted (Broom and Kirkden 2004). Glucocorticoid increases in response to acute stress are not necessarily negative and can often be adaptive coping responses. For example, acute stress and physiological arousal

are associated with increased exploratory behaviors, increased foraging behaviors and enhanced spatial memory (Luine *et al.* 1996, Saldanha *et al.* 2000). Chronic stress, however, can have significant functional repercussions, leading to weight loss and anorexia (Harris *et al.* 2002). Chronic stress can also impair immune function by reducing circulating lymphocyte and eosinophil numbers and by suppressing both B cell and cytotoxic T cell activity (Gillis *et al.* 1979, MacDermott and Stacey 1981, Griffin 1989).

Measuring physiological stress is not the only welfare assessment tool available. Scientists can employ methods from veterinary epidemiology and pathology to assess health (Fraser 2009). For example, mastitis in cows was more common when cows must lie on hard surfaces while the metabolic disease "milk fever" was reported less common in indoor systems compared to pasture systems (Ekesbo 1966). Tauson (1998) reported that certain cage designs were associated with lesion development and feather damage in hens. Additionally, reproductive success, mortality rates, and growth rates can provide useful welfare assessment information (Adams and Craig 1985).

The second main welfare assessment approach involves inferring an animal's affective state. Positive states such as comfort and contentment tend to be sought after by animals, while negative states such as fear, suffering, and frustration are avoided (Dawkins 1990). The capacity for animals to experience emotions can be inferred *via* analogy (Dawkins 1990). Since behavioral and physiological similarities exist between humans and non-human animals, non-human animals as well are likely to experience emotions. Though once considered outside the realm of behavioral sciences, recent years have seen a resurgence in attempts to study affective states as legitimate biological phenomena (Duncan and Fraser 1997).

Welfare scientists have devised methods to empirically study affective states. The key is

in determining behavioral indicators that reveal subjective experiences (Dawkins 1988). For example, in motivation testing an animal must work to either gain access to a resource or end an irritating stimulus (Dawkins 1988). This method assumes animals will work harder to escape unpleasant experiences or obtain access to desirable or necessary resources than they will for neutral experiences or resources. Need can be determined by using demand curves to measure motivational strength to obtain a commodity (Dawkins 1988). Demand curves plot the rate at which demand for a commodity declines as cost to obtain it increases. Cost can be raised by increasing required work to obtain commodity access (Dawkins 1988). For example, how heavy a door will an animal push through to gain a resource? Animals will demonstrate inelastic responses to needs (e.g. food and water) while more elastic responses will be observed for lower priority commodities (Dawkins 1988).

The final approach to studying welfare is based on an animal's display of ability and opportunity to express species-specific behaviors (i.e. natural living). This approach assumes animals are strongly motivated to display adaptive behaviors important over evolutionary time (Dawkins 1990, Hill and Broom 2009). Welfare issues arise when there is a disconnect between an animal's adaptations and challenges posed by captive environments and management practices. Many behaviors critical for survival or reproduction in wild environments are unnecessary in captivity (e.g. migration or predator avoidance of zoo-going public), though captive animals can still be highly motivated to express them (Dawkins 1988).

Inability to perform strongly motivated natural behaviors can lead to chronic stress and frustration, both of which are associated with increased abnormal behavior, coprophagy, and/or agonistic behavior (Diezinger and Anderson 1986, de Monte *et al.* 1992, Maestripieri *et al.* 1992, Carlstead 1998, Castles and Whiten 1998). Examples of abnormal behavior include stereotypies,

vacuum activities, and rebound effects. Stereotypies are repetitive, invariant behaviors without functional purpose (e.g. pacing). Stereotypies might be redirected forms of natural behaviors an animal is unable to express in captivity or their modified expression (Mason and Latham 2004, Mason *et al.* 2007). Stereotypies will be discussed more in depth later. Other common abnormal behaviors include vacuum activities, in which animals attempt to express a behavior despite lacking appropriate conditions (e.g. chickens "dustbathing" without substrate) (Vestergaard *et al.* 1999), and rebound effects, in which animals express a behavior at greatly increased frequency after being prevented from performing it for some time (Nicol 1987, Vestergaard *et al.* 1999).

Observed wild behavior and natural history data can be used as guides in determining important environmental features of a species' natural habitat. For example, Clubb and Mason (2007) compared carnivores that fared well in captivity to those that did poorly to identify important natural history factors that could predict captivity problems. The authors found that wild ranging behavior correlates with observed pacing time in captivity, and home-range size and body weight together could be used to predict levels of stereotypic behavior. Clubb and Mason (2007) were able to offer several suggestions to zoos to help aid carnivore species in captivity, such as providing multiple den sites, increased space, and enhanced control over stimulus exposure. In another study, Brummer *et al.* (2010) determined that captive coyotes (*Canis latrans*) kept in larger enclosures behaved more similarly to wild populations.

Not all wild behaviors are necessarily desirable in captivity. Predator avoidance behaviors, for example, are associated with increased stress levels and could result in potential injury as an animal seeks to flee a perceived predator. Additionally, if a particular behavior is not expressed, it might not result in decreased welfare. If the stimulus that prompts a behavior is absent, there could be no motivation to perform the behavior (Dawkins 1990). Furthermore,

captive animals might adjust to their captive environment and not need to express their entire behavioral repertoire (Dawkins 1990). Rather than focusing on all possible behaviors, Duncan and Fraser (1997) suggested focusing on conditional rules by which animals determine behavior. If an animal experiences hunger, discomfort, or anxiety, ideally it should be able to address this deficiency *via* behavior (Duncan and Fraser 1997).

None of the previous three welfare approaches (health and functioning, affective states, and natural living) are mutually exclusive. An individual's true well-being can best be assessed utilizing multiple measures (Duncan and Fraser 1997, Fraser 2009). For example, relying solely on stress measures could lead to misinterpretations, as elevated glucocorticoid levels could be associated with positive stimuli and behaviors such as play (Luine *et al.* 1996, Saldanha *et al.* 2000). Further complications exist when these approaches contradict each other. A physically healthy animal could still express stereotypic behaviors (Broom and Kirkden 2004). At this point, a value judgment must be made about which criteria should be weighed most heavily when assessing welfare (Fraser 2009).

Welfare considerations by zoos and aquariums:

Ensuring captive animal welfare is a primary goal of modern zoos and aquaria (Seidensticker and Forthman 1998). This can be a difficult undertaking because animals in zoos are confined in exhibits smaller, and far less complex than wild environments to which they are adapted (Chamove and Anderson 1989, Mason *et al*. 2007). Furthermore, despite veterinary care and protection from predation and starvation, zoo animals still show high infant mortality, low conception, and poor adult survivorship rates, potentially indicating chronic stress (Clubb and Mason 2007). Additionally, many animals perceive sights, sounds, smells and other stimuli humans either are accustomed to or cannot detect. Ultra- and infrasonic sounds, sound and light

intensity, lighting types, odors, and temperature are important to many species. If not taken into account, welfare can be negatively impacted as reviewed by Morgan and Tromborg (2007).

Environmental enrichment is a common method for improving zoo animal welfare that seeks to provide appropriate stimuli and challenges for animals' physiological and psychological needs (Shepherdson *et al.* 1993). An anthropomorphic idea of 'naturalness' is often not as important as providing animals control and/or ecologically relevant experiences (Chamove 1989, Woolverton *et al.* 1989, Lindburg 1998, Mellen and MacPhee 2001). Examples of biologically relevant stimuli include addition of varied substrates, barriers and landscaping, toys, novel objects, feeding-based enrichment, and training (Swaisgood and Shepherdson 2005). Appropriate enrichment can provide several benefits to animals. Animals reared in complex, enriched environments can be more likely to reproduce successfully as well as display appropriate parental care (Carlstead and Shepherdson 1994). Additionally, enrichment is the primary means for decreasing performance of stereotypic behavior (Swaisgood and Shepherdson 2005, Shyne 2006).

Stereotypic behavior as discussed earlier is the occurrence of repetitive, invariant behavioral patterns without apparent function (Carlstead 1998, Broom and Kirkden 2004, Mason and Latham 2004). Low environmental complexity, physical restraint, frustration, negative keeper interactions, diet type, feeding schedule, or inability to escape from stressful situations can lead to stereotypy development (Carlstead 1998, Mellen *et al.* 1998, Mason *et al.* 2007). However, determining the exact cause of a stereotypic behavior in any particular situation can be difficult. Stereotypic behaviors tend to persevere even when the original cause is absent (Mason and Latham 2004, Mason *et al.* 2007). In such cases, stereotypic behavior might indicate past subpar conditions but reveal nothing about an animal's current situation (Mason and Latham

2004). Furthermore, environmental or husbandry changes promoting improved welfare can result in increased stereotypic behavior frequency (Mason and Latham 2004). There are cases where stereotypies have served some purpose, such as reducing stress levels or as a coping mechanism (Carlstead 1998, Mason and Latham 2004). Stereotypic behavior becomes a poor welfare indicator when used by itself. The most one can say is an environment leading to stereotypic behavior formation is worse than environments that do not (Mason and Latham 2004).

Enrichment effectiveness for decreasing stereotypic behaviors will be determined by how well that enrichment addresses underlying behavioral causes (Mason and Latham 2004). Carlstead and Seidensticker (1991) successfully reduced stereotypies in an American black bear (*Ursus americanus*) *via* two methods. During breeding season, it was hypothesized that pacing represented a frustrated attempt at locating a mate. Pacing during the non-breeding season could be redirected foraging behavior. Therefore, during breeding season, keepers spread female bear scent throughout the exhibit, while food was hidden during both seasons. Bear scent was highly effective at reducing pacing during the breeding season, while foraging-based enrichment was more successful during the non-breeding season.

Complementary to enrichment item provision, ensuring a complex captive environment is another strategy aimed at improving zoo animal well-being. Complex environments enhance learning and behavioral flexibility in developing animals and improve reproductive success later in life (Carlstead and Shepherdson 1994). Additionally, complex environments and enrichment may ameliorate an animal's stress response (Carlstead and Shepherdson 1994). Like enrichment, the captive environment should be designed to be ecologically relevant (Chamove 1989, Woolverton *et al.* 1989, Lindburg 1998, Mellen and MacPhee 2001). For example, knowing

orangutans (*Pongo pygmaeus*) to be arboreal, the Fort Wayne's Children's Zoo created a multi-tiered exhibit with a flooded floor to encourage vertical space usage. Consequently, their orangutans spent most of their time in the canopies, using the upper canopy for resting and privacy from visitors and the lower for active behaviors. Stereotypic activity was rarely observed in these animals (Hebert and Bard 2000).

In captivity, animals are necessarily in close contact with humans. Positive keeper-animal relationships can be paramount to ensuring an animal's good welfare. Carlstead (2009) examined a variety of factors that affected keeper-animal interactions, and found certain keeper-styles were associated with higher animal fear levels (e.g. entering enclosures with the animals present). Interestingly, increased keeper job satisfaction was associated with lower animal fear levels, indicating reciprocal effects between animals and keepers. Other studies found training sessions with keepers can lower abnormal behavior occurrence in some species (Baker *et al.* 2003).

In addition to keeper interactions, zoo animals must cope with exposure to the zoo-going public. Studies have reported crowds as being aversive and stressful to some captive species (Baker 2004). Orangutans responded negatively to increased visitor numbers and noisier conditions by hiding beneath sacks and remaining in closer contact with conspecifics (Birke 2002). Exposure to high visitor numbers increased glucocorticoid concentrations in black rhinos (*Diceros bicornis*) (Carlstead and Brown 2005). Additionally, visitor days in Indian zoos resulted in higher levels of abnormal behaviors in lion-tailed macaques (*Macaca silenus*) (Mallapur *et al.* 2005) and decreased resting behavior in leopards (*Panthera pardus*) (Mallapur and Chelam 2002). By providing refuges and visual barriers between animal and visitors, zoos can provide an animal some level of self-control relative to how much visitor exposure it

receives (Carlstead 1996). Environmental control could be considered the ultimate adaptive goal of behavior, where animals are allowed to contribute to their good welfare (Sambrook and Buchanan-Smith 1997).

Captive social groupings are often outside an animal's control and can contribute to stress. Less than ideal social groupings often occur in zoos with too many individuals and not enough exhibit space or in zoos with too few individuals to form proper groups (Price and Stoinski 2007). In general, housing animals singly or in too-small groups results in lowered breeding success, while too-large groups are associated with increased aggression and abnormal behaviors as reviewed by Price and Stoinski (2007). Group composition should also be considered by zoos (Price and Stoinski 2007). For example, reproductive suppression in young callitrichine monkey females is triggered by the presence of elder females (Dietz 2004). This pattern is common in many cooperatively breeding species.

This is not an exhaustive list of topics for zoos to consider when attempting good welfare practices and not all approaches discussed are equally relevant to all species. However, at least it represents an understanding of unique difficulties facing zoos and zoo animals. A particularly important topic in captive management not yet discussed is feeding, addressed in the following sections.

The four phases of obtaining food:

Procuring food encompasses four phases: contact, acquisition, preparation, and ingestion (Lindburg 1998). The contact phase is defined by how an animal initially locates or encounters a food source (e.g. hunting live prey, searching for fruit, a spider forming a web). The acquisition phase covers food item capture. Once a food source has been located, herbivores must appropriately harvest seeds, fruits, nectar, or leaves, while predators stalk or chase down prey.

The preparation phase can be simple, as for predators that swallow food whole and for grazers, or more complex (e.g. a sea otter cracking open an abalone shell). Finally, ingestion includes mastication and swallowing. Enrichment opportunities exist at all four stages. Environmental enrichment promoting food- and foraging-related behaviors is a particularly effective means of enhancing zoo animal welfare, as feeding is an important survival activity in an animal's life. Performance of appetitive, food-getting behaviors can be rewarding to an animal independent of actual food consumption (Hughes and Duncan 1988).

In addition, other feeding variables should be considered in zoos, such as timing of feeding, feeding schedule predictability, and meal frequency. Though generally determined by keeper schedules, modifying these variables can have important captive behavior effects (Lindburg 1998).

Feeding predictability:

Two ways predictability can be manipulated are stimulus timing and signal reliability preceding stimulus presentation (Bassett and Buchanan-Smith 2007). Additionally, in the case of feeding or enrichment, placement can also be made predictable or unpredictable. Stimulus predictability can have important behavioral and physiological effects. The Preparatory Response Hypothesis states that signals preceding events allow for preparation, reducing negative experience aversiveness and enhancing positive experiences (Badia *et al.* 1979). Mice wheel running, carnivore pacing, and glucose secretion in pigs are examples of food anticipatory activities (Anderson 1974, Terlouw *et al.* 1993, Mistlberger 1994, Carlstead 1998).

Predictable feedings can result in lower stress levels (Bassett and Buchanan-Smith 2007). Social and active behavior frequency increased when capuchin monkeys were placed on a predictable as compared to an unpredictable schedule (Ulyan *et al.* 2006). Additionally, cortisol

levels increased on unpredictable feeding days, indicating that irregular feeding schedules were potentially stressful. Being an event outside a captive's control, feeding times can be less stressful when they are predictable (Weinberg and Levine 1980, Waitt and Buchanan-Smith 2001).

However, predictable feeding schedules are not without issues. Predictable schedules are associated with increased aggressive behaviors in baboons (Wasserman and Cruikshank 1983) and increased stereotypic behaviors in other species (Carlstead 1998). Additionally, increased unpredictability might have some positive effects. Spatial and temporal unpredictability in food presentation resulted in more exploratory behavior, fewer stereotypies and greater behavioral range in leopard cats (*Prionailurus bengalensis*) (Shepherdson *et al.* 1993). Similarly, Amur tigers (*Panthera tigris altaica*) displayed fewer stereotypies when subjected to an unpredictable feeding regime where food was available in boxes only openeable at random times (Jenny and Schmid 2002). Unpredictable feeding times have been associated with decreased inactivity and coprophagy in chimpanzees (*Pan troglodytes*) (Bloomsmith and Lambeth 1995), while temporal and spatial feeding unpredictability promoted higher activity levels and a larger behavioral repertoire in red foxes (*Vulpes vulpes*) (Kistler et al. 2009). Finally, decreased stereotypic behavior was observed in two Oriental small-clawed otters (*Aonyx cinereus*) when placement and timing of food was randomized *via* launching meals from a catapult six random times per day (Hawke *et al.* 2000).

Feeding frequency:

The frequency at which animals in the wild seek out food can also have important captive management implications (Shepherdson *et al.* 1993). Zoo animals might be limited to only a few meals per day, regardless of their wild foraging ecology. Most studies investigating feeding

frequency have been carried out in agricultural harvesting systems. Broiler chickens are generally kept on restricted feeding regimens to prevent health problems later in life caused by heightened growth capacity. Such restrictions resulted in abnormal behaviors indicative of hunger, including oral stereotypies (de Jong *et al.* 2004). Broiler chickens were placed in one of four feeding regimes: one feeding from a trough per day, two feedings from a trough per day, one scattered feeding per day, and two scattered feedings per day. Feeding twice per day increased the percentage of time broiler chickens spent performing locomotion-related behaviors and decreased drinking frequency. However, the authors noted this increased locomotory activity appeared to be stereotypic in origin. They concluded that increased feeding frequency failed to reduce hunger and/or frustration in those animals (de Jong *et al.* 2004). Feeding horses more frequently resulted in increased feeding-related behaviors, decreased oral-related stereotypies and decreased bedding-related behaviors when compared to horses fed two meals per day. However, other forms of stereotypies increased with frequent meals, including nodding and weaving (Cooper *et al.* 2005).

Perhaps the most extensively studied system and the one most relevant to the current study is that of farmed mink (*Neovison vison*). Mink farms feed captive mink only once or twice per day (Hansen and Møller 2008). A variety of studies reported increased stereotypic behavior resulting from restricted diets. Hansen and Møller (2008) subjected mink to a control diet, an *ad libitum* diet, and a restricted diet and found that restricted feeding was associated with higher stereotypic behavior frequencies and increased passive behavior. Damgaard *et al.* (2004) fed mink an *ad libitum* diet, a restricted diet, and an *ad libitum* diet with less metabolic energy per unit food (substantial diet). Stereotypic behaviors were performed at least once by 52.6% of mink fed on a restricted feeding schedule as compared to 26.7% and 26.8% for the *ad libitum*

and substantial diets respectively (Damgaard *et al.* 2004). Bildsøe *et al.* (1991) reported that restricted feeding led to increased activity and stereotypic behavior. Upon return to an unrestricted feeding schedule, activity levels decreased to baseline levels, while levels of stereotypic behavior remained elevated (Bildsøe *et al.* 1991).

Only one study has specifically addressed how feeding frequency affects captive zoo animal behavior. Providing leopard cats (*P. bengalensis*) multiple reduced meals daily decreased stereotypic pacing and increased their behavioral repertoire, though these effects were not significant until the meals were also hidden throughout the enclosure (Shepherdson *et al.* 1993). These results warrant investigation in additional taxa as to whether modifying feeding frequency could serve as a simple, inexpensive, and effective method for keeper implementation in zoos.

III. METHODS

Study sites and subjects:

Behavioral observations of five otters were made at two Michigan zoos: Potter Park Zoo in Lansing and John Ball Zoo in Grand Rapids (Table 1). Potter Park Zoo's exhibit (~235 m^2) contains predominately grass cover, a variety of trees and logs, and three ponds containing ~50,000 liters (deepest at 1.5 meters) connected by small streams (Figure 1). A building connected to the exhibit contains holding cages and food preparation areas. Holding cages ranged in size from ~2.2 m^2 to 5 m^2, two of which contain small (1.4 m^2) pools. Keepers entered the exhibit with the otters once per day for cleaning and maintenance.

John Ball Zoo's exhibit (~95 m^2) consists of a gunite peninsula surrounded by a moat

Table 1
Study otter characteristics

Otter	Sex	Age (years)	Zoo	Captive-born?
Mike	Male	7	Potter Park Zoo	Yes
Jilly	Female	4	Potter Park Zoo	No
Shaq[a]	Male	20	Potter Park Zoo	Yes
Chumani	Female	3	John Ball Zoo	Yes
Otto[b]	Male	2 months	John Ball Zoo	No

[a] Shaq passed away July 28, 2010. Prior to his passing, Shaq and Mike were not housed together due to aggression issues. Mike was given daily exhibit access with Jilly until the afternoon feeding around 3:30 PM and Shaq was given exhibit access after the afternoon feeding and overnight. All observation periods for Shaq were from 3 PM to 5 PM and observation periods for Mike were from 9 AM to 3 PM. After Shaq's passing, Mike was available for observation at all hours.

[b] Introductions between Otto and Chumani began in holding during June. By July 15, both otters were given exhibit access, but never together. Chumani was on exhibit during mornings and Otto was on exhibit during afternoons.

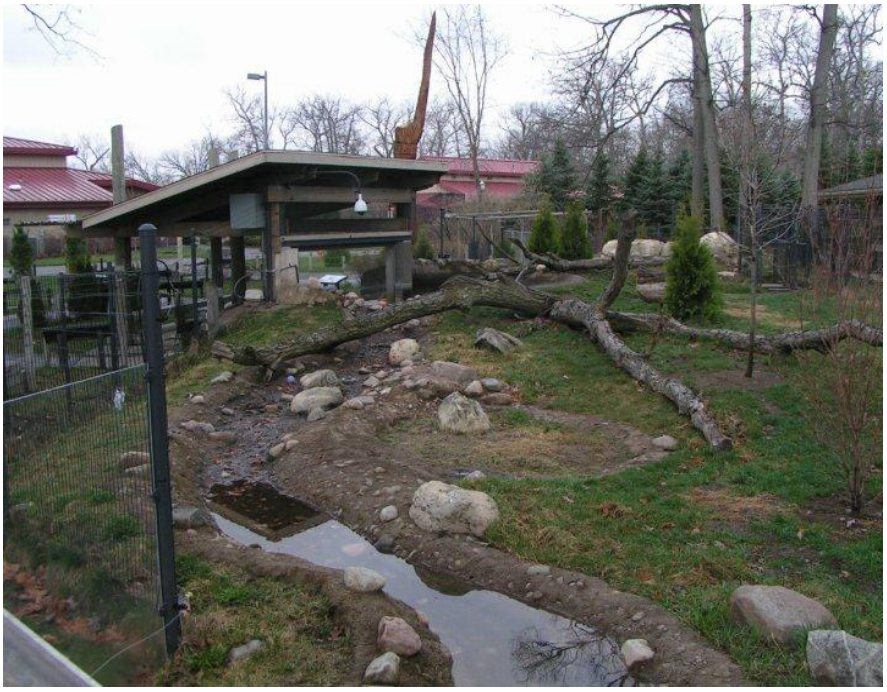

Figure 1: Potter Park Zoo's river otter exhibit. For interpretation of the references to color in this and all other figures, the reader is referred to the electronic version of this thesis.

Figure 2: John Ball Zoo's river otter exhibit.

Table 2
Total observation hours per otter

Otter	Number of observation hours
Mike	54.25
Jilly	65.25
Shaq	12
Chumani	52.5
Otto	13.5
	Total=197.5

Table 3
Sample observation schedule for when two otters where present in an exhibit. Fifteen minutes were spent each hour observing each individual otter

Hour	9:00 AM		10:00 AM		11:00 AM		12:00 PM		1:00 PM		2:00 PM		3:00 PM		4:00 PM		5:00 PM	
Observation periods (min.)	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15

containing ~137,874 liters (Figure 2). The exhibit also contains a waterfall, a tree and various logs. The exhibit connects to holding through two small portals for otters and a larger door for keepers. Holding cages were 1.36 m^2. Otters were not given holding access while on exhibit. Keepers never entered the exhibit with an otter on-exhibit.

Behavioral observations:

Data collection took place from May 24th to August 13th, 2010 for a total of 197.5 hours of observation divided between both exhibits (Table 2). Data were collected from 9 AM to 5 PM, Monday through Friday. Continuous focal-animal sampling was used after Altmann (1974) for 15-minute intervals once per hour per otter. For example, if two otters were on exhibit, 30 total

Table 4

River otter ethogram used for data collection at Potter Park and John Ball Zoos

Behavior	Definition
Resting	Otter is stationary and not supporting weight on its legs
Locomotion	Otter is walking or running on the ground
Social Interaction-Affiliative	Otter is interacting with conspecific in a benign manner (e.g. play or grooming)
Social Interaction-Agonistic	Otter is interacting with another otter in an aggressive manner with the possibility of causing injury
Feeding	Otter is chewing or ingesting food
Swim	Otter is swimming in the water without any of its weight being supported by its legs
Rub	Otter is rubbing itself upon the ground or another surface; may be accompanied by sniffing
Alert	Otter is stationary and directing its attention towards a specific object, person, or direction
Sniff	Otter is sniffing the ground, an object, another otter, etc. while not engaged in the Rub behavior
Manipulation	Otter is handling an object in its environment
Latrine Dance	Otter stomps its rear legs several times before defecating and/or urinating
Stereotypic Behavior	Otter performs a repetitive, invariant motion >2 consecutive times
Grooming	Otter scratches, bites, gnaws, or otherwise manipulates its own fur or body
Breeding	Otters are engaged in copulatory activities
Out of Sight	Otter is out of observer's sight
Other	Otter performs a behavior not listed above

Table 5
Behavioral categories used in data analysis

Behavioral category	Included behavior(s)
Resting	Resting
Locomotion	Swim, Locomotion
Social	Social Interaction-Affiliative, Social Interaction-Agonistic, Breeding
Feeding	Feeding
Maintenance	Grooming, Rub
Investigative	Alert, Sniff, Manipulation
Stereotypic Behavior	Stereotypic Behavior
Other	Latrine Dance, Out of Sight, Other

minutes were spent observing each hour (15 minutes per otter) (Table 3).

The ethogram used for data collection at both sites originally included sixteen behaviors (Table 4), which were later condensed into eight behaviors during data analysis (Table 5).

Time of day:

The time (i.e. hour and minutes) of each 15-minute observation period was recorded. Observations were subsequently grouped into one-hour blocks for analysis (Appendix A: Table 14). For example, all observations occurring from 9:00 AM to 9:59 AM were grouped into the 9 AM category for analysis.

Number of feedings per day:

Access to keeper logs provided data on the total number of meals taken each day. These observations included regular meals, training sessions with food reinforcement, and food-based enrichment. Meal frequency ranged from two to five meals per day.

Potter Park Zoo's otters were fed dog food, capelin, and herring daily as follows: 520 grams of fish and 60 grams of dog food for Shaq, 420 grams of fish and 80 grams of dog food for Jilly, and 500 grams of fish and 80 grams of dog food for Mike.

At John Ball Zoo, Chumani was fed Toronto Brand Feline Diet (350 grams), trout (150 grams), and one chopped carrot daily. On Saturdays, she was given a small knucklebone. At the time of the study, Otto was fed Natural Balance Carnivore Diet (225 ounces) and eight ounces of smelt or trout daily.

Visitor presence:

The number of visitors present at the exhibit was counted at the beginning and end of each observation period. Averaging before and after provided a crowd level estimate for that period.

Weather:

Weather was subjectively assessed using a 1-4 scale devised for this study.

1. Sunny; few to no clouds; no precipitation
2. Partly cloudy (<50% clouds); no precipitation
3. Cloudy (>50% clouds); no precipitation
4. Precipitation, thunder, and/or lightning

Temperature:

Hourly temperature reports were obtained from Capital City Airport in Lansing, MI and Gerald R. Ford International Airport in Grand Rapids, MI for Potter Park Zoo and John Ball Zoo respectively.

Data analysis:

Data analysis used a mixed effect regression model which allows incorporation of both fixed effect predictor variables and random effects (Singer and Willett 2003, Chatterjee and Hadi 2006). The effects of feeding frequency, visitor presence, time of day, temperature, and weather

were tested as fixed effects, while the otters were entered as random effects. Each otter's regression parameters were expected to deviate from the mean population values. By entering otters as random effects, estimation of each otter's individual regression coefficients was possible.

For final model selection, a mixed effect multiple regression model was used, allowing two or more fixed effect predictor variables to be entered into the model. This model takes the form of:

$$Y_{ij} = \beta_0 + \beta_1 \text{Predictor}_1 + \beta_2 \text{Predictor}_2 + ... + \beta_i \text{Predictor}_i + \varepsilon_{ij} + \alpha_i$$

with behavioral response variable Y_{ij} (i.e. resting behavior); intercept β_0; residual error ε_{ij}; and otter error term α_i. β_i is the expected change in Y_{ij} per unit change in Predictor_i when all other predictors are held constant. ε_{ij} is assumed to be normally distributed with variance σ^2 and α_i is assumed to be normally distributed with variance δ^2. Simple linear change was assumed for each behavioral response variable to each predictor.

All analyses were performed using the lme4 package for R ver. 2.12.1 (Bates *et al.* 2008, R Development Core Team 2010). This package was specifically designed for mixed effect modeling. Model fitting used full maximum likelihood methods (Singer and Willett 2003). Normality of the residuals was assessed using normal probability plots. Side-by-side boxplots were used to assess homogeneity of residual variances (Chatterjee and Hadi 2006).

Final model selection was based on a combination of predictor significance as determined by t-test ($\alpha = 0.05$) and Akaike's Information Criterion (AIC) (Singer and Willet 2003). All

possible combinations of the five predictor variables and their interaction effects were considered. Significant interaction effects led to increased correlation coefficients between predictor variables, potentially indicating the presence of multicollinearity, and were subsequently removed from the final models. As the category 'Other' (Table 5) had no functional meaning, it was not analytically included. Traditionally in regression analysis, an R^2 statistic indicates the total variation in the response variable explained by the predictor variable(s), helping to distinguish practical from mere statistical significance (Chatterjee and Hadi 2006). In mixed effect models, total response variation is partitioned into multiple variance components (Singer and Willett 2003). This prevented calculation of an R^2 statistic and made assessing practical significance difficult (Singer and Willett 2003). Therefore, all statistically significant results were discussed, regardless of effect sizes.

IV. RESULTS

Time budgets:

The total percentage of time each otter spent engaged in each behavioral category (Table 5) from 9 AM to 5 PM is provided in Figures 3-7. Chumani and Jilly spent the greatest percentage of their time engaged in locomotive (38% and 35% respectively; Figures 3 & 4) and resting behavior (47% and 44%; Figures 3 & 4). Mike and Otto spent the majority of their time engaged in locomotory behavior (61% and 57% respectively; Figures 5 & 6). Shaq spent 71% of his time resting (Figure 7). Comparatively little time was spent engaged in feeding, social, maintenance, investigative, stereotypic, or other behaviors.

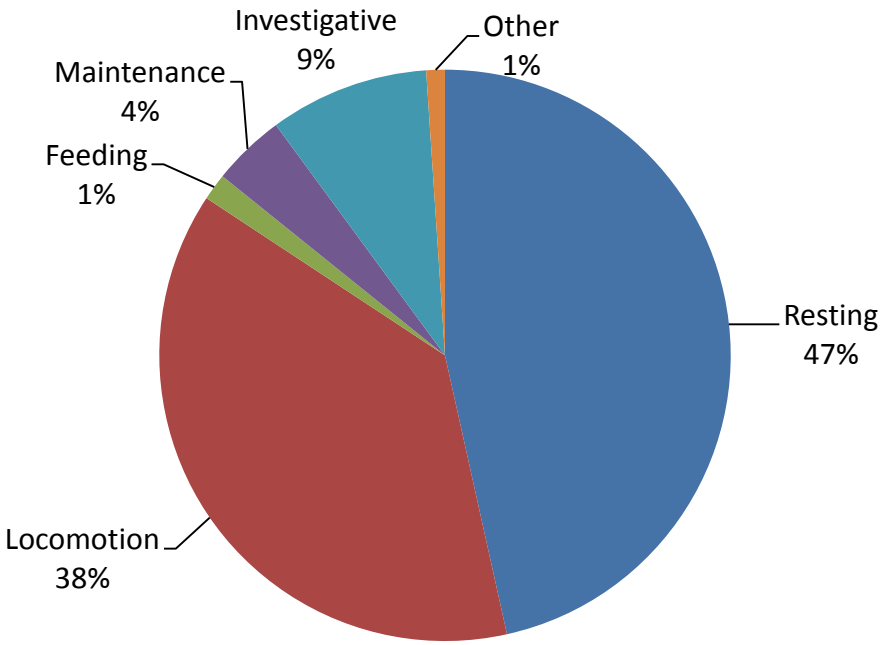

Figure 3: Time budget for Chumani providing the total percentage of time spent performing the indicated behaviors from 9 AM to 5 PM.

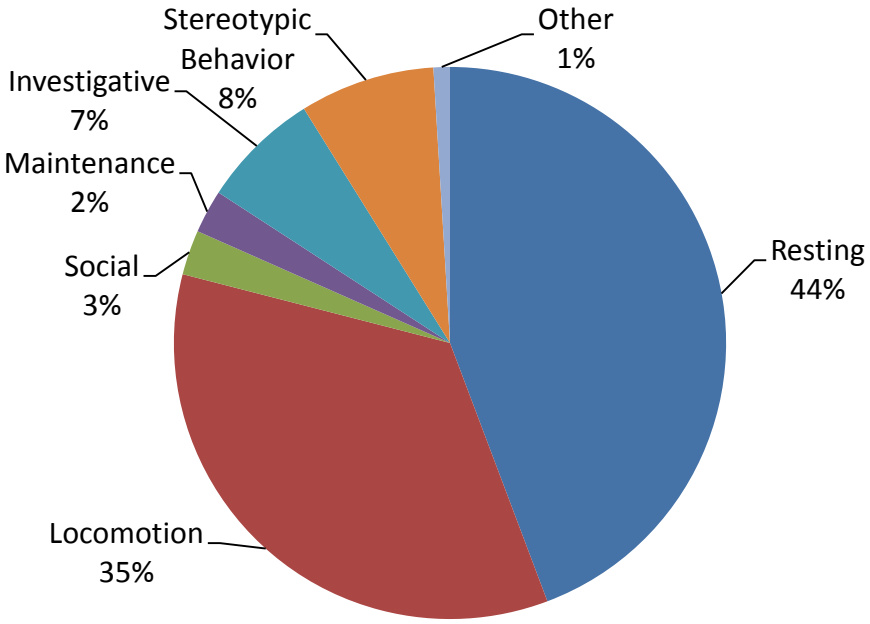

Figure 4: Time budget for Jilly providing the total percentage of time spent performing the indicated behaviors from 9 AM to 5 PM.

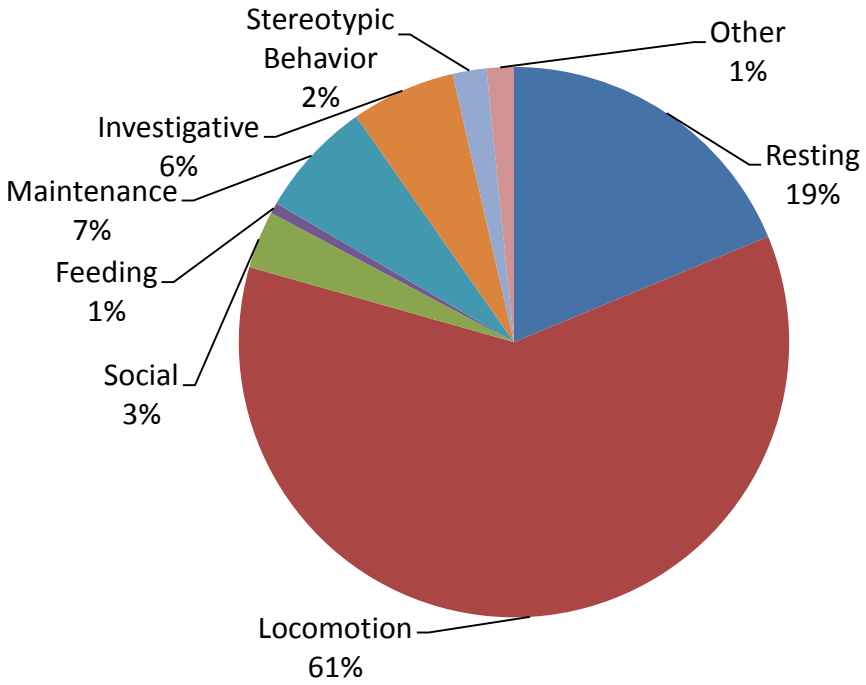

Figure 5: Time budget for Mike providing the total percentage of time spent performing the indicated behaviors from 9 AM to 5 PM.

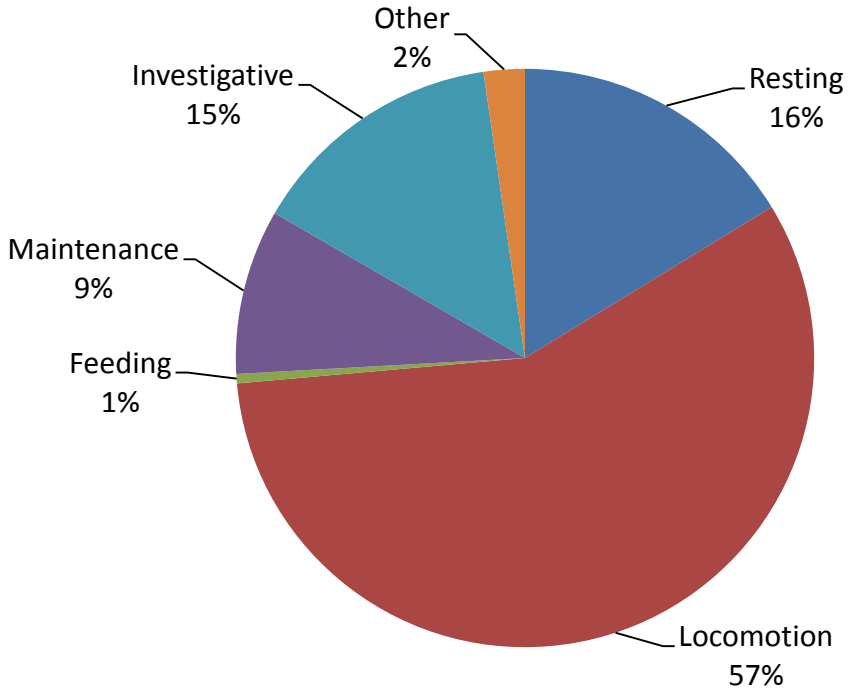

Figure 6: Time budget for Otto from providing the total percentage of time spent performing the indicated behaviors from 9 AM to 5 PM.

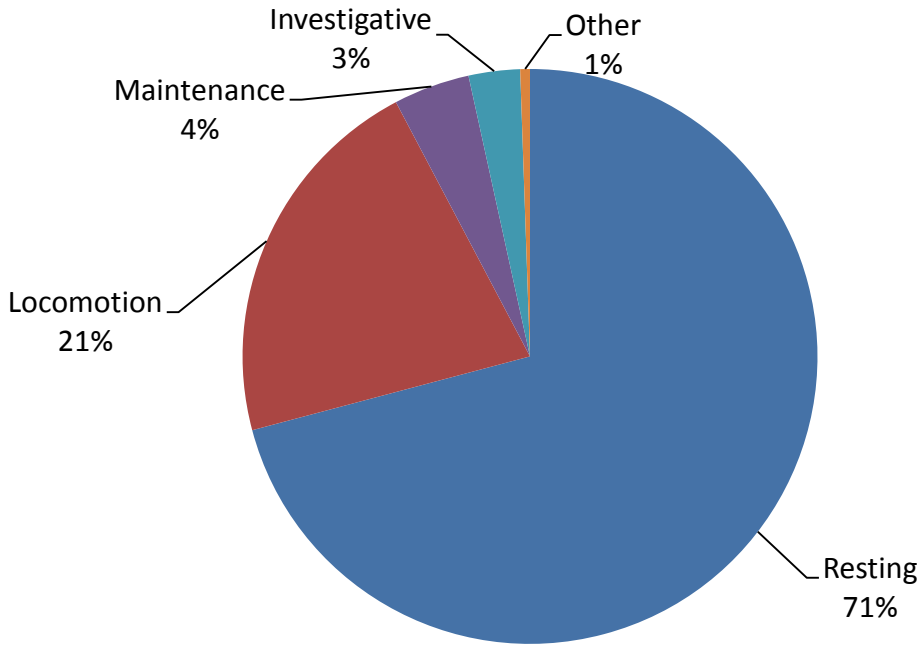

Figure 7: Time budget for Shaq providing the total percentage of time spent performing the indicated behaviors from 9 AM to 5 PM.

Predictor effects:

Feeding frequency: No significant effect of increasing daily meal frequency was found for any behavior.

Visitor presence: The number of people present at an exhibit was significantly associated with resting (t-value = 5.144, $p < 0.001$), locomotory (t-value = 6.329, $p < 0.001$), and stereotypic behavior (t-value = 2.141, $p < 0.001$). During periods of high crowd level, otters expressed decreased resting behavior and increased locomotory and stereotypic behavior (Table 6).

Time of day: Time of day was significantly associated with resting (t-value = 3.990, $p < 0.001$), locomotory (t-value = 3.290, $p = 0.001$), social (t-value = 2.957, $p < 0.001$), feeding (t-value = 2.406, $p < 0.001$), investigative (t-value = 2.557, $p < 0.001$), and stereotypic behaviors (t-value = 2.120, $p < 0.001$). Increased resting and stereotypic behavior was observed in the afternoon, while locomotory, social, feeding, and investigative behavior decreased in frequency in the afternoon (Table 6).

Weather: Weather had a statistically significant effect on resting (t-value = 3.520, $p < 0.001$) and investigative behaviors (t-value = 3.740, $p < 0.001$). Precipitation was associated with decreased resting and increased investigative behavior (Table 6).

Temperature: Temperature had a statistically significant effect on investigative (t-value = 3.634, $p < 0.001$) and stereotypic behaviors (t-value = 3.417, $p < 0.001$). Higher temperatures were associated with decreased investigatory behavior and increased stereotypic behavior (Table 6).

Table 6
Simple linear mixed regression results for all behaviors

	Estimate (β_1)	Standard Error	t-value	p-value
Resting				
Meal Frequency	4.163	2.496	2.242	0.095
Visitor Presence	-1.227	0.238	5.144	<0.001*
Time of Day	2.620	0.628	4.171	<0.001*
Weather	-5.106	1.535	3.485	0.002*
Temperature (^{o}C)	0.418	0.422	0.990	0.322
Locomotion				
Meal Frequency	-2.789	2.098	1.329	0.184
Visitor Presence	1.301	0.199	6.538	<0.001*
Time of Day	-1.948	0.530	3.667	<0.001*
Weather	2.499	1.300	2.242	0.072
Temperature (^{o}C)	-0.433	0.356	1.218	0.223
Social Behavior				
Meal Frequency	-0.240	0.302	0.795	0.421
Visitor Presence	-0.063	0.038	1.626	0.104
Time of Day	-0.292	0.099	2.957	<0.001*
Weather	0.260	0.246	0.899	0.325
Temperature (^{o}C)	0.005	0.067	0.072	0.943
Feeding				
Meal Frequency	-0.048	0.219	0.219	0.827
Visitor Presence	0.009	0.022	0.402	0.688
Time of Day	-0.131	0.055	2.406	<0.001*
Weather	0.023	0.139	0.244	0.876
Temperature (^{o}C)	0.025	0.038	0.667	0.505

*denotes significant p-value ($\alpha = 0.05$)

Table 6 (cont.)

	Estimate (β_1)	Standard Error	t-value	p-value
Maintenance				
Meal Frequency	-0.776	0.580	1.338	0.181
Visitor Presence	-0.108	0.060	1.801	0.072
Time of Day	-0.268	0.156	1.724	0.085
Weather	-0.039	0.386	0.170	0.924
Temperature (^{o}C)	-0.018	0.105	0.167	0.867
Investigate				
Meal Frequency	0.197	0.569	0.347	0.729
Visitor Presence	-0.010	0.054	0.185	0.853
Time of Day	-0.363	0.142	2.557	<0.001*
Weather	1.319	0.345	3.740	<0.001*
Temperature (^{o}C)	-0.342	0.094	3.634	<0.001*
Stereotypic Behavior				
Meal Frequency	-0.486	0.648	0.750	0.453
Visitor Presence	0.136	0.063	2.141	<0.001*
Time of Day	0.351	0.166	2.120	<0.001*
Weather	0.790	0.406	1.774	0.069
Temperature (^{o}C)	0.376	0.110	3.417	<0.001*

*denotes significant p-value ($\alpha = 0.05$)

Table 7
Final model for resting behavior

Fixed effects	Estimate	Standard error
β_0	42.856	8.841
Time of Day (β_1)	2.312	0.615
Visitor Presence (β_2)	-1.236	0.236
Weather (β_3)	-5.609	1.609
Random effects	Variance	Standard deviation
Otters	246.55	15.702
Residual	1623.42	40.292

Table 8
Final model for locomotory behavior

Fixed effects	Estimate	Standard Error
β_0	39.352	6.788
Time of Day (β_1)	-1.660	0.515
Visitor Presence (β_2)	1.296	0.198
Weather (β_3)	3.101	1.352
Random effects	Variance	Standard deviation
Otters	129.06	11.360
Residual	1146.51	33.860

Final models:

Resting behavior: The final model for resting behavior incorporated three predictors: time of day, visitor level, and weather. Resting behavior increased as the day progressed with a β_1 of 2.312 ± 0.615 (mean ± standard error) (t-value = 3.760, $p < 0.001$). This means for each hour, resting behavior frequency increased on average 2.312 ± 0.615% when all other predictors were held constant. Decreased resting behavior was associated with increased visitor presence (β_2 = -1.236 ± 0.236, t-value = -5.237, $p < 0.001$) and increased precipitation (β_3 = -5.609 ± 1.609, t-value = -3.487, $p < 0.001$). Residual variance was 1623.42 ± 40.292 (mean ± SD), while otter error variance was 246.55 ± 15.702. Examination of residual plots and correlation coefficients

Table 9
Final model for social behavior

Fixed effects	Estimate	Standard Error
β_0	3.0677	0.813
Time of Day (β_1)	-0.294	0.098
Random effects	Variance	Standard deviation
Otters	1.422	1.192
Residual	43.547	6.599

Table 10
Final model for feeding behavior

Fixed effects	Estimate	Standard Error
β_0	1.409	0.365
Time of Day (β_1)	-0.131	0.054
Random effects	Variance	Standard deviation
Otters	0.138	0.371
Residual	13.919	3.731

indicated no normality or multicollinearity issues. The model is summarized in Table 7 and the final equation is as follows:

$$\text{Resting Behavior}_{ij} = \beta_0 + \beta_1(\text{Time of Day}) + \beta_2(\text{Crowd Level}) + \beta_3(\text{Weather}) + \varepsilon_{ij} + \alpha_i$$

Locomotory behavior: The final model for locomotory behavior incorporated time of day, visitor presence, and weather as predictors. Locomotory behaviors decreased in the afternoon (β_1 = -1.660 ± 0.515, t-value = -3.220, p = 0.001). Conversely, increased locomotory behavior was associated with increased crowd levels (β_2 = 1.296 ± 0.198, t-value = 6.537, p < 0.001) or precipitation (β_3 = 3.101 ± 1.352, t-value = 2.294, p = 0.005). Residual variance was 1146.51 ± 33.860 and otter error variance was 129.06 ± 11.36. Examination of residual plots and correlation coefficients indicated no normality or multicollinearity issues. The model is

Table 11
Final model for investigative behavior

Fixed effects	Estimate	Standard Error
β_0	12.658	3.305
Weather (β_1)	1.009	0.385
Temperature (β_2)	-0.262	0.098
Random effects	**Variance**	**Standard deviation**
Otters	13.479	3.671
Residual	85.288	9.265

Table 12
Final model for stereotypic behavior

Fixed effects	Estimate	Standard Error
β_0	-7.911	3.186
Visitor Presence (β_1)	0.128	0.063
Temperature (β_2)	0.365	0.110
Random effects	**Variance**	**Standard deviation**
Otters	9.560	3.098
Residual	117.438	10.837

summarized in Table 8 and the final equation is as follows:

$$\text{Locomotory Behavior}_{ij} = \beta_0 + \beta_1(\text{Time of Day}) + \beta_2(\text{Crowd Level}) + \beta_3(\text{Weather}) + \varepsilon_{ij} + \alpha_i$$

Social behavior: The final model for social behavior only incorporated time of day as a predictor. Social behavior decreased in frequency in the afternoon ($\beta_1 = -0.294 \pm 0.098$, t-value = -2.995, $p = 0.003$). This result could be due from breeding behavior only being observed in the morning (personal observation). Residual variance was 43.5471 ± 6.599 and otter residual variance was 1.4217 ± 1.192. Examination of residual plots and correlation coefficients indicated no normality or multicollinearity issues. The model is summarized in

Table 13
Individual intercepts for final models

	Final Model					
Otter	Resting	Locomotion	Social	Feeding	Investigative	Stereotypic Behavior
Chumani	52.39	33.44	1.559	1.88	13.74	-9.77
Jilly	49.98	29.99	3.98	1.05	11.68	-2.27
Mike	28.47	52.41	4.45	1.26	10.74	-7.90
Otto	21.66	52.65	2.35	1.40	18.86	-10.25
Shaq	61.78	28.27	3.00	1.46	8.28	-9.36

Table 9 and the final equation is as follows:

$$\text{Social Behavior}_{ij} = \beta_0 + \beta_1(\text{Time of Day}) + \varepsilon_{ij} + \alpha_i$$

Feeding behavior: The final model for feeding behavior only incorporated time of day as a predictor. Feeding behavior decreased in frequency in the afternoon (β_1 = -0.1312 ± 0.054, t-value = -2.426, p = 0.015). Residual variance was 13.9193 ± 3.731 and otter residual variance was 0.13770 ± 0.37108. Examination of residual plots and correlation coefficients indicated no normality or multicollinearity issues. The model is summarized in Table 10 and the final equation is as follows:

$$\text{Feeding Behavior}_{ij} = \beta_0 + \beta_1(\text{Time of Day}) + \varepsilon_{ij} + \alpha_i$$

Maintenance behavior: No predictor variables were found to significantly predict maintenance behavior frequency.

Investigative behavior: The final model for investigative behavior incorporated weather and temperature as predictor effects. Investigative behavior increased during precipitation (β_1 = 1.009 ± 0.385, t-value = 2.622, p = 0.009) and decreased as temperature increased (β_2 = -0.262 ±

0.098, t-value = -2.672, $p = 0.008$). Residual variance was 85.288 ± 9.235 and otter residual variance was 13.479 ± 3.6714. Examination of the residual plots and correlation coefficients indicated no normality or multicollinearity issues. The model is summarized in Table 11 and the final equation is as follows:

$$\text{Investigative Behavior}_{ij} = \beta_0 + \beta_1(\text{Weather}) + \beta_2(\text{Temperature}) + \varepsilon_{ij} + \alpha_i$$

Stereotypic behavior: The final model for stereotypic behavior incorporated visitor presence and temperature as predictor effects. Stereotypic behavior increased as visitor presence increased ($\beta_1 = 0.128 \pm 0.063$, t-value = 2.026, $p = 0.043$) and as temperature increased ($\beta_2 = 0.365 \pm 0.110$, t-value = 3.324, $p < 0.001$). Residual variance was 117.438 ± 10.837 and otter residual variance was 9.560 ± 3.098. Examination of the residual plots and correlation coefficients indicated no normality or multicollinearity issues. The model is summarized in Table 12 and the final equation is as follows:

$$\text{Stereotypic Behavior}_{ij} = \beta_0 + \beta_1(\text{Visitor Presence}) + \beta_2(\text{Temperature}) + \varepsilon_{ij} + \alpha_i$$

Individual effects:

The individual otters were incorporated into the final models as random effects with fixed slopes but varying intercepts. Table 13 lists each otter's individual regression intercepts for the final models.

V. DISCUSSION

The objective of this study was to assess whether increased meal frequency resulted in positive behavioral effects in captive river otters. Since having frequent meals is similar to wild conditions, it was predicted that higher activity levels would be associated with increased meal frequency and decreased resting and stereotypic behavior. The study results did not confirm this prediction. Over the range studied, meal frequency alone did not affect behavior. However, this study cannot conclusively state that meal frequency alone has no behavioral effects. It is possible change in meal frequency might not have been great enough to stimulate a behavioral response, i.e. three or four meals per day might not be a biologically significant change from two meals. Additionally, husbandry considerations led to confounding factors that might have obscured any potential effects of feeding frequency.

Meal frequency:

First, there was limited control over daily meal frequency, resulting in only one day in which otters were fed five times. Generally, meal frequency only ranged from two to four meals per day. Second, daily meal frequency fluctuated from day to day. For example, the longest stretch of consecutive observation days in which Jilly was fed three meals per day was 17 and the longest stretch of observation days in which she was fed four meals per day was seven. Jilly was never fed two meals per day for two or more consecutive observation days. Conversely, Chumani was once fed two meals per day for 14 consecutive observation days and was fed three meals per day for 15 consecutive observation days. This unbalanced design led to meal frequency effects being confounded with the effects of feeding schedule predictability. Controlling for meal frequency and schedule across institutions, including a larger sample size,

and investigating the potential effects of meal frequency over a greater range (e.g. two *vs*. four *vs*. six meals per day) could reveal effects obscured by the current study's shortcomings.

Alternatively, additional factors related to feeding could be of greater relevance to the animals (e.g. food presentation). Some meals were simply placed on stall floors, while others were scattered throughout the exhibit, requiring otters to search them out. Otters were occasionally provided enrichment devices requiring manipulation to extract food or meals were used as positive reinforcement during training. Often the otters themselves were out of sight during feeding since scheduled meals and training sessions took place within holding areas. Therefore, it was impossible to observe otter behavior immediately following a feeding event. Behavioral responses to feeding could be short-lived and therefore not recorded during observation periods.

While this study was unable to examine the behavioral effects of presentation style itself, there is a wealth of topical literature (Lindburg 1998). Scatter feeding is a common zoo practice (Carlstead and Seidensticker 1991, Lindburg 1998). In one study, Shepherdson *et al.* (1993) successfully reduced stereotypic pacing in leopard cats and increased their behavioral repertoire by hiding meals throughout the enclosure, thus promoting active foraging behaviors. Providing browse to orangutans led to increased activity as orangutans searched for food items amongst the substrate (Birke 2002). Enrichment devices can challenge animals to extract food prior to eating it (Lindburg 1998), while training sessions utilizing food reinforcement are associated with positive outcomes, such as decreased abnormal behaviors and lowered stress levels (Baker *et al*. 2003).

Certain forms of presentation are inherently more stimulating than others (i.e. live feeding *vs*. eating out of a pan). Consequently, varied presentation styles recorded in the current study

further obscured any potential effects of meal frequency. Future studies should control the fashion in which meals are presented when attempting to investigate meal frequency.

Another potentially important feeding-related factor is that of meal predictability. For example, the afternoon meal at Potter Park Zoo was highly predictable, nearly always occurring around 3:30 PM. Mike and Jilly became very active in the time leading up to feeding, and stereotypic behavior showed a slight but statistically significant increase in the afternoon (Table 12). This finding was supported by the literature in which associations have been reported between predictable feeding schedules and anticipatory stereotypies (Carlstead 1998). Meal predictability has also been shown to influence stress levels, aggression, and abnormal behaviors in many captive species (Wasserman and Cruikshank 1983, Bassett and Buchanan-Smith 2007).

It might be inferred that introducing unpredictability into feeding regimes of these otters could be beneficial. Hawke *et al.* (2000) randomized meal timing and placement of two Oriental small-clawed otters by launching the otters' diet *via* catapult. This procedure reduced occurrence of stereotypic behavior. Additional studies have reported decreases in stereotypy and increases in behavioral repertoire for carnivores responding to unpredictable feeding (Jenny and Schmid 2002, Kistler *et al.* 2009). In the current study, some of the otters (e.g. Jilly and Mike) were day to day subjected to unpredictability in the number of meals they received. Chumani and Otto experienced a more predictable feeding schedule, often being fed either two or three meals per day. This confounding of meal frequency and predictability could have masked the behavioral effects of feeding frequency alone.

Unreliable signaling of events preceding a meal could have also influenced otter behavior. At both Potter Park and John Ball Zoos, keepers were always visible to the otters prior to feeding as they passed by the exhibit to enter the food preparation area. Therefore, otters were

always alerted to a possible meal. Keeper presence or activity was not always followed by food presentation, generating an unreliable signal. Often keeper arrival triggered onset of anticipatory stereotypies in Mike and Jilly. Such behavioral responses could indicate that unreliable signaling was a source of stress. Unreliable stimulus signaling has been associated with increased stress and aggression as reviewed by Bassett and Buchanan-Smith (2007). Assessing fecal glucocorticoids could help resolve whether predictable or unpredictable schedules are preferred by these animals, as well as whether they find unreliable signaling to be stressful.

The time of day:

External stimuli, such as keeper presence, could help explain the statistically significant association between the time of day and many behaviors (Table 6). Factors, such as keeper routines, visitor observation, or lawn maintenance appeared to have a great effect on the otters' behavior (pers. obs.). Such events occurred on a relatively regular schedule, thereby structuring some individual otter's daily activity patterns. For example, increased social and investigatory behavior early in the day could be due to the morning reunion between Jilly and Mike. For most of the study, Mike was kept in holding overnight while Shaq was provided exhibit access (Table 1). Reed-Smith (2008) reviewed several reports in which a reunion between two otters resulted in increased sexual behavior within the first hour of being together. In the current study, breeding behavior was rarely viewed in the afternoon (pers. obs.). This finding supports previous reports that separation and subsequent reunion of a male and female pair can be an effective breeding strategy for otters (Reed-Smith 2008). Furthermore, it emphasizes the importance of external events (e.g. reunion) in structuring activity patterns.

Wild river otters in freshwater environments are reported to be crepuscular and/or nocturnal with activity peaks around midnight and dawn (Melquist and Hornocker 1983), while

otters living in marine environments tend to be more diurnal (Kruuk 2006). These differences in daily behavioral rhythms appear to be driven by food availability (Kruuk 2006). Melquist and Hornocker (1983) reported more late afternoon river otter activity in preparation for evening and nocturnal foraging. Resting behavior in the current study was observed throughout the day, but it tended to increase in the afternoon (Table 7). The notable exception was prior to the 3:30 PM feeding at Potter Park Zoo in which locomotory and stereotypic behavior tended to dramatically increase for both Mike and Jilly (Tables 8 & 12). These otters could on occasion become more active prior to feeding, as wild otters do, but had little motivation to continue activity after feeding. Peaks in captive otter activity and resting seem to be dictated more by extrinsic, environmental factors rather than endogenous rhythms. Nevertheless, many animals display nocturnal behavior in captivity, which suggests this subject deserves further study in zoos (Brockett *et al.* 1999, Weller and Bennett 2001, Wilson *et al.* 2006).

Visitor presence:

The zoo-going public is an influential determinant of behavior. Higher crowd levels were associated with increased locomotory and stereotypic behavior and decreased resting behavior (Tables 6, 7, 8 & 12). For each additional person present at the exhibit, the final models estimated a decrease in resting behavior of 1.236 ± 0.236% (Table 7) and an increase in locomotion and stereotypic behavior by 1.296 ± 0.198% and 0.1277 ± 0.063% respectively (Tables 8 & 12). While the stereotypic behavior increase appears to be of modest size, stereotypic behavior only made up 8% and 2% of Jilly and Mike's time budgets respectively (Figures 4 & 5). Even this small estimated increase in stereotypic behavior could significantly impact these animals (Mason and Latham 2004, Mason *et al*. 2007).

Because of limits to the experimental design, this study cannot infer a causal relationship

between visitor presence and otter behavioral responses. The otters could have been disturbed by large crowds causing them to become more active, but it was equally likely that larger crowds were attracted by active otters. Note that Mike and Otto tended to be extremely active much of the time (Figures 5 & 6), regardless of the number of people at the exhibit, and might not have been disturbed or negatively affected by the public.

Alternately, these results could indicate people at the exhibit were stressful and disturbing to the otters, resulting in decreased resting behavior. Supporting this interpretation, decreased resting behavior was observed in leopards on days when visitors were present in Indian zoos (Mallapur and Chelam 2002). Other studies have associated crowd size with abnormal behaviors and avoidance of the public (Birke 2002, Mallapur *et al*. 2005). Incorporating fecal glucocorticoid measurements could aid in determining whether these animals perceive crowds as stressful (Carlstead and Brown 2005).

Temperature and weather:

Increased temperature could also have contributed to stress as evidenced by the association between higher temperature and an increase in stereotypic behavior of 0.3649 ± 0.1098% (Table 12). Zoo exhibits are smaller and far less complex than wild habitats (Chamove and Anderson 1989, Mason *et al.* 2007), providing the animal less microhabitat control choice, potentially leading to stressful conditions (Carlstead 1996, Sambrook and Buchanan-Smith 1997). However, otters always had access to pools for swimming which would presumably alleviate thermal stress. Most of Jilly's stereotypic behavior consisted of a particular swimming pattern (pers. obs.). This could explain the association between temperature and stereotypic behavior.

Closely linked to temperature was the local weather. Precipitation was associated with

higher levels of investigatory behavior and lower resting levels. For each increase on the 1-4 weather scale, resting behavior frequency was predicted to decrease 5.609 ± 1.609% (Table 7), while investigation increased 1.009 ± 0.385% (Table 11). Novel environmental conditions could provoke such responses in which wetter conditions could have resulted in olfactory stimulation and exhibit textures. While precipitation could be a source of stress to some animals, this is unlikely for the amphibious otters. The value of such sources of 'impromptu enrichment' could prove more enriching than many purposeful manipulations.

Individual behavioral responses:

Finally, this study highlights how important individual animal responses are in behavioral research. A quick examination of Figures 3-7 and Table 13 clearly demonstrates the individual differences in response to the studied variables. These differences, combined with limited sample size, made generalizing to a larger population difficult. However, they also provided valuable information. Animals in behavioral research are often overtly or tacitly assumed to be species representatives and individual differences are treated as simple dispersion around the mean. Fraser (2009) argues individual differences are important phenomena in their own right that provide support for, and impetus to study affective states and personalities in animals. Furthermore, when welfare is assessed, primary concern lies with the state of the individual animal, rather than larger population welfare (Barber 2009).

For example, Mike and Otto were generally more active than the other three otters (Figures 5 & 6). While the regression models indicate an increase in resting behavior in the afternoon, both Mike and Otto often maintained a high level of activity throughout the day. Additionally, Chumani and Jilly spent very similar amounts of time engaged in both resting and locomotory behavior (Figures 3 & 4). The five otters included in this study span a wide range of

ages (Table 1), making it difficult to disentangle the effects of gender versus age. Nevertheless, it is interesting that both of the females and two of the males (excluding Shaq) exhibit such behavioral similarities. Inclusion of a larger sample of otters while controlling for age, could reveal persistent differences in how male and female river otters partition their daily activity.

While this study has attempted to take individual differences into account through statistical modeling, other methods currently exist or will likely be developed. Qualitative methods and descriptive accounts can contain a wealth of data difficult to convey in purely statistical terms. Keepers are likely to know the individual animals under their care better than any other and keepers frequently use their accumulated qualitative knowledge, combined with knowledge of species' natural history, to make the best decisions they can for the animals under their care.

APPENDIX

APPENDIX A

Legend:

PPZ-Potter Park Zoo

JBZ-John Ball Zoo

Meals-Total number of meals the otter was fed that day

Vstr-Number of visitors present for the observation

Wthr-Weather assessed on a 1-6 scale (see Methods)

Tmp (^{o}C)-Temperature in degrees Celsius

Rst-Resting

Eat-Feeding

Stp-Stereotypic Behavior

Mnt-Maintenance

Soc-Social

Loc-Locomotion

Inv-Investigative

Otr-Other

Table 14
Complete study data set

Date	Zoo	Time	Block	Otter	Meals	Vstr	Wthr	Tmp (oC)	Rst	Eat	Stp	Mnt	Soc	Loc	Inv	Otr
5/24/2010	PPZ	09:07 AM	09:00 AM	Jilly	4	0	2	26	4.13	0	0	0	22.47	55.2	2.67	15.53
5/24/2010	PPZ	09:24 AM	09:00 AM	Mike	3	2	2	26	0	0.2	0	2.07	25.93	56.73	7.53	7.53
5/24/2010	PPZ	10:19 AM	10:00 AM	Jilly	4	6	1	27	99.53	0	0	0.47	0	0	0	0
5/24/2010	PPZ	10:01 AM	10:00 AM	Mike	3	13.5	2	27	0	0.8	2.8	1.53	0	88.27	6.6	0
5/24/2010	PPZ	11:15 AM	11:00 AM	Mike	3	0	2	27	0	0	0	0.47	0.67	78.53	9	11.33
5/24/2010	PPZ	11:00 AM	11:00 AM	Jilly	4	3	2	27	0	0.8	0	0	5.33	89.33	4.53	0
5/24/2010	PPZ	12:02 PM	12:00 PM	Mike	3	2.5	2	28	0	0	21.67	2	0	67.87	4.13	4.33
5/24/2010	PPZ	12:20 PM	12:00 PM	Jilly	4	4.5	1	28	98.87	0	0	0	0	0.47	0.67	0
5/24/2010	PPZ	01:10 PM	01:00 PM	Jilly	4	6.5	1	28	0	0	65.93	0	0	25.13	3.73	5.2
5/24/2010	PPZ	01:27 PM	01:00 PM	Mike	3	8.5	1	28	0	0	27	0	0.33	70.73	1.47	0.47
5/24/2010	PPZ	02:03 PM	02:00 PM	Mike	3	0	2	28	0	0	9.33	0.87	0.47	81	2.67	5.67
5/24/2010	PPZ	02:20 PM	02:00 PM	Jilly	4	3.5	2	28	0	0	29.87	0	0	62.6	4.73	2.8

Table 14 (cont.)

Date	Zoo	Time	Block	Otter	Meals	Vstr	Wthr	Tmp (^{o}C)	Rst	Eat	Stp	Mnt	Soc	Loc	Inv	Otr
5/24/2010	PPZ	03:25 PM	03:00 PM	Shaq	3	3.5	2	29	0	8.13	0	29	0.47	62.4	0	0
5/24/2010	PPZ	03:08 PM	03:00 PM	Jilly	4	1	2	29	0	0	0	0	0	68.53	6.33	25.13
5/24/2010	PPZ	04:03 PM	04:00 PM	Shaq	3	0	2	29	97.8	0	0	2.2	0	0	0	0
5/24/2010	PPZ	04:18 PM	04:00 PM	Jilly	4	0	2	29	100	0	0	0	0	0	0	0
5/24/2010	PPZ	05:02 PM	05:00 PM	Shaq	3	2	2	29	0	0	0	2.53	3.87	90.27	0	3.33
5/24/2010	PPZ	05:19 PM	05:00 PM	Jilly	4	2	2	29	18.87	0	0	0	0	59.2	18.6	3.33
5/25/2010	PPZ	09:37 AM	09:00 AM	Jilly	3	8	1	25	0	2.53	0	0	0.53	87.07	9.87	0
5/25/2010	PPZ	09:55 AM	09:00 AM	Mike	2	6	1	25	0	0.47	0	16	2.13	73.6	4.67	3.13
5/25/2010	PPZ	10:27 AM	10:00 AM	Jilly	3	18	1	26	1.47	0	0	0.33	0.53	81.67	10.8	5.2
5/25/2010	PPZ	10:44 AM	10:00 AM	Mike	2	7	1	26	0.33	0	0	13.87	0	73.33	5.8	6.67
5/25/2010	PPZ	11:16 AM	11:00 AM	Jilly	3	3.5	1	26	9.33	0	0	0	0	85.27	4.73	0.67
5/25/2010	PPZ	11:32 AM	11:00 AM	Mike	2	12	1	26	0	0	7.47	5.13	0.87	77.4	2.13	7
5/25/2010	PPZ	12:33 PM	12:00 PM	Mike	2	11.5	1	27	0	0	8.13	0	0	90.73	1.13	0
5/25/2010	PPZ	12:52 PM	12:00 PM	Jilly	3	7.5	1	27	100	0	0	0	0	0	0	0
5/25/2010	PPZ	01:39 PM	01:00 PM	Jilly	3	2	1	27	100	0	0	0	0	0	0	0
5/25/2010	PPZ	01:23 PM	01:00 PM	Mike	2	3	1	27	0	0	10.8	7.8	0	74.2	7.2	0
05/25/10	PPZ	02:26 PM	02:00 PM	Jilly	3	1	2	27	100	0	0	0	0	0	0	0
5/25/2010	PPZ	02:09 PM	02:00 PM	Mike	2	0	1	27	0	0	25.33	2	0	64.93	5.33	2.4
5/25/2010	PPZ	03:17 PM	03:00 PM	Jilly	3	1.5	1	27	60.53	0	0	1.13	0	20.6	2.67	15.07
5/25/2010	PPZ	03:01 PM	03:00 PM	Mike	2	0	1	27	0	0	9.47	0	0	85.6	4.73	0.2
5/25/2010	PPZ	04:20 PM	04:00 PM	Shaq	2	0	1	28	96.87	0	0	3.13	0	0	0	0
5/25/2010	PPZ	04:03 PM	04:00 PM	Jilly	3	0.5	1	28	2.33	0	14	0.8	0	78.67	4.2	0
5/25/2010	PPZ	05:15 PM	05:00 PM	Shaq	2	0	2	28	100	0	0	0	0	0	0	0
5/25/2010	PPZ	05:00 PM	05:00 PM	Jilly	3	0	1	28	17	0	0	1.47	0	67.4	14.13	0
5/26/2010	PPZ	09:01 AM	09:00 AM	Jilly	3	0	1	26	8.87	1.2	0	0	21.27	52.67	7.87	8.13
5/26/2010	PPZ	09:17 AM	09:00 AM	Mike	3	17.5	1	26	0	0.33	0	17.2	0	80.53	1.47	0.47
5/26/2010	PPZ	10:00 AM	10:00 AM	Mike	3	8	1	27	0.47	0	29.87	0.33	0	65.8	2.67	0.87
5/26/2010	PPZ	10:15 AM	10:00 AM	Jilly	3	15	1	27	21.53	0	0	0	65.93	11.2	1.33	0
5/26/2010	PPZ	11:00 AM	11:00 AM	Jilly	3	20.5	1	29	0	0	2.33	0	0.33	96.33	1	0
5/26/2010	PPZ	11:15 AM	11:00 AM	Mike	3	31	1	29	0.87	0	0	1.67	0	95.47	2	0
5/26/2010	PPZ	12:00 PM	12:00 PM	Jilly	3	12	1	29	1.33	0.2	0	0.2	0	92.33	5.93	0

Table 14 (cont.)

Date	Zoo	Time	Block	Otter	Meals	Vstr	Wthr	Tmp (^{o}C)	Rst	Eat	Stp	Mnt	Soc	Loc	Inv	Otr
5/26/2010	PPZ	12:15 PM	12:00 PM	Mike	3	18.5	1	29	0	0	13.33	4.2	0	80	2.47	0
5/26/2010	PPZ	01:03 PM	01:00 PM	Jilly	3	9.5	1	29	97.93	0	0	0	0	0.53	1.53	0
5/26/2010	PPZ	01:18 PM	01:00 PM	Mike	3	12	2	29	0	0	3.8	1.87	12.87	60.93	13.2	7.33
5/26/2010	PPZ	02:00 PM	02:00 PM	Jilly	3	9.5	1	30	0	0	0	2.67	0	85.13	7.33	4.87
5/26/2010	PPZ	02:15 PM	02:00 PM	Mike	3	4.5	2	30	0	0	6.47	0.87	0	85.33	7.33	0
5/26/2010	PPZ	03:04 PM	03:00 PM	Shaq	3	2	2	31	3.53	4.33	0	0.67	0	87	4.47	0
5/26/2010	PPZ	03:18 PM	03:00 PM	Jilly	3	1	2	31	14.47	0	0	0	0	68.33	17.2	0
5/26/2010	PPZ	04:00 PM	04:00 PM	Shaq	3	0	1	31	100	0	0	0	0	0	0	0
5/26/2010	PPZ	04:00 PM	04:00 PM	Jilly	3	0	1	31	100	0	0	0	0	0	0	0
5/26/2010	PPZ	05:00 PM	05:00 PM	Jilly	3	0	1	31	100	0	0	0	0	0	0	0
5/26/2010	PPZ	05:00 PM	05:00 PM	Shaq	3	0	1	31	100	0	0	0	0	0	0	0
5/27/2010	JBZ	09:14 AM	09:00 AM	Chumani	2	2	2	23	0	0.2	0	13.07	0	58.07	19.8	8.87
5/27/2010	JBZ	10:00 AM	10:00 AM	Chumani	2	12.5	2	24	15	3.8	0	13.33	0	62.67	4.73	0.47
5/27/2010	JBZ	11:00 AM	11:00 AM	Chumani	2	4.5	2	24	96.87	0	0	0	0	0	3.13	0
5/27/2010	JBZ	12:02 PM	12:00 PM	Chumani	2	10	2	27	0	0.53	0	0	0	89.07	3.8	6.6
5/27/2010	JBZ	01:07 PM	01:00 PM	Chumani	2	8	1	28	0	0	0	1.53	0	86	12.47	0
5/27/2010	JBZ	02:05 PM	02:00 PM	Chumani	2	5.5	1	28	0	0	0	7	0	73.93	19.07	0
5/27/2010	JBZ	03:04 PM	03:00 PM	Chumani	2	0	2	28	100	0	0	0	0	0	0	0
5/27/2010	JBZ	04:04 PM	04:00 PM	Chumani	2	2	1	29	95.33	0	0	0	0	0	4.67	0
5/27/2010	JBZ	05:01 PM	05:00 PM	Chumani	2	0	1	29	0	0	0	3.53	0	45.47	29.4	21.6
5/28/2010	JBZ	09:17 AM	09:00 AM	Chumani	3	8.5	1	20	97.33	0	0	0	0	0	2.67	0
5/28/2010	JBZ	10:04 AM	10:00 AM	Chumani	3	1.5	1	22	95.93	0	0	2.53	0	0	1.53	0
5/28/2010	JBZ	11:04 AM	11:00 AM	Chumani	3	12.5	1	24	0	0.47	0	0	0	90.2	7.87	1.47
5/28/2010	JBZ	12:08 PM	12:00 PM	Chumani	3	7	1	26	0	0	0	0	0	59.87	36.8	3.33
5/28/2010	JBZ	01:09 PM	01:00 PM	Chumani	3	8.5	1	27	3	1.53	0	17.67	0	51.2	26.13	0.47
5/28/2010	JBZ	02:10 PM	02:00 PM	Chumani	3	8.5	1	29	0	0	0	0	0	77.53	20	2.47
5/28/2010	JBZ	03:08 PM	03:00 PM	Chumani	3	2	1	29	40.07	0	15.8	5.87	0	16.53	18.2	3.53
5/28/2010	JBZ	04:01 PM	04:00 PM	Chumani	3	3	1	30	100	0	0	0	0	0	0	0
5/28/2010	JBZ	05:00 PM	05:00 PM	Chumani	3	3	1	29	0	0.87	0	0	0	78.6	10.2	10.33
5/31/2010	JBZ	10:01 AM	10:00 AM	Chumani	2	0	3	24	0	11.8	0	0	0	78.4	9.8	0
5/31/2010	JBZ	11:03 AM	11:00 AM	Chumani	2	7	3	27	0	0	0	6.87	0	89.13	4	0
5/31/2010	JBZ	12:13 PM	12:00 PM	Chumani	2	6.5	3	27	0	10.13	0	1.2	0	79.4	7.47	1.8

Table 14 (cont.)

Date	Zoo	Time	Block	Otter	Meals	Vstr	Wthr	Tmp (^{o}C)	Rst	Eat	Stp	Mnt	Soc	Loc	Inv	Otr
5/31/2010	JBZ	01:00 PM	01:00 PM	Chumani	2	8.5	3	27	100	0	0	0	0	0	0	0
5/31/2010	JBZ	02:00 PM	02:00 PM	Chumani	2	6	4	25	100	0	0	0	0	0	0	0
5/31/2010	JBZ	03:26 PM	03:00 PM	Chumani	2	1	4	21	0	5.33	0	0.53	0	73.6	11.53	9
5/31/2010	JBZ	04:06 PM	04:00 PM	Chumani	2	0	4	21	0	1.33	0	2.13	0	75.07	19.6	1.87
5/31/2010	JBZ	05:00 PM	05:00 PM	Chumani	2	0	4	21	0	0	0	0.67	0	74.13	22.73	2.47
6/1/2010	JBZ	09:28 AM	09:00 AM	Chumani	3	0	1	21	0	3.87	0	0.67	0	85.8	9.67	0
6/1/2010	JBZ	10:00 AM	10:00 AM	Chumani	3	0	1	21	100	0	0	0	0	0	0	0
6/1/2010	JBZ	11:00 AM	11:00 AM	Chumani	3	20.5	1	22	0	1.53	0	0	0	89.27	8.67	0.53
6/1/2010	JBZ	12:34 PM	12:00 PM	Chumani	3	5	1	26	96.47	0	0	0	0	0	3.53	0
6/1/2010	JBZ	01:00 PM	01:00 PM	Chumani	3	5.5	1	26	100	0	0	0	0	0	0	0
6/1/2010	JBZ	02:02 PM	02:00 PM	Chumani	3	3.5	1	26	100	0	0	0	0	0	0	0
6/1/2010	JBZ	03:00 PM	03:00 PM	Chumani	3	2.5	1	27	100	0	0	0	0	0	0	0
6/1/2010	JBZ	04:03 PM	04:00 PM	Chumani	3	1	1	27	0	1.33	0	1.13	0	89.73	6.93	0.87
6/1/2010	JBZ	05:00 PM	05:00 PM	Chumani	3	2	1	27	0	0.47	0	0	0	72.93	22.6	4
6/2/2010	JBZ	09:23 AM	09:00 AM	Chumani	2	0	4	19	0	7.67	0	0	0	86.2	6.13	0
6/2/2010	JBZ	10:11 AM	10:00 AM	Chumani	2	0	4	19	0	2.47	0	4.33	0	74.33	14.33	4.53
6/2/2010	JBZ	11:09 AM	11:00 AM	Chumani	2	3	4	19	0	0	0	0.87	0	86	13.13	0
6/2/2010	JBZ	12:25 PM	12:00 PM	Chumani	2	5	4	20	0	0	0	8.33	0	67.53	24.13	0
6/2/2010	JBZ	01:07 PM	01:00 PM	Chumani	2	7	3	21	0	0	0	5.8	0	72.73	21.47	0
6/2/2010	JBZ	02:05 PM	02:00 PM	Chumani	2	6	3	22	52.33	0	0	24.47	0	1.87	17.53	3.8
6/2/2010	JBZ	03:25 PM	03:00 PM	Chumani	2	1	3	23	0	0.53	0	5.87	0	55.73	37.87	0
6/2/2010	JBZ	04:00 PM	04:00 PM	Chumani	2	0	2	23	0	0	0	0.67	0	70.53	28.8	0
6/2/2010	JBZ	05:00 PM	05:00 PM	Chumani	2	0	3	23	0	0	0	2.47	0	52.87	43.47	1.2
6/3/2010	PPZ	09:12 AM	09:00 AM	Jilly	3	0	3	17	0	0	0	1.2	13.6	74.73	10.47	0
6/3/2010	PPZ	09:28 AM	09:00 AM	Mike	3	0	3	18	0	0	0	1.67	7	88.2	2.8	0.33
6/3/2010	PPZ	10:02 AM	10:00 AM	Mike	3	15	3	18	0	0	0	0.47	0.87	96.13	2.2	0.33
6/3/2010	PPZ	10:18 AM	10:00 AM	Jilly	3	27.5	3	18	1.33	0	0	5.67	0	79	14	0
6/3/2010	PPZ	11:14 AM	11:00 AM	Jilly	3	9	3	19	0	0	3.67	0	1.67	80.93	13.53	0.2
6/3/2010	PPZ	11:30 AM	11:00 AM	Mike	3	11.5	3	19	0	0	0	2.87	0	94.8	2.33	0
6/3/2010	PPZ	12:03 PM	12:00 PM	Jilly	3	37.5	3	19	86	0	0	0	5.47	0	8.53	0
6/3/2010	PPZ	12:19 PM	12:00 PM	Mike	3	25	3	20	0	0	0	0	0	95.07	2	2.93
6/3/2010	PPZ	01:30 PM	01:00 PM	Mike	3	4	3	21	0	0	0	5.67	1.33	92.2	0.8	0

Table 14 (cont.)

Date	Zoo	Time	Block	Otter	Meals	Vstr	Wthr	Tmp (^{o}C)	Rst	Eat	Stp	Mnt	Soc	Loc	Inv	Otr
6/3/2010	PPZ	01:46 PM	01:00 PM	Jilly	3	9	3	21	26.87	0	0	2.53	2	39.73	28.87	0
6/3/2010	PPZ	02:07 PM	02:00 PM	Mike	3	8.5	3	22	0	0	0	0	0	99	1	0
6/3/2010	PPZ	02:24 PM	02:00 PM	Jilly	3	4	3	23	88.87	0	0	0	0	0	11.13	0
6/3/2010	PPZ	03:03 PM	03:00 PM	Mike	3	3	3	23	0	0	0	1.13	0	94.67	3.2	1
6/3/2010	PPZ	03:50 PM	03:00 PM	Jilly	3	3.5	3	23	0	0	0	32	0	43.67	21.2	3.13
6/3/2010	PPZ	04:05 PM	04:00 PM	Shaq	2	0	3	23	34.53	0	0	59.27	0	6.2	0	0
6/3/2010	PPZ	04:21 PM	04:00 PM	Jilly	3	0	2	23	100	0	0	0	0	0	0	0
6/3/2010	PPZ	05:00 PM	05:00 PM	Jilly	3	2	3	23	96.87	0	0	0	0	0	3.13	0
6/3/2010	PPZ	05:00 PM	05:00 PM	Shaq	2	2	3	23	100	0	0	0	0	0	0	0
6/4/2010	PPZ	09:15 AM	09:00 AM	Mike	4	20	3	19	0	0	0	5.73	15.87	56.53	13.2	8.67
6/4/2010	PPZ	09:31 AM	09:00 AM	Jilly	3	14.5	3	21	75.67	0	0	8.73	10.67	1.13	3.8	0
6/4/2010	PPZ	10:06 AM	10:00 AM	Jilly	3	8.5	3	21	40.47	0	0	4.33	0	50.93	4.27	0
6/4/2010	PPZ	10:24 AM	10:00 AM	Mike	4	17.5	3	23	0	0	0	0	0	94.13	5.87	0
6/4/2010	PPZ	11:21 AM	11:00 AM	Mike	4	26	3	23	0	2.13	0	2.53	8.87	62.4	23.87	0.2
6/4/2010	PPZ	11:37 AM	11:00 AM	Jilly	3	26	3	23	7.8	0	0	3.33	0	72.8	15.53	0.53
6/4/2010	PPZ	12:27 PM	12:00 PM	Mike	4	17.5	3	23	0	0	19.8	0.2	0	78.47	1.53	0
6/4/2010	PPZ	12:44 PM	12:00 PM	Jilly	3	12	3	23	98.47	0	0	0	0	0	1.53	0
6/4/2010	PPZ	01:09 PM	01:00 PM	Jilly	3	14	3	23	94.53	0	0	4.13	0	0	1.33	0
6/4/2010	PPZ	01:27 PM	01:00 PM	Mike	4	8.5	3	24	0	0	29.8	0	8.47	52.47	8.8	0.47
6/4/2010	PPZ	02:05 PM	02:00 PM	Jilly	3	4.5	3	24	0	0	0	3.53	0	88.33	5.93	2.2
6/4/2010	PPZ	02:21 PM	02:00 PM	Mike	4	0	3	24	0	0	36	0	0	57.07	5.8	1.13
6/4/2010	PPZ	03:00 PM	03:00 PM	Mike	4	2.5	3	25	0	0	18.8	0	0	65.27	13.53	2.4
6/4/2010	PPZ	03:28 PM	03:00 PM	Jilly	3	2	3	25	0	0	18.47	0	0	70.6	6.27	4.67
6/4/2010	PPZ	04:02 PM	04:00 PM	Jilly	3	0	3	25	84	0	0	5.6	0	1.53	8.87	0
6/4/2010	PPZ	04:20 PM	04:00 PM	Shaq	4	2	3	25	0	0	0	0.33	0	75	22.33	2.33
6/4/2010	PPZ	05:00 PM	05:00 PM	Jilly	3	0	3	26	42.67	0	0	2	0	24.2	31.13	0
6/4/2010	PPZ	05:16 PM	05:00 PM	Shaq	4	1.5	3	25	0	0	0	1.53	12.13	83	0	3.33
6/7/2010	PPZ	10:19 AM	10:00 AM	Mike	3	18	1	16	0	0	0	2.8	5.47	57.87	33	0.87
6/7/2010	PPZ	10:40 AM	10:00 AM	Jilly	4	6.5	1	17	27.47	0	0	0	3.93	42.53	20.07	6
6/7/2010	PPZ	11:40 AM	11:00 AM	Mike	3	11	1	18	0	0.47	0	1.2	6.13	84.6	7.6	0
6/7/2010	PPZ	11:56 AM	11:00 AM	Jilly	4	11.5	1	18	0	0	0	0	0	92.47	7.53	0
6/7/2010	PPZ	12:18 PM	12:00 PM	Mike	3	13.5	1	18	0	0	0	0.67	2.47	92.2	4.67	0

Table 14 (cont.)

Date	Zoo	Time	Block	Otter	Meals	Vstr	Wthr	Tmp (^{o}C)	Rst	Eat	Stp	Mnt	Soc	Loc	Inv	Otr
6/7/2010	PPZ	12:34 PM	12:00 PM	Jilly	4	6.5	1	19	86	0	0	1.67	4.47	0	7.87	0
6/7/2010	PPZ	01:29 PM	01:00 PM	Mike	3	8	1	19	83.6	0	0	13.87	0	0	2.53	0
6/7/2010	PPZ	01:45 PM	01:00 PM	Jilly	4	1	1	19	87.8	0	0	1.33	2.53	3.67	4.67	0
6/7/2010	PPZ	02:04 PM	02:00 PM	Mike	3	2	1	19	0	0	38.67	0	0	56.87	4.47	0
6/7/2010	PPZ	02:22 PM	02:00 PM	Jilly	4	3	1	19	70.6	0	0	2.2	0	10	17.2	0
6/7/2010	PPZ	03:09 PM	03:00 PM	Mike	3	4	1	19	0	0	9.13	1.47	4.8	82.4	2	0.2
6/7/2010	PPZ	03:43 PM	03:00 PM	Jilly	4	0	1	21	22.2	2.67	0	19.13	0	5.73	50.27	0
6/7/2010	PPZ	04:04 PM	04:00 PM	Shaq	4	4	1	21	77.73	0	0	0	0	2.8	19.47	0
6/7/2010	PPZ	04:25 PM	04:00 PM	Jilly	4	1	1	21	100	0	0	0	0	0	0	0
6/7/2010	PPZ	05:00 PM	05:00 PM	Jilly	4	0	1	21	100	0	0	0	0	0	0	0
6/7/2010	PPZ	05:15 PM	05:00 PM	Shaq	4	0	1	21	100	0	0	0	0	0	0	0
6/8/2010	PPZ	09:20 AM	09:00 AM	Jilly	3	3.5	2	17	0	0.47	0	2.2	13.2	66.27	17.87	0
6/8/2010	PPZ	09:41 AM	09:00 AM	Mike	3	0.5	2	18	0	0	0	12.53	3.47	81.53	2.47	0
6/8/2010	PPZ	10:12 AM	10:00 AM	Jilly	3	9	2	18	0	0	2.87	2.8	9.8	69.47	14.4	0.67
6/8/2010	PPZ	10:29 AM	10:00 AM	Mike	3	19.5	2	19	0	0	0	0	2.67	92.13	4.73	0.47
6/8/2010	PPZ	11:00 AM	11:00 AM	Jilly	3	11.5	2	19	90.8	0	0	0	2.67	0	6.53	0
6/8/2010	PPZ	11:15 AM	11:00 AM	Mike	3	16.5	2	19	0	0	15.47	3.67	4.67	72	4.2	0
6/8/2010	PPZ	12:04 PM	12:00 PM	Jilly	3	1.5	2	19	99.8	0	0	0	0	0	0.2	0
6/8/2010	PPZ	12:04 PM	12:00 PM	Mike	3	1.5	2	19	99.2	0	0	0	0	0	0.8	0
6/8/2010	PPZ	01:03 PM	01:00 PM	Mike	3	16	3	21	0	0	0	0.87	2.87	69.73	26.33	0.2
6/8/2010	PPZ	01:27 PM	01:00 PM	Jilly	3	11.5	3	19	0	0	9.53	0	0	87.67	2.6	0.2
6/8/2010	PPZ	02:04 PM	02:00 PM	Mike	3	4	3	19	0	0	0	2	0	86.67	8.2	3.13
6/8/2010	PPZ	02:35 PM	02:00 PM	Jilly	3	5	3	18	0	0	2.53	0	0	93.33	2.33	1.8
6/8/2010	PPZ	03:04 PM	03:00 PM	Mike	3	3	3	18	0	0	0	0	0	79.93	16.93	3.13
6/8/2010	PPZ	03:23 PM	03:00 PM	Jilly	3	0	4	16	0	0	25	0	0	60.87	3.13	11
6/8/2010	PPZ	04:00 PM	04:00 PM	Shaq	3	0	4	16	0	0	0	0	0	91.73	6.93	1.33
6/8/2010	PPZ	05:03 PM	05:00 PM	Shaq	3	0	4	17	0	0	0	12.2	0	68.8	6.8	12.2
6/9/2010	PPZ	09:00 AM	09:00 AM	Mike	3	13	3	17	0	0	25.67	9.33	9.13	52.8	3.07	0
6/9/2010	PPZ	09:18 AM	09:00 AM	Jilly	3	8	3	18	0	0	0	1.67	2	73.33	21.2	1.8
6/9/2010	PPZ	10:02 AM	10:00 AM	Jilly	3	0	3	18	81.67	0	0	0	14.67	0.53	3.13	0
6/9/2010	PPZ	10:17 AM	10:00 AM	Mike	3	4	3	18	0	0	63.53	0	0	32.27	0	4.2
6/9/2010	PPZ	11:00 AM	11:00 AM	Mike	3	5.5	3	21	0	0	0	0.13	0	61.4	3	35.47

Table 14 (cont.)

Date	Zoo	Time	Block	Otter	Meals	Vstr	Wthr	Tmp (^{o}C)	Rst	Eat	Stp	Mnt	Soc	Loc	Inv	Otr
6/9/2010	PPZ	11:18 AM	11:00 AM	Jilly	3	12	3	21	1.53	1.8	0	0	0	54.2	27.67	14.8
6/9/2010	PPZ	12:09 PM	12:00 PM	Mike	3	1	2	22	90.33	0	0	6.87	1.13	1.33	0.33	0
6/9/2010	PPZ	12:09 PM	12:00 PM	Jilly	3	1	2	22	99	0	0	0	0	0	1	0
6/9/2010	PPZ	01:00 PM	01:00 PM	Jilly	3	4.5	1	24	96.8	0	0	1	0	0	2.2	0
6/9/2010	PPZ	01:15 PM	01:00 PM	Mike	3	0	1	24	0	1.53	0	21	2.8	61.6	13.07	0
6/9/2010	PPZ	02:00 PM	02:00 PM	Mike	3	7.5	1	25	0	0	0	0	4.2	90.33	5.13	0.33
6/9/2010	PPZ	02:19 PM	02:00 PM	Jilly	3	6	1	25	0	0	46.67	0	0	46.33	6.67	0.33
6/9/2010	PPZ	03:01 PM	03:00 PM	Jilly	3	3	1	25	0	0	68.93	0	0	27.73	3.33	0
6/9/2010	PPZ	03:20 PM	03:00 PM	Mike	3	3.5	1	25	0	0	0	0	0	77.87	5.13	17
6/9/2010	PPZ	04:03 PM	04:00 PM	Jilly	3	4.5	1	25	96.33	0	0	2.2	0	0	1.47	0
6/9/2010	PPZ	04:03 PM	04:00 PM	Shaq	3	4.5	1	25	35.93	0	0	24.87	0	28.33	10.87	0
6/9/2010	PPZ	05:00 PM	05:00 PM	Jilly	3	0	2	24	1.8	0	16.67	2.53	0	76.67	2.33	0
6/9/2010	PPZ	05:00 PM	05:00 PM	Shaq	3	0	2	24	100	0	0	0	0	0	0	0
6/10/2010	JBZ	09:08 AM	09:00 AM	Chumani	3	0	1	19	93.4	0	0	3.8	0	0	2.8	0
6/10/2010	JBZ	10:08 AM	10:00 AM	Chumani	3	2	1	21	98.53	0	0	0	0	0	1.47	0
6/10/2010	JBZ	11:04 AM	11:00 AM	Chumani	3	7.5	1	22	100	0	0	0	0	0	0	0
6/10/2010	JBZ	12:02 PM	12:00 PM	Chumani	3	8.5	1	23	0	4	0	0.47	0	85.47	9.2	0.87
6/10/2010	JBZ	01:20 PM	01:00 PM	Chumani	3	6	1	24	0	0	0	3.87	0	77.53	14.27	4.33
6/10/2010	JBZ	02:04 PM	02:00 PM	Chumani	3	8	1	24	21.87	0	0	36.33	0	4.8	37	0
6/10/2010	JBZ	03:01 PM	03:00 PM	Chumani	3	9	1	23	100	0	0	0	0	0	0	0
6/10/2010	JBZ	04:08 PM	04:00 PM	Chumani	3	0	1	23	100	0	0	0	0	0	0	0
6/10/2010	JBZ	05:00 PM	05:00 PM	Chumani	3	4	2	23	0	0.87	0	0	0	83.27	13.2	2.67
6/11/2010	JBZ	09:12 AM	09:00 AM	Chumani	2	0	3	22	0	3	0	17.73	0	55.13	13.33	10.8
6/11/2010	JBZ	10:14 AM	10:00 AM	Chumani	2	0	3	22	100	0	0	0	0	0	0	0
6/11/2010	JBZ	11:14 AM	11:00 AM	Chumani	2	1.5	4	19	100	0	0	0	0	0	0	0
6/11/2010	JBZ	12:43 PM	12:00 PM	Chumani	2	1.5	3	22	0	0	0	0	0	69.33	26.47	4.2
6/11/2010	JBZ	01:02 PM	01:00 PM	Chumani	2	0	3	22	0	2.13	0	0	0	82.93	12.4	2.53
6/11/2010	JBZ	02:00 PM	02:00 PM	Chumani	2	5.5	2	24	99.13	0	0	0.87	0	0	0	0
6/11/2010	JBZ	03:02 PM	03:00 PM	Chumani	2	0	2	26	100	0	0	0	0	0	0	0
6/14/2010	JBZ	10:28 AM	10:00 AM	Chumani	2	3	2	23	98.47	0	0	1.53	0	0	0	0
6/14/2010	JBZ	11:00 AM	11:00 AM	Chumani	2	8.5	2	23	100	0	0	0	0	0	0	0
6/14/2010	JBZ	12:00 PM	12:00 PM	Chumani	2	15.5	3	24	0	0	0	0	0	87.53	10.07	2.4

Table 14 (cont.)

Date	Zoo	Time	Block	Otter	Meals	Vstr	Wthr	Tmp (^{o}C)	Rst	Eat	Stp	Mnt	Soc	Loc	Inv	Otr
6/14/2010	JBZ	01:00 PM	01:00 PM	Chumani	2	8.5	3	24	65	0	0	33.33	0	0	1.67	0
6/14/2010	JBZ	02:05 PM	02:00 PM	Chumani	2	4	3	23	99.2	0	0	0	0	0	0.8	0
6/14/2010	JBZ	03:08 PM	03:00 PM	Chumani	2	2.5	4	23	100	0	0	0	0	0	0	0
6/14/2010	JBZ	04:05 PM	04:00 PM	Chumani	2	0	3	23	100	0	0	0	0	0	0	0
6/14/2010	JBZ	05:00 PM	05:00 PM	Chumani	2	2	3	23	100	0	0	0	0	0	0	0
6/15/2010	JBZ	09:32 AM	09:00 AM	Chumani	2	0	3	18	99.2	0	0	0	0	0	0.8	0
6/15/2010	JBZ	10:09 AM	10:00 AM	Chumani	2	0	3	19	99.67	0	0	0	0	0	0.33	0
6/15/2010	JBZ	11:00 AM	11:00 AM	Chumani	2	1.5	4	20	0	0	0	1.8	0	57.2	36.33	4.67
6/15/2010	JBZ	12:00 PM	12:00 PM	Chumani	2	6.5	3	21	100	0	0	0	0	0	0	0
6/15/2010	JBZ	01:07 PM	01:00 PM	Chumani	2	5.5	3	22	100	0	0	0	0	0	0	0
6/15/2010	JBZ	02:02 PM	02:00 PM	Chumani	2	7.5	3	23	100	0	0	0	0	0	0	0
6/15/2010	JBZ	03:02 PM	03:00 PM	Chumani	2	2	3	23	100	0	0	0	0	0	0	0
6/15/2010	JBZ	04:02 PM	04:00 PM	Chumani	2	0	3	23	100	0	0	0	0	0	0	0
6/15/2010	JBZ	05:00 PM	05:00 PM	Chumani	2	0	3	24	61.47	0	0	33.67	0	0	4.87	0
6/16/2010	JBZ	09:34 AM	09:00 AM	Chumani	2	2	3	21	92.8	0	0	1.2	0	0	6	0
6/16/2010	JBZ	10:00 AM	10:00 AM	Chumani	2	0	2	21	92.47	0	0	0	0	0	7.53	0
6/16/2010	JBZ	11:00 AM	11:00 AM	Chumani	2	9	3	21	100	0	0	0	0	0	0	0
6/16/2010	JBZ	12:00 PM	12:00 PM	Chumani	2	11	3	21	98.8	0	0	0	0	0	1.2	0
6/16/2010	JBZ	01:01 PM	01:00 PM	Chumani	2	4.5	3	21	100	0	0	0	0	0	0	0
6/16/2010	JBZ	02:00 PM	02:00 PM	Chumani	2	7	3	21	93.27	0	0	2.2	0	0	4.53	0
6/16/2010	JBZ	03:28 PM	03:00 PM	Chumani	2	10	3	22	0	0	0	0	0	87.87	11.33	0.8
6/16/2010	JBZ	04:01 PM	04:00 PM	Chumani	2	3.5	3	22	0	0	0	11	0	75.27	13.07	0.67
6/16/2010	JBZ	05:00 PM	05:00 PM	Chumani	2	3	3	21	0	0	0	0.2	0	82	12	5.8
6/17/2010	PPZ	09:10 AM	09:00 AM	Mike	3	0	2	18	0	0	0	24.33	0.8	65.2	9.33	0.33
6/17/2010	PPZ	09:26 AM	09:00 AM	Jilly	3	2.5	2	18	2.33	0	0	1.67	9.8	57.33	28.53	0.33
6/17/2010	PPZ	10:12 AM	10:00 AM	Mike	3	4	2	19	100	0	0	0	0	0	0	0
6/17/2010	PPZ	10:28 AM	10:00 AM	Jilly	3	10.5	2	19	100	0	0	0	0	0	0	0
6/17/2010	PPZ	11:02 AM	11:00 AM	Mike	3	3	2	21	0	0	0	0.67	7.67	77.4	13.8	0.47
6/17/2010	PPZ	11:18 AM	11:00 AM	Jilly	3	0.5	2	21	0	4.67	0	4.13	0.2	68.6	22.4	0
6/17/2010	PPZ	12:01 PM	12:00 PM	Mike	3	1.5	1	22	45.13	0	0	35.53	0	19.33	0	0
6/17/2010	PPZ	12:18 PM	12:00 PM	Jilly	3	2.5	1	22	100	0	0	0	0	0	0	0
6/17/2010	PPZ	01:04 PM	01:00 PM	Mike	3	8	1	23	38.67	0	0	6.67	0	52.67	1.67	0.33

Table 14 (cont.)

Date	Zoo	Time	Block	Otter	Meals	Vstr	Wthr	Tmp (°C)	Rst	Eat	Stp	Mnt	Soc	Loc	Inv	Otr
6/17/2010	PPZ	01:22 PM	01:00 PM	Jilly	3	9.5	1	23	100	0	0	0	0	0	0	0
6/17/2010	PPZ	02:07 PM	02:00 PM	Mike	3	8.5	1	24	0	0	0	0	0	96.33	3.67	0
6/17/2010	PPZ	02:25 PM	02:00 PM	Jilly	3	12	1	24	100	0	0	0	0	0	0	0
6/17/2010	PPZ	03:00 PM	03:00 PM	Mike	3	4	1	24	0	0	0	0	0	81.2	0.47	18.33
6/17/2010	PPZ	03:31 PM	03:00 PM	Jilly	3	5.5	1	24	2.53	0	0	0	0	73.67	23.33	0.47
6/17/2010	PPZ	04:05 PM	04:00 PM	Jilly	3	2.5	1	24	100	0	0	0	0	0	0	0
6/17/2010	PPZ	04:05 PM	04:00 PM	Shaq	2	2.5	1	24	100	0	0	0	0	0	0	0
6/17/2010	PPZ	05:00 PM	05:00 PM	Jilly	3	3	1	25	100	0	0	0	0	0	0	0
6/17/2010	PPZ	05:00 PM	05:00 PM	Shaq	2	3	1	25	100	0	0	0	0	0	0	0
6/18/2010	PPZ	09:27 AM	09:00 AM	Mike	3	3	2	23	0	0	0	15.73	11.47	67.33	5.47	0
6/18/2010	PPZ	09:42 AM	09:00 AM	Jilly	3	3	2	23	75.87	0	0	1.2	22.93	0	0	0
6/18/2010	PPZ	10:01 AM	10:00 AM	Mike	3	0	2	23	0	0	0	2.87	16.8	37.93	34.4	8
6/18/2010	PPZ	10:18 AM	10:00 AM	Jilly	3	2.5	3	23	5.53	0	0	0	0.47	76.53	16.47	1
6/18/2010	PPZ	11:09 AM	11:00 AM	Mike	3	7.5	3	26	3.87	0	0	0	1.87	69.07	21	4.2
6/18/2010	PPZ	11:25 AM	11:00 AM	Jilly	3	5	2	28	83.47	0	0	0	11.87	2.33	2.33	0
6/18/2010	PPZ	12:09 PM	12:00 PM	Mike	3	6	1	28	0	1.33	0	13.2	4	69.27	11.67	0.53
6/18/2010	PPZ	12:24 PM	12:00 PM	Jilly	3	3.5	1	28	94.27	0	0	3.07	0	1.8	0.87	0
6/18/2010	PPZ	01:00 PM	01:00 PM	Mike	3	3	1	28	100	0	0	0	0	0	0	0
6/18/2010	PPZ	01:00 PM	01:00 PM	Jilly	3	3	1	28	100	0	0	0	0	0	0	0
6/18/2010	PPZ	02:25 PM	02:00 PM	Jilly	3	6.5	1	31	100	0	0	0	0	0	0	0
6/18/2010	PPZ	02:41 PM	02:00 PM	Mike	3	5.5	1	31	0	0	0	0	0	94.13	5.87	0
6/18/2010	PPZ	03:00 PM	03:00 PM	Mike	3	6.5	1	31	0	0	0	0	0	95.33	4.67	0
6/18/2010	PPZ	03:15 PM	03:00 PM	Jilly	3	4	2	31	86.6	0	0	0	0.67	0.87	11.87	0
6/18/2010	PPZ	04:09 PM	04:00 PM	Shaq	2	8	2	28	3.53	0	0	4.8	6	80.33	5.33	0
6/18/2010	PPZ	04:24 PM	04:00 PM	Jilly	3	11	2	31	0	0	0	10.8	0	81.87	7.33	0
6/18/2010	PPZ	05:00 PM	05:00 PM	Shaq	2	1	1	31	100	0	0	0	0	0	0	0
6/18/2010	PPZ	05:00 PM	05:00 PM	Jilly	3	1	1	31	82.47	0	0	0	0	10.67	6.87	0
6/21/2010	JBZ	09:46 AM	09:00 AM	Chumani	2	0	1	25	0	9.33	0	0	0	76.8	13.87	0
6/21/2010	JBZ	10:15 AM	10:00 AM	Chumani	2	4	1	25	0	11.33	0	0	0	72.13	16.53	0
6/21/2010	JBZ	11:01 AM	11:00 AM	Chumani	2	9	2	26	0	7.2	0	2.2	0	88.8	1.8	0
6/21/2010	JBZ	12:02 PM	12:00 PM	Chumani	2	12	2	26	0	1.8	0	0	0	85.27	12.93	0
6/21/2010	JBZ	01:08 PM	01:00 PM	Chumani	2	4.5	3	26	97.93	0	0	0.87	0	0	1.2	0

Table 14 (cont.)

Date	Zoo	Time	Block	Otter	Meals	Vstr	Wthr	Tmp (^{o}C)	Rst	Eat	Stp	Mnt	Soc	Loc	Inv	Otr
6/21/2010	JBZ	02:08 PM	02:00 PM	Chumani	2	1.5	3	26	100	0	0	0	0	0	0	0
6/21/2010	JBZ	03:09 PM	03:00 PM	Chumani	2	3.5	3	27	98	0	0	1.2	0	0	0.8	0
6/21/2010	JBZ	04:00 PM	04:00 PM	Chumani	2	7	3	27	100	0	0	0	0	0	0	0
6/21/2010	JBZ	05:00 PM	05:00 PM	Chumani	2	0	2	28	100	0	0	0	0	0	0	0
6/22/2010	JBZ	09:22 AM	09:00 AM	Chumani	3	0	2	24	0	2.33	0	93.2	0	0	4.47	0
6/22/2010	JBZ	10:12 AM	10:00 AM	Chumani	3	1	2	24	98.47	0	0	0.47	0	0	0.53	0.53
6/22/2010	JBZ	11:04 AM	11:00 AM	Chumani	3	5.5	2	24	58.4	19.2	0	1.8	0	18.47	2.13	0
6/22/2010	JBZ	12:00 PM	12:00 PM	Chumani	3	8	2	26	0	10.47	0	8.07	0	72.87	8.6	0
6/22/2010	JBZ	01:12 PM	01:00 PM	Chumani	3	8	1	27	100	0	0	0	0	0	0	0
6/22/2010	JBZ	02:12 PM	02:00 PM	Chumani	3	1	1	27	100	0	0	0	0	0	0	0
6/22/2010	JBZ	03:02 PM	03:00 PM	Chumani	3	6.5	1	28	100	0	0	0	0	0	0	0
6/22/2010	JBZ	04:04 PM	04:00 PM	Chumani	3	3	1	28	87.33	0	0	4.67	0	0	8	0
6/22/2010	JBZ	05:00 PM	05:00 PM	Chumani	3	2	1	28	0	0	0	0	0	52.2	9.33	38.47
6/23/2010	JBZ	09:43 AM	09:00 AM	Chumani	2	0	4	22	0	10.87	0	0	0	85.93	3.2	0
6/23/2010	JBZ	10:31 AM	10:00 AM	Chumani	2	1	3	24	0	6.53	0	20	0	51.2	22.27	0
6/23/2010	JBZ	11:11 AM	11:00 AM	Chumani	2	0	3	24	10.13	0	0	60.47	0	2.8	26.6	0
6/23/2010	JBZ	12:14 PM	12:00 PM	Chumani	2	0	3	26	0	0	0	0	0	17.6	82.4	0
6/23/2010	JBZ	01:04 PM	01:00 PM	Chumani	2	0	3	27	0	0	0	0	0	73.87	26.13	0
6/23/2010	JBZ	02:38 PM	02:00 PM	Chumani	2	0	1	30	98.87	0	0	0	0	0	1.13	0
6/23/2010	JBZ	03:20 PM	03:00 PM	Chumani	2	0	1	30	100	0	0	0	0	0	0	0
6/23/2010	JBZ	04:00 PM	04:00 PM	Chumani	2	3	1	29	100	0	0	0	0	0	0	0
6/23/2010	JBZ	05:00 PM	05:00 PM	Chumani	2	0	1	28	100	0	0	0	0	0	0	0
6/24/2010	PPZ	09:09 AM	09:00 AM	Mike	5	2	3	22	0	0	0	9.8	0	85.27	4.93	0
6/24/2010	PPZ	09:25 AM	09:00 AM	Jilly	5	1.5	2	22	85.6	0	0	12.67	0	1.2	0.53	0
6/24/2010	PPZ	10:02 AM	10:00 AM	Mike	5	0.5	2	22	92.8	0	0	7.2	0	0	0	0
6/24/2010	PPZ	10:19 AM	10:00 AM	Jilly	5	6	1	23	100	0	0	0	0	0	0	0
6/24/2010	PPZ	11:07 AM	11:00 AM	Mike	5	4	1	23	0	0	0	5.87	0	83.67	10	0.47
6/24/2010	PPZ	11:23 AM	11:00 AM	Jilly	5	3	1	24	94.93	0	0	1.67	0	0	3.4	0
6/24/2010	PPZ	12:03 PM	12:00 PM	Mike	5	0	2	24	100	0	0	0	0	0	0	0
6/24/2010	PPZ	12:19 PM	12:00 PM	Jilly	5	9	1	24	98.33	0	0	0	1.67	0	0	0
6/24/2010	PPZ	01:11 PM	01:00 PM	Mike	5	12	2	24	0	5.33	0	4.53	0	83.47	5.53	1.13
6/24/2010	PPZ	01:27 PM	01:00 PM	Jilly	5	2.5	2	25	91	0	0	0	0	2.53	6.47	0

Table 14 (cont.)

Date	Zoo	Time	Block	Otter	Meals	Vstr	Wthr	Tmp (^{o}C)	Rst	Eat	Stp	Mnt	Soc	Loc	Inv	Otr
6/24/2010	PPZ	02:01 PM	02:00 PM	Mike	5	8.5	1	25	100	0	0	0	0	0	0	0
6/24/2010	PPZ	02:17 PM	02:00 PM	Jilly	5	4	1	25	91.87	0	0	0	0	0	8.13	0
6/24/2010	PPZ	03:00 PM	03:00 PM	Mike	5	6.5	1	26	0	0	0	0	0	96.33	3.67	0
6/24/2010	PPZ	03:00 PM	03:00 PM	Jilly	5	6.5	1	26	100	0	0	0	0	0	0	0
6/24/2010	PPZ	04:00 PM	04:00 PM	Jilly	5	5.5	1	26	0	3.87	6.67	0	0	81.53	7.6	0.33
6/24/2010	PPZ	04:15 PM	04:00 PM	Shaq	5	3	1	26	100	0	0	0	0	0	0	0
6/24/2010	PPZ	05:00 PM	05:00 PM	Jilly	5	2	2	25	100	0	0	0	0	0	0	0
6/24/2010	PPZ	05:00 PM	05:00 PM	Shaq	5	2	2	25	100	0	0	0	0	0	0	0
6/25/2010	PPZ	09:16 AM	09:00 AM	Mike	Unknown	9.5	1	20	0	0	0	6.53	17.53	74.27	1.67	0
6/25/2010	PPZ	09:32 AM	09:00 AM	Jilly	Unknown	0	1	22	44.73	0	0	15.47	2.53	23.47	13.8	0
6/25/2010	PPZ	10:02 AM	10:00 AM	Mike	Unknown	3	1	22	0.87	0	0	30.47	0.87	45.33	19.33	3.13
6/25/2010	PPZ	10:19 AM	10:00 AM	Jilly	Unknown	5	1	22	100	0	0	0	0	0	0	0
6/25/2010	PPZ	11:00 AM	11:00 AM	Mike	Unknown	9	1	23	0.87	11	0	3.47	0.8	76.8	6.87	0.2
6/25/2010	PPZ	11:52 AM	11:00 AM	Jilly	Unknown	14.5	1	24	0	0	0	6.2	4.13	84.13	5.53	0
6/25/2010	PPZ	12:10 PM	12:00 PM	Mike	Unknown	1.5	1	24	64.93	0	0	33.27	0	1.8	0	0
6/25/2010	PPZ	12:25 PM	12:00 PM	Jilly	Unknown	1.5	1	25	100	0	0	0	0	0	0	0
6/25/2010	PPZ	01:01 PM	01:00 PM	Mike	Unknown	8	1	25	0	0	0	1.2	8.47	75.67	14.67	0
6/25/2010	PPZ	01:17 PM	01:00 PM	Jilly	Unknown	15	1	25	0	0	0	1.53	14.53	83.47	0.47	0
6/25/2010	PPZ	02:12 PM	02:00 PM	Mike	Unknown	11	1	26	0	19.8	0	1.33	0	57.2	4.87	16.8
6/25/2010	PPZ	02:28 PM	02:00 PM	Jilly	Unknown	11	1	26	35.13	0.8	0	20.13	0	26.4	11.33	6.2
6/25/2010	PPZ	03:00 PM	03:00 PM	Mike	Unknown	6	1	26	0	0	0	0	0	97	2.8	0.2
6/25/2010	PPZ	03:17 PM	03:00 PM	Jilly	Unknown	10	1	26	0	0	0	0.87	0	89.8	9.33	0
6/25/2010	PPZ	04:01 PM	04:00 PM	Jilly	Unknown	1.5	1	26	99.33	0	0	0	0	0	0.67	0
6/25/2010	PPZ	04:17 PM	04:00 PM	Shaq	Unknown	0	1	26	66.2	0	0	22.67	0	0	11.13	0
6/25/2010	PPZ	05:00 PM	05:00 PM	Jilly	Unknown	2.5	1	26	100	0	0	0	0	0	0	0
6/25/2010	PPZ	05:00 PM	05:00 PM	Shaq	Unknown	2.5	1	26	100	0	0	0	0	0	0	0
6/28/2010	PPZ	09:21 AM	09:00 AM	Mike	3	3	1	24	0	0	0	6.47	0	80.4	2.67	10.47
6/28/2010	PPZ	09:37 AM	09:00 AM	Jilly	3	0	1	26	55.87	0	0	2.47	0	34.33	7.33	0
6/28/2010	PPZ	10:00 AM	10:00 AM	Mike	3	2	1	26	100	0	0	0	0	0	0	0
6/28/2010	PPZ	10:16 AM	10:00 AM	Jilly	3	6	1	26	100	0	0	0	0	0	0	0
6/28/2010	PPZ	11:02 AM	11:00 AM	Mike	3	11.5	1	26	0	0	0	4.33	0	84.33	7.67	3.67
6/28/2010	PPZ	11:18 AM	11:00 AM	Jilly	3	11	1	26	0	0	0	0.87	0	65.13	6.53	27.47

Table 14 (cont.)

Date	Zoo	Time	Block	Otter	Meals	Vstr	Wthr	Tmp (^{o}C)	Rst	Eat	Stp	Mnt	Soc	Loc	Inv	Otr
6/28/2010	PPZ	12:11 PM	12:00 PM	Mike	3	3.5	2	26	47.6	0	0	3.2	0	45.67	3.53	0
6/28/2010	PPZ	12:26 PM	12:00 PM	Jilly	3	9	2	27	0	0	6.53	0	14.13	72.73	6.27	0.33
6/28/2010	PPZ	01:00 PM	01:00 PM	Jilly	3	3	2	27	12.53	0	19.13	1.47	12	46.67	8.2	0
6/28/2010	PPZ	01:16 PM	01:00 PM	Mike	3	7.5	2	27	3.2	79.87	0	5.67	6.33	4.6	0	0.33
6/28/2010	PPZ	02:32 PM	02:00 PM	Mike	3	4	2	26	0	0	0	3.6	46.2	47.2	3	0
6/28/2010	PPZ	02:48 PM	02:00 PM	Jilly	3	6	2	26	0	0	2.67	0	0	93.67	3.2	0.47
6/28/2010	PPZ	03:04 PM	03:00 PM	Mike	3	11.5	2	26	0	0	0	0	0	98.33	1.47	0.2
6/28/2010	PPZ	03:20 PM	03:00 PM	Jilly	3	6.5	2	26	2	0	2.33	24	0	67.67	3.2	0.8
6/28/2010	PPZ	04:14 PM	04:00 PM	Jilly	3	3	2	26	31.67	0	0	12.2	0	43	13.13	0
6/28/2010	PPZ	04:32 PM	04:00 PM	Shaq	3	1.5	2	24	100	0	0	0	0	0	0	0
6/28/2010	PPZ	05:00 PM	05:00 PM	Jilly	3	0	2	24	100	0	0	0	0	0	0	0
6/28/2010	PPZ	05:00 PM	05:00 PM	Shaq	3	0	2	24	100	0	0	0	0	0	0	0
6/29/2010	PPZ	09:06 AM	09:00 AM	Mike	3	0	2	16	0	0	0	6.67	5.2	61.8	26.33	0
6/29/2010	PPZ	09:22 AM	09:00 AM	Jilly	3	2	1	16	0	0	0	0	4.13	89.07	6.8	0
6/29/2010	PPZ	10:01 AM	10:00 AM	Mike	3	1	1	17	0	0	0	13.53	0	79.67	6.47	0.33
6/29/2010	PPZ	10:18 AM	10:00 AM	Jilly	3	11.5	2	17	0	0	0	3.33	0	80.8	15.67	0.2
6/29/2010	PPZ	11:00 AM	11:00 AM	Jilly	3	2.5	1	18	87.8	0	0	11.87	0	0	0.33	0
6/29/2010	PPZ	11:15 AM	11:00 AM	Mike	3	5	1	18	21.33	0	0	0	0	63.53	15.13	0
6/29/2010	PPZ	12:00 PM	12:00 PM	Mike	3	2	2	19	0	0	0	8.13	0	83.93	7.93	0
6/29/2010	PPZ	12:17 PM	12:00 PM	Jilly	3	2.5	2	19	100	0	0	0	0	0	0	0
6/29/2010	PPZ	01:03 PM	01:00 PM	Mike	3	4	3	20	15.67	0	0	1.33	8.13	59.53	15.13	0.2
6/29/2010	PPZ	01:19 PM	01:00 PM	Jilly	3	12.5	2	20	0	0	0	0.87	11	77.4	9.87	0.87
6/29/2010	PPZ	02:00 PM	02:00 PM	Mike	3	5	3	20	0	0	0	0	0	99.47	0.53	0
6/29/2010	PPZ	02:16 PM	02:00 PM	Jilly	3	11.5	2	20	0	0	0	5.67	0	82.67	11.67	0
6/29/2010	PPZ	03:01 PM	03:00 PM	Mike	3	12	2	21	0	0	0	0	0	99.13	0.87	0
6/29/2010	PPZ	03:17 PM	03:00 PM	Jilly	3	13.5	2	21	0	0	3.8	14.13	1.87	76.53	3.33	0.33
6/29/2010	PPZ	04:00 PM	04:00 PM	Shaq	3	2	3	21	6.8	0	0	2.53	0	71.67	17	2
6/29/2010	PPZ	04:16 PM	04:00 PM	Jilly	3	2	3	21	78.6	0	0	0	0	15.2	6.2	0
6/29/2010	PPZ	05:00 PM	05:00 PM	Jilly	3	0	2	21	99.13	0	0	0	0	0	0.87	0
6/29/2010	PPZ	05:00 PM	05:00 PM	Shaq	3	0	2	21	100	0	0	0	0	0	0	0
6/30/2010	PPZ	09:11 AM	09:00 AM	Mike	4	0	2	17	0	0	0	6.47	21.67	71.33	0.53	0
6/30/2010	PPZ	09:28 AM	09:00 AM	Jilly	4	0	2	18	0	0	0	6.33	0	79.67	14	0

Table 14 (cont.)

Date	Zoo	Time	Block	Otter	Meals	Vstr	Wthr	Tmp (^{o}C)	Rst	Eat	Stp	Mnt	Soc	Loc	Inv	Otr
6/30/2010	PPZ	10:00 AM	10:00 AM	Mike	4	2	1	18	100	0	0	0	0	0	0	0
6/30/2010	PPZ	10:15 AM	10:00 AM	Jilly	4	0.5	1	18	100	0	0	0	0	0	0	0
6/30/2010	PPZ	11:12 AM	11:00 AM	Mike	4	22	1	18	2.47	3.8	0	1.53	0.67	68	23.53	0
6/30/2010	PPZ	11:28 AM	11:00 AM	Jilly	4	2	1	19	14.87	0	0	11.47	26.67	28.27	18.73	0
6/30/2010	PPZ	12:00 PM	12:00 PM	Mike	4	9.5	1	19	18.13	0	0	0	0	75.33	6.07	0.47
6/30/2010	PPZ	12:16 PM	12:00 PM	Jilly	4	15.5	1	19	100	0	0	0	0	0	0	0
6/30/2010	PPZ	01:00 PM	01:00 PM	Mike	4	1.5	1	21	100	0	0	0	0	0	0	0
6/30/2010	PPZ	01:16 PM	01:00 PM	Jilly	4	9.5	1	21	10.33	4.33	0	9.8	6.33	59	9.87	0.33
6/30/2010	PPZ	02:04 PM	02:00 PM	Mike	4	14.5	1	21	0	0	0	0	0	98.87	1.13	0
6/30/2010	PPZ	02:21 PM	02:00 PM	Jilly	4	16.5	1	21	0	0	3.33	10.13	0	70.47	16.07	0
6/30/2010	PPZ	03:01 PM	03:00 PM	Mike	4	20.5	1	22	0	0	0	0	0	96	4	0
6/30/2010	PPZ	03:18 PM	03:00 PM	Jilly	4	9	2	22	2.47	0	0	7.13	8.47	75.2	5.6	1.13
6/30/2010	PPZ	04:02 PM	04:00 PM	Shaq	4	2.5	2	21	54.67	0	0	3	0	32.33	10	0
6/30/2010	PPZ	04:19 PM	04:00 PM	Jilly	4	6	2	21	0	0	0	2.47	0	81.93	15.6	0
6/30/2010	PPZ	05:00 PM	05:00 PM	Jilly	4	0	2	22	95.13	0	0	0	0	0	4.87	0
6/30/2010	PPZ	05:00 PM	05:00 PM	Shaq	4	0	2	22	100	0	0	0	0	0	0	0
7/1/2010	JBZ	09:52 AM	09:00 AM	Chumani	3	5	1	19	0	4	0	2.87	0	73.73	19.4	0
7/1/2010	JBZ	10:35 AM	10:00 AM	Chumani	3	2	1	21	100	0	0	0	0	0	0	0
7/1/2010	JBZ	11:11 AM	11:00 AM	Chumani	3	4.5	1	21	99.47	0	0	0	0	0	0.53	0
7/1/2010	JBZ	12:00 PM	12:00 PM	Chumani	3	1.5	1	22	28.87	0	0	42.6	0	20.67	7	0.87
7/1/2010	JBZ	01:19 PM	01:00 PM	Chumani	3	13.5	1	23	0	0	0	11.33	0	76.33	12.33	0
7/1/2010	JBZ	02:04 PM	02:00 PM	Chumani	3	12	1	24	0.47	3.53	0	0.67	0	82.67	12.67	0
7/1/2010	JBZ	03:03 PM	03:00 PM	Chumani	3	9	1	24	0	0	0	5.67	0	81.87	12.47	0
7/1/2010	JBZ	04:03 PM	04:00 PM	Chumani	3	7.5	1	24	60.47	0	0	21.6	0	1.13	16.8	0
7/1/2010	JBZ	05:00 PM	05:00 PM	Chumani	3	5	1	24	99.33	0	0	0.67	0	0	0	0
7/2/2010	JBZ	09:25 AM	09:00 AM	Chumani	3	0	1	24	0	5.13	0	1.53	0	71.47	21.87	0
7/2/2010	JBZ	10:10 AM	10:00 AM	Chumani	3	10.5	1	24	0	1.2	0	0	0	87.8	11	0
7/2/2010	JBZ	11:02 AM	11:00 AM	Chumani	3	4	1	24	99	0	0	1	0	0	0	0
7/2/2010	JBZ	12:00 PM	12:00 PM	Chumani	3	3	1	25	100	0	0	0	0	0	0	0
7/2/2010	JBZ	01:20 PM	01:00 PM	Chumani	3	5.5	1	26	0	29.47	0	21.73	0	24	24.8	0
7/2/2010	JBZ	02:01 PM	02:00 PM	Chumani	3	9	1	27	0	0	0	2.8	0	78.53	18.67	0
7/2/2010	JBZ	03:00 PM	03:00 PM	Chumani	3	9.5	1	27	100	0	0	0	0	0	0	0

Table 14 (cont.)

Date	Zoo	Time	Block	Otter	Meals	Vstr	Wthr	Tmp (^{o}C)	Rst	Eat	Stp	Mnt	Soc	Loc	Inv	Otr
7/2/2010	JBZ	04:00 PM	04:00 PM	Chumani	3	2	1	28	100	0	0	0	0	0	0	0
7/2/2010	JBZ	05:00 PM	05:00 PM	Chumani	3	3	1	28	100	0	0	0	0	0	0	0
7/5/2010	JBZ	09:27 AM	09:00 AM	Chumani	3	0	2	29	58	0	0	23.8	0	0	16.53	1.67
7/5/2010	JBZ	10:11 AM	10:00 AM	Chumani	3	3	3	29	9.8	0.87	0	11.47	0	68.33	8.87	0.67
7/5/2010	JBZ	11:01 AM	11:00 AM	Chumani	3	13	2	31	0	4.2	0	0	0	89.67	6.13	0
7/5/2010	JBZ	12:08 PM	12:00 PM	Chumani	3	5.5	3	32	0	0	0	0	0	89.27	10.73	0
7/5/2010	JBZ	01:03 PM	01:00 PM	Chumani	3	6	1	32	0	0	0	0	0	100	0	0
7/5/2010	JBZ	02:00 PM	02:00 PM	Chumani	3	10	1	33	100	0	0	0	0	0	0	0
7/5/2010	JBZ	03:03 PM	03:00 PM	Chumani	3	9	1	33	0	0	0	0	0	95.53	4.47	0
7/5/2010	JBZ	04:01 PM	04:00 PM	Chumani	3	2	2	32	100	0	0	0	0	0	0	0
7/5/2010	JBZ	05:00 PM	05:00 PM	Chumani	3	0	2	32	100	0	0	0	0	0	0	0
7/6/2010	JBZ	09:34 AM	09:00 AM	Chumani	3	0	1	29	0	3.2	0	8.6	0	62.8	25.4	0
7/6/2010	JBZ	10:16 AM	10:00 AM	Chumani	3	0	1	29	100	0	0	0	0	0	0	0
7/6/2010	JBZ	11:01 AM	11:00 AM	Chumani	3	2.5	1	30	0	0	0	0.47	0	69.33	30.2	0
7/6/2010	JBZ	12:01 PM	12:00 PM	Chumani	3	4.5	2	31	0	7.33	0	0.33	0	84.6	7.73	0
7/6/2010	JBZ	01:03 PM	01:00 PM	Chumani	3	4.5	2	32	0	6.33	0	5.13	0	78.4	10.13	0
7/6/2010	JBZ	02:00 PM	02:00 PM	Chumani	3	2.5	1	32	100	0	0	0	0	0	0	0
7/6/2010	JBZ	03:00 PM	03:00 PM	Chumani	3	2.5	1	32	100	0	0	0	0	0	0	0
7/6/2010	JBZ	04:00 PM	04:00 PM	Chumani	3	2	1	33	100	0	0	0	0	0	0	0
7/6/2010	JBZ	05:00 PM	05:00 PM	Chumani	3	2	2	32	0	2.2	0	0	0	78.93	11.67	7.2
7/7/2010	JBZ	09:22 AM	09:00 AM	Chumani	3	2	1	27	0	0	0	0	0	96.13	3.87	0
7/7/2010	JBZ	10:03 AM	10:00 AM	Chumani	3	6.5	1	29	0	0	0	0	0	98.8	1.2	0
7/7/2010	JBZ	11:00 AM	11:00 AM	Chumani	3	14	1	30	0	0	0	0	0	96.47	3.53	0
7/7/2010	JBZ	12:21 PM	12:00 PM	Chumani	3	2	1	31	100	0	0	0	0	0	0	0
7/7/2010	JBZ	01:00 PM	01:00 PM	Chumani	3	0	1	32	35.53	0	0	6.67	0	50.2	4.6	3
7/7/2010	JBZ	02:00 PM	02:00 PM	Chumani	3	7	1	33	0	0	0	0.53	0	81.27	18.2	0
7/7/2010	JBZ	03:01 PM	03:00 PM	Chumani	3	11	1	32	0	6.67	0	0	0	31.2	62.13	0
7/7/2010	JBZ	04:02 PM	04:00 PM	Chumani	3	1.5	1	33	18.67	0	0	25.67	0	47.33	8.33	0
7/7/2010	JBZ	05:00 PM	05:00 PM	Chumani	3	1.5	1	33	99.53	0	0	0	0	0	0.47	0
7/8/2010	PPZ	09:18 AM	09:00 AM	Mike	4	3.5	1	23	0	0	0	5.8	0	90.4	3.8	0
7/8/2010	PPZ	09:34 AM	09:00 AM	Jilly	4	2	1	23	0	0	0	1.33	0	91	7.67	0
7/8/2010	PPZ	10:07 AM	10:00 AM	Mike	4	0	2	22	79.47	0	0	19.53	0	0	1	0

Table 14 (cont.)

Date	Zoo	Time	Block	Otter	Meals	Vstr	Wthr	Tmp (^{o}C)	Rst	Eat	Stp	Mnt	Soc	Loc	Inv	Otr
7/8/2010	PPZ	10:23 AM	10:00 AM	Jilly	4	0	1	22	86.47	0	0	0	0	11	2.53	0
7/8/2010	PPZ	11:04 AM	11:00 AM	Mike	4	2.5	2	22	0	0	0	0.53	4.67	90.8	1.33	2.67
7/8/2010	PPZ	11:21 AM	11:00 AM	Jilly	4	1.5	2	22	8.13	0	0	1.87	0	74.8	15.2	0
7/8/2010	PPZ	12:23 PM	12:00 PM	Mike	4	1	4	22	43.67	0	0	0.67	0	9.67	40.2	5.8
7/8/2010	PPZ	01:12 PM	01:00 PM	Mike	4	0	4	22	0	0	0	3.8	0	81	2.67	12.53
7/8/2010	PPZ	01:29 PM	01:00 PM	Jilly	4	2	4	22	0	0	0	0.87	0	69.27	16.4	13.47
7/8/2010	PPZ	02:02 PM	02:00 PM	Mike	4	1	4	22	0	0	0	0	0	86	14	0
7/8/2010	PPZ	02:18 PM	02:00 PM	Jilly	4	0	4	23	0	0	31.33	0	0.67	64.13	3.87	0
7/8/2010	PPZ	03:00 PM	03:00 PM	Mike	4	0	4	25	99.53	0	0	0	0.47	0	0	0
7/8/2010	PPZ	03:15 PM	03:00 PM	Jilly	4	2	3	25	100	0	0	0	0	0	0	0
7/8/2010	PPZ	04:02 PM	04:00 PM	Jilly	4	1.5	3	26	27.8	0	0	0.87	0	50.4	20.73	0.2
7/8/2010	PPZ	04:18 PM	04:00 PM	Shaq	4	0	3	26	94	0	0	6	0	0	0	0
7/8/2010	PPZ	05:00 PM	05:00 PM	Jilly	4	0	2	26	100	0	0	0	0	0	0	0
7/8/2010	PPZ	05:00 PM	05:00 PM	Shaq	4	0	2	26	100	0	0	0	0	0	0	0
7/9/2010	PPZ	09:01 AM	09:00 AM	Mike	3	0	3	23	0	0	0	8.8	3.67	83.87	3.67	0
7/9/2010	PPZ	09:17 AM	09:00 AM	Jilly	3	0	3	23	45.27	0	0	3.67	0	12.67	38.4	0
7/9/2010	PPZ	10:00 AM	10:00 AM	Mike	3	3	3	24	0	0	0	7.2	0	83	9.8	0
7/9/2010	PPZ	10:17 AM	10:00 AM	Jilly	3	4.5	3	24	0	0	0	0	30.13	67.53	2.33	0
7/9/2010	PPZ	11:01 AM	11:00 AM	Mike	3	14	2	26	0	0	0	0	0	95.8	3.87	0.33
7/9/2010	PPZ	11:18 AM	11:00 AM	Jilly	3	11.5	2	26	31.53	0	0	17.2	0	38.67	12.13	0.47
7/9/2010	PPZ	12:00 PM	12:00 PM	Mike	3	16.5	2	26	0	0	0	0	0	92.33	7.33	0.33
7/9/2010	PPZ	12:16 PM	12:00 PM	Jilly	3	11.5	2	26	23.67	6.33	0	12.87	0.47	48.53	8.13	0
7/9/2010	PPZ	01:30 PM	01:00 PM	Mike	3	11	1	28	0	0	0	0	0	87.2	12.8	0
7/9/2010	PPZ	01:45 PM	01:00 PM	Jilly	3	14.5	1	28	0	0	0	0.67	0	97.13	1.67	0.53
7/9/2010	PPZ	02:13 PM	02:00 PM	Mike	3	4.5	1	28	0	0	0	6.8	0	89.13	4.07	0
7/9/2010	PPZ	02:29 PM	02:00 PM	Jilly	3	6.5	1	28	29.87	0	0	4.8	0	33.13	32.2	0
7/9/2010	PPZ	03:01 PM	03:00 PM	Mike	3	12.5	1	28	0	0	0	0	0	96.87	3.13	0
7/9/2010	PPZ	03:16 PM	03:00 PM	Jilly	3	8	1	28	0	0	0	2.2	0	90.53	6.6	0.67
7/9/2010	PPZ	04:09 PM	04:00 PM	Shaq	3	1	1	28	3.2	8.87	0	0	0	81.93	6	0
7/9/2010	PPZ	04:25 PM	04:00 PM	Jilly	3	1	1	28	61.2	0	0	1.13	0	25	12.33	0.33
7/9/2010	PPZ	05:00 PM	05:00 PM	Jilly	3	1.5	1	28	100	0	0	0	0	0	0	0
7/9/2010	PPZ	05:00 PM	05:00 PM	Shaq	3	1.5	1	28	100	0	0	0	0	0	0	0

Table 14 (cont.)

Date	Zoo	Time	Block	Otter	Meals	Vstr	Wthr	Tmp (^{o}C)	Rst	Eat	Stp	Mnt	Soc	Loc	Inv	Otr
7/12/2010	PPZ	09:06 AM	09:00 AM	Mike	4	0	2	22	0	0	0	3.33	15.67	55.47	12	13.53
7/12/2010	PPZ	09:23 AM	09:00 AM	Jilly	4	0	2	22	0	0	7.33	2.53	0	65.6	24.53	0
7/12/2010	PPZ	10:00 AM	10:00 AM	Mike	4	0	2	22	0	0	0	9.47	7.13	67.6	15.8	0
7/12/2010	PPZ	10:16 AM	10:00 AM	Jilly	4	1	2	22	6.8	0	0	1.8	0	58.87	32.53	0
7/12/2010	PPZ	11:04 AM	11:00 AM	Mike	4	5	3	24	29.33	0	0	21.53	0	29	7.47	12.67
7/12/2010	PPZ	11:21 AM	11:00 AM	Jilly	4	3.5	2	24	44.13	0	0	0.47	0	25.53	29.87	0
7/12/2010	PPZ	12:01 PM	12:00 PM	Mike	4	3.5	2	25	58.87	0	0	24.13	0	12.2	4.8	0
7/12/2010	PPZ	12:17 PM	12:00 PM	Jilly	4	6.5	2	25	96.13	0	0	0	0	0	3.87	0
7/12/2010	PPZ	01:00 PM	01:00 PM	Mike	4	11	2	26	71.67	0.47	0	1.13	0	20.33	2.53	3.87
7/12/2010	PPZ	01:00 PM	01:00 PM	Jilly	4	11	2	26	100	0	0	0	0	0	0	0
7/12/2010	PPZ	02:19 PM	02:00 PM	Mike	4	2	2	27	0	0	0	0.87	0	72.6	26.07	0.47
7/12/2010	PPZ	02:35 PM	02:00 PM	Jilly	4	4	2	28	0	0	42.87	0	0	57.13	0	0
7/12/2010	PPZ	03:00 PM	03:00 PM	Mike	4	2	2	28	0	0	0	0	0	88.93	9.53	1.53
7/12/2010	PPZ	03:15 PM	03:00 PM	Jilly	4	5.5	2	28	0	0	65.87	3.47	0	28.33	2.33	0
7/12/2010	PPZ	04:02 PM	04:00 PM	Shaq	4	0	2	28	44.13	0	0	21.87	0	24.47	9.53	0
7/12/2010	PPZ	04:18 PM	04:00 PM	Jilly	4	0	2	28	86.53	0	0	0	0	3.13	10.33	0
7/12/2010	PPZ	05:00 PM	05:00 PM	Jilly	4	1	2	27	99	0	0	0	0	0	1	0
7/12/2010	PPZ	05:00 PM	05:00 PM	Shaq	4	1	2	27	100	0	0	0	0	0	0	0
7/13/2010	PPZ	09:01 AM	09:00 AM	Mike	4	1.5	3	22	44.93	0	0	31.67	0	13.07	10.33	0
7/13/2010	PPZ	09:17 AM	09:00 AM	Jilly	4	0.5	3	22	98.87	0	0	0	0	0	1.13	0
7/13/2010	PPZ	10:01 AM	10:00 AM	Mike	4	3	3	23	73.87	0	0	18.07	0	0	8.07	0
7/13/2010	PPZ	10:17 AM	10:00 AM	Jilly	4	9	3	23	43.33	0	0	0	5.67	42.33	8.13	0.53
7/13/2010	PPZ	11:00 AM	11:00 AM	Mike	4	21.5	3	24	0	0	0	0	0	94.93	4.4	0.67
7/13/2010	PPZ	11:16 AM	11:00 AM	Jilly	4	18.5	3	25	0	0	36.2	0.33	0	53.6	9.33	0.53
7/13/2010	PPZ	12:00 PM	12:00 PM	Mike	4	26.5	3	24	0	0	0	6	0	90.87	3.13	0
7/13/2010	PPZ	12:16 PM	12:00 PM	Jilly	4	24.5	3	25	0	0	84.4	0	0	14.13	1.13	0.33
7/13/2010	PPZ	01:00 PM	01:00 PM	Jilly	4	4	3	24	98.87	0	0	0	0	0	1.13	0
7/13/2010	PPZ	01:17 PM	01:00 PM	Mike	4	18	3	24	10.13	0	0	43.4	0	38.2	8.07	0.2
7/13/2010	PPZ	02:00 PM	02:00 PM	Mike	4	22	3	26	0	0	0	0	0	95.6	4.2	0.2
7/13/2010	PPZ	02:16 PM	02:00 PM	Jilly	4	30.5	4	26	0	0	62.33	0	0	34.53	2.47	0.67
7/13/2010	PPZ	03:00 PM	03:00 PM	Mike	4	31.5	3	26	0	0	0	0	0	97.87	2.13	0
7/13/2010	PPZ	03:16 PM	03:00 PM	Jilly	4	24	3	26	0	0	3.47	2.33	0	66.2	21.53	6.47

Table 14 (cont.)

Date	Zoo	Time	Block	Otter	Meals	Vstr	Wthr	Tmp (°C)	Rst	Eat	Stp	Mnt	Soc	Loc	Inv	Otr
7/13/2010	PPZ	04:00 PM	04:00 PM	Jilly	4	13.5	3	27	59.93	0	0	8.13	0	8.87	20.4	2.67
7/13/2010	PPZ	04:15 PM	04:00 PM	Shaq	4	7	3	27	100	0	0	0	0	0	0	0
7/13/2010	PPZ	05:00 PM	05:00 PM	Jilly	4	12.5	2	27	57.13	0	0	0	0	42.33	0.53	0
7/13/2010	PPZ	05:00 PM	05:00 PM	Shaq	4	12.5	2	27	100	0	0	0	0	0	0	0
7/14/2010	PPZ	09:20 AM	09:00 AM	Jilly	4	6.5	1	24	81.13	0	0	3	0	11.47	3.87	0.53
7/14/2010	PPZ	09:37 AM	09:00 AM	Mike	4	7	1	26	0	0	0	9.53	7.87	77.47	0	5.13
7/14/2010	PPZ	10:13 AM	10:00 AM	Mike	4	9	1	26	38.53	0	0	8.53	0.2	47.53	5.2	0
7/14/2010	PPZ	10:29 AM	10:00 AM	Jilly	4	22.5	1	27	0.67	0	13.13	2.47	0	73.73	10	0
7/14/2010	PPZ	11:00 AM	11:00 AM	Mike	4	25.5	1	27	0	0	0	9.6	0.67	80.8	1.4	7.53
7/14/2010	PPZ	11:16 AM	11:00 AM	Jilly	4	19.5	1	27	30.73	0	24.8	6.67	0	21.13	16.67	0
7/14/2010	PPZ	12:00 PM	12:00 PM	Mike	4	28.5	1	28	0	0	0	2.13	7.33	83.53	6.2	0.8
7/14/2010	PPZ	12:16 PM	12:00 PM	Jilly	4	28	1	28	0	0	56	0	0	43.53	0.47	0
7/14/2010	PPZ	01:00 PM	01:00 PM	Mike	4	26.5	1	29	0	0	0	5.33	0	90.33	4.33	0
7/14/2010	PPZ	01:15 PM	01:00 PM	Jilly	4	41	1	29	0	0	45.27	2.13	0	43.67	7.07	1.87
7/14/2010	PPZ	02:34 PM	02:00 PM	Mike	4	27	2	30	90.53	0	0	0.33	0	7.47	1.67	0
7/14/2010	PPZ	02:34 PM	02:00 PM	Jilly	4	27	2	30	89.73	0	0	0	0	3.13	7.13	0
7/14/2010	PPZ	03:00 PM	03:00 PM	Mike	4	24	2	30	0	0	0	0.2	0	91.67	8.13	0
7/14/2010	PPZ	03:44 PM	03:00 PM	Jilly	4	21.5	1	29	39.13	3.87	0	0	0	37.33	19.67	0
7/14/2010	PPZ	04:00 PM	04:00 PM	Shaq	4	16.5	1	29	75.53	0	0	0	0	24.47	0	0
7/14/2010	PPZ	04:16 PM	04:00 PM	Jilly	4	17.5	1	29	99.8	0	0	0	0	0.2	0	0
7/14/2010	PPZ	05:00 PM	05:00 PM	Jilly	4	15.5	1	29	0	0	1.13	0	0	98.87	0	0
7/14/2010	PPZ	05:00 PM	05:00 PM	Shaq	4	15.5	1	29	5.53	0	0	0	0	91.13	1.87	1.47
7/15/2010	JBZ	09:11 AM	09:00 AM	Chumani	3	0	1	28	0	8.13	0	0	0	71.87	20	0
7/15/2010	JBZ	10:01 AM	10:00 AM	Chumani	3	7	3	28	0	3	0	0.53	0	84.93	11.53	0
7/15/2010	JBZ	11:03 AM	11:00 AM	Chumani	3	4	2	30	69.27	5.87	0	13.47	0	1.13	9.07	1.2
7/15/2010	JBZ	12:00 PM	12:00 PM	Chumani	3	2	2	31	100	0	0	0	0	0	0	0
7/15/2010	JBZ	01:00 PM	01:00 PM	Otto	3	5	2	30	0	21.8	0	0	0	14.47	63.73	0
7/15/2010	JBZ	02:00 PM	02:00 PM	Otto	3	8.5	3	31	0	0	0	0	0	99.53	0.47	0
7/15/2010	JBZ	03:00 PM	03:00 PM	Otto	3	2	3	29	0	0	0	0	0	57.87	42.13	0
7/15/2010	JBZ	04:07 PM	04:00 PM	Otto	3	3	2	28	0	0	0	1.33	0	73.87	15.47	9.33
7/15/2010	JBZ	05:00 PM	05:00 PM	Otto	3	1	1	28	0	0	0	0.67	0	99.33	0	0
7/16/2010	JBZ	09:21 AM	09:00 AM	Chumani	3	0	1	26	0	0	0	36.4	0	51.73	11.87	0

Table 14 (cont.)

Date	Zoo	Time	Block	Otter	Meals	Vstr	Wthr	Tmp (^{o}C)	Rst	Eat	Stp	Mnt	Soc	Loc	Inv	Otr
7/16/2010	JBZ	10:02 AM	10:00 AM	Chumani	3	3	1	28	98	0	0	2	0	0	0	0
7/16/2010	JBZ	11:03 AM	11:00 AM	Chumani	3	5	1	28	100	0	0	0	0	0	0	0
7/16/2010	JBZ	12:00 PM	12:00 PM	Chumani	3	7	1	29	97.33	0	0	0	0	0	2.67	0
7/16/2010	JBZ	01:01 PM	01:00 PM	Chumani	3	8.5	1	30	0	1.67	0	0	0	94.47	3.87	0
7/16/2010	JBZ	02:00 PM	02:00 PM	Chumani	3	12.5	1	30	0	7.87	0	1.13	0	82.8	8.2	0
7/16/2010	JBZ	03:00 PM	03:00 PM	Chumani	3	0.5	1	31	97.33	0	0	1.67	0	0	1	0
7/16/2010	JBZ	04:00 PM	04:00 PM	Chumani	3	11	1	31	96.73	0	0	2.13	0	0	1.13	0
7/16/2010	JBZ	05:00 PM	05:00 PM	Chumani	3	3.5	1	31	100	0	0	0	0	0	0	0
7/19/2010	PPZ	10:17 AM	10:00 AM	Mike	3	8	2	23	0	1.13	0	25.2	0	62.33	11.33	0
7/19/2010	PPZ	10:33 AM	10:00 AM	Jilly	3	2.5	2	23	67.2	0	0	18.8	1.33	0	12.67	0
7/19/2010	PPZ	11:05 AM	11:00 AM	Mike	3	1.5	2	23	9.87	0	0	60.8	0	24	5.33	0
7/19/2010	PPZ	11:22 AM	11:00 AM	Jilly	3	0	2	23	100	0	0	0	0	0	0	0
7/19/2010	PPZ	12:18 PM	12:00 PM	Mike	3	2	2	24	71.4	0.2	0	1.33	0	18.87	7.33	0.87
7/19/2010	PPZ	12:33 PM	12:00 PM	Jilly	3	3	2	25	0	0	32	1.33	5.2	61.47	0	0
7/19/2010	PPZ	01:02 PM	01:00 PM	Mike	3	1	2	25	100	0	0	0	0	0	0	0
7/19/2010	PPZ	01:20 PM	01:00 PM	Jilly	3	2.5	2	25	10.13	0	14.13	1.33	0	54	20.4	0
7/19/2010	PPZ	02:00 PM	02:00 PM	Mike	3	10.5	2	25	0	0	0	0	0	95.53	3.8	0.67
7/19/2010	PPZ	02:16 PM	02:00 PM	Jilly	3	8.5	2	25	0	0	24.87	0	0	73.33	1.8	0
7/19/2010	PPZ	03:01 PM	03:00 PM	Mike	3	4.5	2	27	0	0	0	0	0	87	4.47	8.53
7/19/2010	PPZ	03:17 PM	03:00 PM	Jilly	3	16.5	2	27	0	0	2	2.2	0.53	78.4	16.33	0.53
7/19/2010	PPZ	04:00 PM	04:00 PM	Shaq	3	3.5	2	27	87	0	0	7.33	0	0	5.67	0
7/19/2010	PPZ	04:15 PM	04:00 PM	Jilly	3	0	2	27	100	0	0	0	0	0	0	0
7/19/2010	PPZ	05:00 PM	05:00 PM	Jilly	3	0	2	26	96.93	0	0	0	0	0.53	2.53	0
7/19/2010	PPZ	05:00 PM	05:00 PM	Shaq	3	0	2	26	87.4	0	0	0	0	12.6	0	0
7/20/2010	PPZ	09:42 AM	09:00 AM	Mike	3	1.5	2	21	0	0	0	0.87	0.33	77.6	4.67	16.53
7/20/2010	PPZ	10:01 AM	10:00 AM	Jilly	3	0	3	21	0	0	0	0.8	0	84.87	13	1.33
7/20/2010	PPZ	10:16 AM	10:00 AM	Mike	3	5.5	3	21	0	0	0	12.73	0	74.93	12.33	0
7/20/2010	PPZ	11:00 AM	11:00 AM	Mike	3	1.5	3	22	31.47	6.53	0	0.33	0	53.13	8.53	0
7/20/2010	PPZ	11:15 AM	11:00 AM	Jilly	3	1	3	22	0	0	0	1	0	67.67	30.53	0.8
7/20/2010	PPZ	12:01 PM	12:00 PM	Mike	3	2.5	3	23	100	0	0	0	0	0	0	0
7/20/2010	PPZ	12:18 PM	12:00 PM	Jilly	3	4.5	3	23	100	0	0	0	0	0	0	0
7/20/2010	PPZ	01:00 PM	01:00 PM	Mike	3	0	3	25	23.13	0	0	36.87	0	37.53	2.47	0

Table 14 (cont.)

Date	Zoo	Time	Block	Otter	Meals	Vstr	Wthr	Tmp (^{o}C)	Rst	Eat	Stp	Mnt	Soc	Loc	Inv	Otr
7/20/2010	PPZ	01:15 PM	01:00 PM	Jilly	3	8.5	3	25	93.2	0	0	0	0	4.33	2.47	0
7/20/2010	PPZ	02:01 PM	02:00 PM	Mike	3	4.5	3	26	22.87	0	0	32.13	19.2	22.2	3.27	0.33
7/20/2010	PPZ	02:16 PM	02:00 PM	Jilly	3	5	3	26	0	0	4.87	0.8	0	83.2	10.47	0.67
7/20/2010	PPZ	03:00 PM	03:00 PM	Mike	3	2	3	27	0	0	0	0	0	95.47	4.07	0.47
7/20/2010	PPZ	03:15 PM	03:00 PM	Jilly	3	4.5	3	26	0	0	75.73	0	0	21.13	3.13	0
7/20/2010	PPZ	04:09 PM	04:00 PM	Jilly	3	3	3	26	0	0	84.33	0	0	15.67	0	0
7/20/2010	PPZ	04:25 PM	04:00 PM	Shaq	3	2.5	3	27	100	0	0	0	0	0	0	0
7/20/2010	PPZ	05:00 PM	05:00 PM	Jilly	3	1.5	3	27	99.33	0	0	0	0	0	0.67	0
7/20/2010	PPZ	05:00 PM	05:00 PM	Shaq	3	1.5	3	27	100	0	0	0	0	0	0	0
7/21/2010	PPZ	09:03 AM	09:00 AM	Mike	3	0	1	26	0	1.13	0	1.53	0	72.53	21.8	3
7/21/2010	PPZ	09:20 AM	09:00 AM	Jilly	3	0	1	26	27.2	0	0	9.87	0	40.8	21.67	0.47
7/21/2010	PPZ	10:00 AM	10:00 AM	Mike	3	4	1	28	0	0	0	3.67	5.67	72.33	17.67	0.67
7/21/2010	PPZ	10:16 AM	10:00 AM	Jilly	3	3.5	1	28	0	0	0	0	0	90.07	9.73	0.2
7/21/2010	PPZ	11:02 AM	11:00 AM	Mike	3	7	1	28	0	0	0	0.47	0	85.4	14.13	0
7/21/2010	PPZ	11:25 AM	11:00 AM	Jilly	3	10.5	1	29	75.33	0	0	0	0	13.13	11.53	0
7/21/2010	PPZ	12:06 PM	12:00 PM	Mike	3	1	2	29	97.53	0	0	0	0	0.33	2.13	0
7/21/2010	PPZ	12:21 PM	12:00 PM	Jilly	3	1	2	29	98	0	0	0	0	0.33	1.67	0
7/21/2010	PPZ	01:01 PM	01:00 PM	Mike	3	4.5	1	29	34.27	0	0	19.67	10.53	31.8	3.73	0
7/21/2010	PPZ	01:17 PM	01:00 PM	Jilly	3	8	2	29	0	0	55.73	1.13	12.8	29.2	1.13	0
7/21/2010	PPZ	02:00 PM	02:00 PM	Mike	3	3.5	1	29	98.2	0	0	0	0	0	1.8	0
7/21/2010	PPZ	02:15 PM	02:00 PM	Jilly	3	2	1	29	63.73	0	12.53	3.13	1	19.13	0.47	0
7/21/2010	PPZ	03:00 PM	03:00 PM	Mike	3	3.5	1	31	0	0	0	0	0	93.53	5.6	0.87
7/21/2010	PPZ	03:15 PM	03:00 PM	Jilly	3	5.5	1	31	0	0	57.33	2.2	0	31.8	8.67	0
7/21/2010	PPZ	04:00 PM	04:00 PM	Jilly	3	7.5	2	30	9	0	16	12.8	0	54.33	7.87	0
7/21/2010	PPZ	04:16 PM	04:00 PM	Shaq	3	1	2	30	96.13	0	0	0	0	3.87	0	0
7/21/2010	PPZ	05:00 PM	05:00 PM	Jilly	3	0	1	29	83.13	0	0	0	0	13	3.87	0
7/21/2010	PPZ	05:00 PM	05:00 PM	Shaq	3	0	1	29	100	0	0	0	0	0	0	0
7/22/2010	JBZ	09:15 AM	09:00 AM	Chumani	2	0	3	23	0	1.67	0	0.47	0	56.47	14.27	27.13
7/22/2010	JBZ	10:02 AM	10:00 AM	Chumani	2	11.5	3	24	42.6	15.2	0	0.2	0	37.67	4.33	0
7/22/2010	JBZ	11:09 AM	11:00 AM	Chumani	2	7.5	3	26	96.33	0	0	1	0	0	2.67	0
7/22/2010	JBZ	12:00 PM	12:00 PM	Chumani	2	10.5	3	26	0	1	0	2.8	0	40.27	55.93	0
7/22/2010	JBZ	01:03 PM	01:00 PM	Otto	2	5	4	25	0	0	0	0	0	74.4	11.73	13.87

Table 14 (cont.)

Date	Zoo	Time	Block	Otter	Meals	Vstr	Wthr	Tmp (^{o}C)	Rst	Eat	Stp	Mnt	Soc	Loc	Inv	Otr
7/22/2010	JBZ	02:03 PM	02:00 PM	Otto	2	0	4	23	0	0	0	1.33	0	77.6	21.07	0
7/22/2010	JBZ	03:11 PM	03:00 PM	Otto	2	0	4	21	0	0	0	4.8	0	47.2	48	0
7/22/2010	JBZ	04:07 PM	04:00 PM	Otto	2	0.5	3	21	0	0	0	0.67	0	56.73	36.47	6.13
7/22/2010	JBZ	05:00 PM	05:00 PM	Otto	2	2	3	22	0	0	0	2.53	0	94.27	3.2	0
7/23/2010	JBZ	09:06 AM	09:00 AM	Chumani	3	0	3	25	0	6.13	0	4.4	0	77.47	11.2	0.8
7/23/2010	JBZ	10:00 AM	10:00 AM	Chumani	3	0	4	26	98.2	0	0	1.8	0	0	0	0
7/23/2010	JBZ	11:01 AM	11:00 AM	Chumani	3	11	3	27	0	1.67	0	0	0	73.2	25.13	0
7/23/2010	JBZ	12:00 PM	12:00 PM	Otto	3	2	3	27	0	0	0	0	0	85.33	14.67	0
7/23/2010	JBZ	01:18 PM	01:00 PM	Otto	3	2.5	2	27	1.87	0	0	73.73	0	1.53	22.87	0
7/23/2010	JBZ	02:01 PM	02:00 PM	Otto	3	5.5	2	29	100	0	0	0	0	0	0	0
7/23/2010	JBZ	03:08 PM	03:00 PM	Otto	3	2.5	1	31	94.47	0	0	0	0	0	5.53	0
7/23/2010	JBZ	04:01 PM	04:00 PM	Otto	3	1	2	29	68	0	0	26.2	0	0	5.8	0
7/23/2010	JBZ	05:00 PM	05:00 PM	Otto	3	1	1	29	88.67	0	0	2.87	0	2.2	6.27	0
7/26/2010	JBZ	09:17 AM	09:00 AM	Chumani	3	0	1	24	0	0	0	1.13	0	83	15.87	0
7/26/2010	JBZ	10:01 AM	10:00 AM	Chumani	3	3	1	26	0	15.2	0	12.47	0	60.67	11.67	0
7/26/2010	JBZ	11:10 AM	11:00 AM	Chumani	3	4	1	27	100	0	0	0	0	0	0	0
7/26/2010	JBZ	12:01 PM	12:00 PM	Otto	3	14	2	27	0	0	0	3.87	0	74.8	18.87	2.47
7/26/2010	JBZ	01:22 PM	01:00 PM	Otto	3	2	1	28	0	0	0	42.13	0	24	33.87	0
7/26/2010	JBZ	02:00 PM	02:00 PM	Otto	3	11	1	29	0	0	0	1.13	0	93.33	5.53	0
7/26/2010	JBZ	03:02 PM	03:00 PM	Otto	3	12	2	29	0	0	0	1.53	0	54.67	40.6	3.2
7/26/2010	JBZ	04:03 PM	04:00 PM	Otto	3	3.5	2	29	0	0	0	6.2	0	68.73	25.07	0
7/26/2010	JBZ	05:00 PM	05:00 PM	Otto	3	0	2	28	92.73	0	0	4.47	0	0	2.8	0
7/27/2010	JBZ	09:16 AM	09:00 AM	Chumani	2	2	1	24	0	0	0	0	0	71.93	28.07	0
7/27/2010	JBZ	10:00 AM	10:00 AM	Chumani	2	8	2	26	0	0	0	0	0	88.87	11.13	0
7/27/2010	JBZ	11:00 AM	11:00 AM	Chumani	2	8.5	1	27	100	0	0	0	0	0	0	0
7/27/2010	JBZ	12:00 PM	12:00 PM	Chumani	2	9	1	28	0	0	0	0	0	93.67	6.33	0
7/27/2010	JBZ	01:09 PM	01:00 PM	Chumani	2	10	1	28	0	0	0	11.13	0	81.53	7.33	0
7/27/2010	JBZ	02:10 PM	02:00 PM	Otto	2	14.5	2	28	0	5.13	0	0	0	94.07	0.8	0
7/27/2010	JBZ	03:08 PM	03:00 PM	Otto	2	3.5	1	29	0	0	0	4.33	0	85.87	9.8	0
7/27/2010	JBZ	04:00 PM	04:00 PM	Otto	2	2.5	1	29	0	0	0	2.13	0	92.67	5.2	0
7/27/2010	JBZ	05:00 PM	05:00 PM	Otto	2	0	1	29	0	0	0	30.53	0	51.27	18.2	0
7/28/2010	JBZ	09:17 AM	09:00 AM	Chumani	Unknown	0	3	27	0	0	0	0	0	98.6	1.4	0

Table 14 (cont.)

Date	Zoo	Time	Block	Otter	Meals	Vstr	Wthr	Tmp (°C)	Rst	Eat	Stp	Mnt	Soc	Loc	Inv	Otr
7/28/2010	JBZ	10:00 AM	10:00 AM	Chumani	Unknown	0	3	28	17.47	0	0	29.8	0	34.8	17.93	0
7/28/2010	JBZ	11:02 AM	11:00 AM	Chumani	Unknown	12	3	28	99.33	0	0	0	0	0	0.67	0
7/28/2010	JBZ	12:00 PM	12:00 PM	Chumani	Unknown	3	3	29	0	2.33	0	1.87	0	90.8	5	0
7/28/2010	JBZ	01:00 PM	01:00 PM	Chumani	Unknown	2	3	27	15.53	1.67	0	0	0	78.8	4	0
7/28/2010	JBZ	02:10 PM	02:00 PM	Chumani	Unknown	3.5	4	25	24.2	0	0	26	0	18.67	31.13	0
7/28/2010	JBZ	03:05 PM	03:00 PM	Chumani	Unknown	4	2	26	99.67	0	0	0.33	0	0	0	0
7/28/2010	JBZ	04:00 PM	04:00 PM	Chumani	Unknown	0	2	28	99.47	0	0	0.53	0	0	0	0
7/29/2010	PPZ	09:07 AM	09:00 AM	Mike	3	2	1	21	0	0	0	6.47	0	92	1.53	0
7/29/2010	PPZ	09:24 AM	09:00 AM	Jilly	3	0	1	22	80.67	0	0	2.33	0	9.33	7.67	0
7/29/2010	PPZ	10:00 AM	10:00 AM	Mike	3	2	1	22	51.8	0	0	1.13	0	40.47	6.13	0.47
7/29/2010	PPZ	10:16 AM	10:00 AM	Jilly	3	4	1	22	0	0	12.33	1.47	1.87	84.33	0	0
7/29/2010	PPZ	11:00 AM	11:00 AM	Mike	3	7	1	24	81.6	0	0	2.8	0	14.13	1.13	0.33
7/29/2010	PPZ	11:16 AM	11:00 AM	Jilly	3	3.5	1	24	99.13	0	0	0	0	0	0.87	0
7/29/2010	PPZ	12:00 PM	12:00 PM	Mike	3	7.5	1	24	100	0	0	0	0	0	0	0
7/29/2010	PPZ	12:16 PM	12:00 PM	Jilly	3	3.5	1	24	9.13	0	0	1.53	21.33	59.13	7.67	1.2
7/29/2010	PPZ	01:38 PM	01:00 PM	Mike	3	8.5	2	26	25.8	0	0	0	0	47.93	26.27	0
7/29/2010	PPZ	01:53 PM	01:00 PM	Jilly	3	13.5	2	26	0	0	8	0	0	85.2	6.13	0.67
7/29/2010	PPZ	02:21 PM	02:00 PM	Mike	3	6.5	2	26	0	0	0	3.33	11.2	82.27	3.2	0
7/29/2010	PPZ	02:37 PM	02:00 PM	Jilly	3	4	3	27	0	0	46.67	0	0	53.33	0	0
7/29/2010	PPZ	03:00 PM	03:00 PM	Mike	3	13	2	27	0	0	0	0	0	95.13	2.33	2.53
7/29/2010	PPZ	03:16 PM	03:00 PM	Jilly	3	7	1	27	0	0	44.47	0.8	0	53.73	1	0
7/30/2010	PPZ	09:11 AM	09:00 AM	Mike	3	4	1	22	0	0	0	10.73	0	84.47	4.8	0
7/30/2010	PPZ	09:27 AM	09:00 AM	Jilly	3	2.5	1	23	36.47	0	3.87	31.13	0	23.33	5.2	0
7/30/2010	PPZ	10:01 AM	10:00 AM	Mike	3	12	1	23	0	0	0	10.67	0	73.2	15.6	0.53
7/30/2010	PPZ	10:16 AM	10:00 AM	Jilly	3	7	1	23	99	0	0	0	0	0	1	0
7/30/2010	PPZ	11:00 AM	11:00 AM	Mike	3	9.5	1	25	0	0	0	19	8.2	63.47	9.33	0
7/30/2010	PPZ	11:16 AM	11:00 AM	Jilly	3	9.5	1	25	96.07	0	0	2.6	0	0	1.33	0
7/30/2010	PPZ	12:00 PM	12:00 PM	Mike	3	9.5	1	26	0	0	0	21.13	0	67.87	11	0
7/30/2010	PPZ	12:16 PM	12:00 PM	Jilly	3	4	1	26	96.6	0	0	1.53	0	0	1.87	0
7/30/2010	PPZ	01:33 PM	01:00 PM	Mike	3	12	1	28	57.13	0	0	24.13	0	17.53	1.2	0
7/30/2010	PPZ	01:49 PM	01:00 PM	Jilly	3	4.5	1	28	99.67	0	0	0	0	0	0.33	0
7/30/2010	PPZ	02:04 PM	02:00 PM	Mike	3	5	2	28	29.53	0	0	0.2	0	66.73	2.87	0.67

Table 14 (cont.)

Date	Zoo	Time	Block	Otter	Meals	Vstr	Wthr	Tmp (°C)	Rst	Eat	Stp	Mnt	Soc	Loc	Inv	Otr
7/30/2010	PPZ	02:19 PM	02:00 PM	Jilly	3	8	2	28	0	0	49.67	0	0	50.33	0	0
7/30/2010	PPZ	03:05 PM	03:00 PM	Mike	3	12	2	27	0	0	0	0	0	94.67	5	0.33
7/30/2010	PPZ	03:20 PM	03:00 PM	Jilly	3	1	2	27	0	0	50.67	0	0	48.33	1	0
7/30/2010	PPZ	04:10 PM	04:00 PM	Mike	3	5	2	27	0	0	0	7.2	0	87.13	5.2	0.47
7/30/2010	PPZ	04:26 PM	04:00 PM	Jilly	3	3	2	27	41.6	0	0	17.6	0	29.13	11.67	0
7/30/2010	PPZ	05:00 PM	05:00 PM	Mike	3	3.5	2	27	79.07	0	0	7.47	0	10.93	1.87	0.67
7/30/2010	PPZ	05:00 PM	05:00 PM	Jilly	3	3.5	2	27	94.2	0	0	0.2	0	0.47	5.13	0
8/2/2010	PPZ	10:00 AM	10:00 AM	Mike	2	0	1	27	85.93	0	0	13.87	0	0	0.2	0
8/2/2010	PPZ	10:15 AM	10:00 AM	Jilly	2	3	1	27	99.33	0	0	0	0	0	0.67	0
8/2/2010	PPZ	11:01 AM	11:00 AM	Mike	2	6.5	1	28	18.8	0	0	29.6	0	39.73	11.87	0
8/2/2010	PPZ	11:17 AM	11:00 AM	Jilly	2	1.5	1	28	79.2	0	0	3.13	0	5.47	12.2	0
8/2/2010	PPZ	12:00 PM	12:00 PM	Mike	2	1.5	2	28	100	0	0	0	0	0	0	0
8/2/2010	PPZ	12:15 PM	12:00 PM	Jilly	2	1.5	2	28	19.13	0	55.6	2.47	0	22.8	0	0
8/2/2010	PPZ	01:05 PM	01:00 PM	Mike	2	9	2	29	83.73	0	0	16.27	0	0	0	0
8/2/2010	PPZ	01:20 PM	01:00 PM	Jilly	2	0	2	29	13.2	0	0	0	0	73	13.8	0
8/2/2010	PPZ	02:00 PM	02:00 PM	Mike	2	8.5	2	28	0.33	0	0	5.67	0.33	83	10.67	0
8/2/2010	PPZ	02:15 PM	02:00 PM	Jilly	2	6	3	28	0	0	22.33	12.2	0	53.2	12.07	0.2
8/2/2010	PPZ	03:00 PM	03:00 PM	Mike	2	7	3	28	0	0	0	9.47	0.33	85.27	4.6	0.33
8/2/2010	PPZ	03:16 PM	03:00 PM	Jilly	2	0	3	28	48.87	0	0	4.33	0	16	2.47	28.33
8/2/2010	PPZ	04:00 PM	04:00 PM	Mike	2	3.5	3	28	39.2	0	0	25.93	0	32.67	2.2	0
8/2/2010	PPZ	04:15 PM	04:00 PM	Jilly	2	3.5	3	28	85.73	0	0	1.67	0	1.47	11.13	0
8/2/2010	PPZ	05:00 PM	05:00 PM	Mike	2	0	2	28	42.27	0	0	20.8	0	31.8	5.13	0
8/2/2010	PPZ	05:00 PM	05:00 PM	Jilly	2	0	2	28	99.67	0	0	0	0	0	0.33	0
8/3/2010	PPZ	09:00 AM	09:00 AM	Mike	3	8.5	2	25	0	0	0	7	43.93	47.27	1.8	0
8/3/2010	PPZ	09:17 AM	09:00 AM	Jilly	3	20	2	25	0	0	8.33	0	1.67	89.67	0.33	0
8/3/2010	PPZ	10:04 AM	10:00 AM	Mike	3	1.5	3	26	53.53	0	0	26.87	0	18.4	1.2	0
8/3/2010	PPZ	10:19 AM	10:00 AM	Jilly	3	1	3	26	95.4	0	0	0.47	0	0	4.13	0
8/3/2010	PPZ	11:00 AM	11:00 AM	Mike	3	1.5	3	27	0	0	0	0	0	98.47	1.33	0.2
8/3/2010	PPZ	11:16 AM	11:00 AM	Jilly	3	0.5	3	27	0	23	34.8	0	0.87	27.13	14.2	0
8/3/2010	PPZ	12:00 PM	12:00 PM	Mike	3	0	2	28	100	0	0	0	0	0	0	0
8/3/2010	PPZ	12:16 PM	12:00 PM	Jilly	3	0	2	28	94.67	0	0	0	0	0	5.33	0
8/3/2010	PPZ	01:00 PM	01:00 PM	Mike	3	4	1	29	0	0	0	3.33	16.13	78.53	2	0

Table 14 (cont.)

Date	Zoo	Time	Block	Otter	Meals	Vstr	Wthr	Tmp (^{o}C)	Rst	Eat	Stp	Mnt	Soc	Loc	Inv	Otr
8/3/2010	PPZ	01:15 PM	01:00 PM	Jilly	3	4	1	29	0	0	31	0	14.53	46.6	7.53	0.33
8/3/2010	PPZ	02:12 PM	02:00 PM	Mike	3	1.5	2	29	0	0	0	0	0	81.33	18.67	0
8/3/2010	PPZ	02:28 PM	02:00 PM	Jilly	3	4	2	30	0	0	43.47	0	0	52.07	3.47	1
8/3/2010	PPZ	03:00 PM	03:00 PM	Mike	3	1	1	30	0	0	0	0	0	71.13	4.87	24
8/3/2010	PPZ	03:41 PM	03:00 PM	Jilly	3	4	1	30	0	0.53	0	0	0	93.2	6.27	0
8/3/2010	PPZ	04:00 PM	04:00 PM	Mike	3	4.5	1	30	0	0	0	25	0	62.47	12.2	0.33
8/3/2010	PPZ	04:15 PM	04:00 PM	Jilly	3	5	1	30	65.33	0	0	18.8	0	8.93	6.93	0
8/3/2010	PPZ	05:00 PM	05:00 PM	Mike	3	4	1	31	0	0	0	30.07	27	41.2	1.53	0.2
8/3/2010	PPZ	05:00 PM	05:00 PM	Jilly	3	4	1	31	0	0	34.93	0	26.87	33.8	4.2	0.2
8/4/2010	PPZ	09:00 AM	09:00 AM	Mike	2	3	1	27	0	0	0	7	1.13	84.07	7.8	0
8/4/2010	PPZ	09:15 AM	09:00 AM	Jilly	2	0	1	27	38.47	0	0	24.53	14.8	14.33	7.87	0
8/4/2010	PPZ	10:01 AM	10:00 AM	Mike	2	3.5	2	28	0	0	0	0	0	94.8	4.73	0.47
8/4/2010	PPZ	10:17 AM	10:00 AM	Jilly	2	5.5	2	28	0	0	0	0.87	0	95.47	3.67	0
8/4/2010	PPZ	11:00 AM	11:00 AM	Mike	2	12	3	28	0	0	0	0	0	99.13	0.87	0
8/4/2010	PPZ	11:35 AM	11:00 AM	Jilly	2	4	2	28	0	8.33	21.2	0	0	57.2	12.8	0.47
8/4/2010	PPZ	12:00 PM	12:00 PM	Mike	2	3.5	3	28	81.53	0	0	8.8	0	7	2.67	0
8/4/2010	PPZ	12:15 PM	12:00 PM	Jilly	2	6.5	3	28	99.8	0	0	0	0	0	0.2	0
8/4/2010	PPZ	01:00 PM	01:00 PM	Mike	2	9	3	29	0	0	0	0	0	93.67	6.33	0
8/4/2010	PPZ	01:16 PM	01:00 PM	Jilly	2	4	3	29	0	0	40.07	0	20.67	37.13	1.67	0.47
8/4/2010	PPZ	02:00 PM	02:00 PM	Mike	2	1	2	29	100	0	0	0	0	0	0	0
8/4/2010	PPZ	02:15 PM	02:00 PM	Jilly	2	2	2	29	84.6	0	3	0	0	9.87	2.53	0
8/4/2010	PPZ	03:00 PM	03:00 PM	Mike	2	5	2	29	0	0	0	0	0	91.53	8.47	0
8/4/2010	PPZ	03:15 PM	03:00 PM	Jilly	2	3	2	29	0	0	71.47	0	3.33	24.33	0.87	0
8/4/2010	PPZ	04:00 PM	04:00 PM	Mike	2	3.5	2	28	0	0	0	8.53	24.87	65.27	1.33	0
8/4/2010	PPZ	04:16 PM	04:00 PM	Jilly	2	3	2	28	0	0	35.53	0	0	64.47	0	0
8/4/2010	PPZ	05:00 PM	05:00 PM	Mike	2	0	2	27	0	0	0	9.47	0	87	3.2	0.33
8/4/2010	PPZ	05:15 PM	05:00 PM	Jilly	2	4	2	27	54.8	0	0	22	0	16.87	6.33	0
8/5/2010	JBZ	09:10 AM	09:00 AM	Chumani	2	2.5	1	26	0	5.8	0	1.67	0	84.53	8	0
8/5/2010	JBZ	10:00 AM	10:00 AM	Chumani	2	24.5	1	28	63.2	0	0	15.2	0	12.27	9.33	0
8/5/2010	JBZ	11:00 AM	11:00 AM	Chumani	2	27.5	1	28	98.47	0	0	1.53	0	0	0	0
8/5/2010	JBZ	12:01 PM	12:00 PM	Chumani	2	24	1	27	0	0	0	0	0	94	6	0
8/5/2010	JBZ	01:04 PM	01:00 PM	Otto	2	21	2	29	0	1	0	5.27	0	69.2	11.27	13.27

Table 14 (cont.)

Date	Zoo	Time	Block	Otter	Meals	Vstr	Wthr	Tmp (^{o}C)	Rst	Eat	Stp	Mnt	Soc	Loc	Inv	Otr
8/5/2010	JBZ	02:00 PM	02:00 PM	Otto	2	26	2	28	0	0	0	15	0	81	1.2	2.8
8/5/2010	JBZ	03:04 PM	03:00 PM	Otto	2	13.5	2	28	0	0	0	79.33	0	3.2	17.47	0
8/5/2010	JBZ	04:00 PM	04:00 PM	Otto	2	11	1	27	100	0	0	0	0	0	0	0
8/6/2010	JBZ	09:04 AM	09:00 AM	Chumani	3	11	1	24	0	0	0	0.33	0	88.73	4.93	6
8/6/2010	JBZ	10:00 AM	10:00 AM	Chumani	3	4	1	26	100	0	0	0	0	0	0	0
8/6/2010	JBZ	11:00 AM	11:00 AM	Chumani	3	16.5	1	26	0	2.13	0	4.33	0	55.67	37.87	0
8/6/2010	JBZ	12:00 PM	12:00 PM	Otto	3	12.5	1	27	0	0.33	0	6.33	0	61.33	16.8	15.2
08/06/10	JBZ	01:00 PM	01:00 PM	Otto	3	19	1	26	0	0	0	0	0	95.4	4.13	0.47
8/6/2010	JBZ	02:00 PM	02:00 PM	Otto	3	8.5	1	27	0	0	0	80.2	0	1.87	17.93	0
8/6/2010	JBZ	03:02 PM	03:00 PM	Otto	3	5	1	26	51	0	0	0.53	0	45.47	3	0
8/6/2010	JBZ	04:00 PM	04:00 PM	Otto	3	9.5	1	26	0	0	0	0.2	0	82.4	9.87	7.53
8/6/2010	JBZ	05:00 PM	05:00 PM	Otto	3	3	1	26	0	0	0	0	0	74.47	13.4	12.13
8/9/2010	JBZ	09:37 AM	09:00 AM	Chumani	3	0	4	23	0	0.8	0	0	0	86.8	8.27	4.13
8/9/2010	JBZ	10:15 AM	10:00 AM	Chumani	3	0	3	23	0	2.53	0	3.53	0	84.4	9.53	0
8/9/2010	JBZ	11:00 AM	11:00 AM	Chumani	3	6	3	24	0	6.67	0	4	0	80.33	9	0
8/9/2010	JBZ	12:00 PM	12:00 PM	Chumani	3	9	4	25	96.67	0	0	0	0	0	3.33	0
8/9/2010	JBZ	01:00 PM	01:00 PM	Chumani	3	0	3	26	100	0	0	0	0	0	0	0
8/9/2010	JBZ	02:15 PM	02:00 PM	Otto	3	3.5	2	28	0	0	0	8.53	0	81.33	10.13	0
8/9/2010	JBZ	03:00 PM	03:00 PM	Otto	3	8.5	2	28	0	0	0	16.8	0	67.4	15.8	0
8/9/2010	JBZ	04:00 PM	04:00 PM	Otto	3	3.5	2	28	0.8	0	0	4.87	0	75.8	18.53	0
8/9/2010	JBZ	05:00 PM	05:00 PM	Otto	3	0	2	29	100	0	0	0	0	0	0	0
8/10/2010	JBZ	09:35 AM	09:00 AM	Chumani	2	4.5	2	26	0	4	0	0	0	88.67	7.33	0
8/10/2010	JBZ	10:16 AM	10:00 AM	Chumani	2	8.5	1	26	85.87	3.53	0	1.33	0	2.53	6.27	0.47
8/10/2010	JBZ	11:08 AM	11:00 AM	Otto	2	11.5	2	28	0	0	0	0	0	100	0	0
8/10/2010	JBZ	12:00 PM	12:00 PM	Otto	2	14.5	2	28	0	0	0	4.13	0	90.07	5.8	0
8/10/2010	JBZ	01:26 PM	01:00 PM	Otto	2	5	2	30	0	0	0	1.33	0	97.13	1.53	0
8/10/2010	JBZ	02:00 PM	02:00 PM	Otto	2	4.5	2	30	0	0	0	5.33	0	79.93	6.6	8.13
8/10/2010	JBZ	03:01 PM	03:00 PM	Otto	2	2	2	31	54.47	0	0	0.2	0	0	45.33	0
8/10/2010	JBZ	04:00 PM	04:00 PM	Otto	2	0	2	30	0	0	0	0	0	93.33	3.87	2.8
8/10/2010	JBZ	05:00 PM	05:00 PM	Otto	2	4	2	31	0	0	0	0.67	0	83.33	11.8	4.2
8/11/2010	JBZ	09:28 AM	09:00 AM	Chumani	2	0	4	22	0	3.53	0	0.8	0	84	11.67	0
8/11/2010	JBZ	10:10 AM	10:00 AM	Chumani	2	0	4	22	1.67	0	0	16.47	0	60.67	21.2	0

Table 14 (cont.)

Date	Zoo	Time	Block	Otter	Meals	Vstr	Wthr	Tmp (^{o}C)	Rst	Eat	Stp	Mnt	Soc	Loc	Inv	Otr
8/11/2010	JBZ	11:03 AM	11:00 AM	Otto	2	1	3	22	0	0	0	0	0	87.53	8.67	3.8
8/11/2010	JBZ	12:01 PM	12:00 PM	Otto	2	0	3	23	0	0	0	8	0	66.47	19.33	6.2
8/11/2010	JBZ	01:02 PM	01:00 PM	Otto	2	4	2	25	0	0	0	9.47	0	69.53	15.13	5.87
8/11/2010	JBZ	02:01 PM	02:00 PM	Otto	2	2	3	27	0	0	0	4.8	0	76.67	17.33	1.2
8/11/2010	JBZ	03:09 PM	03:00 PM	Otto	2	3	2	28	38.87	0	0	34	0	2.47	24.67	0
8/11/2010	JBZ	04:00 PM	04:00 PM	Otto	2	2	2	29	87.2	0	0	0	0	0	12.8	0
8/11/2010	JBZ	05:00 PM	05:00 PM	Otto	2	3	2	28	0	0	0	3	0	87.07	4.47	5.47
8/12/2010	PPZ	09:03 AM	09:00 AM	Mike	Unknown	0	4	23	0	0	0	4.13	50.27	44.8	0.8	0
8/12/2010	PPZ	09:19 AM	09:00 AM	Jilly	Unknown	0	4	23	0	0	3.53	0.67	24.2	53.27	15.87	2.47
8/12/2010	PPZ	10:01 AM	10:00 AM	Mike	Unknown	1	3	23	7.53	0	0	43.2	19.8	28.33	1.13	0
8/12/2010	PPZ	10:17 AM	10:00 AM	Jilly	Unknown	1.5	3	23	100	0	0	0	0	0	0	0
8/12/2010	PPZ	11:02 AM	11:00 AM	Mike	Unknown	4	4	24	100	0	0	0	0	0	0	0
8/12/2010	PPZ	11:17 AM	11:00 AM	Jilly	Unknown	2	3	24	15.53	0	0	0	1.2	69.2	13.33	0.73
8/12/2010	PPZ	12:00 PM	12:00 PM	Mike	Unknown	5	3	25	0	0	0	0	0	97.67	2.13	0.2
8/12/2010	PPZ	12:15 PM	12:00 PM	Jilly	Unknown	2.5	3	25	0	0	21.13	0	0	76.93	1.93	0
8/12/2010	PPZ	01:02 PM	01:00 PM	Mike	Unknown	22.5	3	26	2	0	0	10.53	0.2	63.6	22	1.67
8/12/2010	PPZ	01:19 PM	01:00 PM	Jilly	Unknown	6.5	3	27	75.6	0	0	2.87	0	0.67	20.87	0
8/12/2010	PPZ	02:03 PM	02:00 PM	Mike	Unknown	7	3	28	99.67	0	0	0	0	0	0.33	0
8/12/2010	PPZ	02:18 PM	02:00 PM	Jilly	Unknown	6.5	3	28	100	0	0	0	0	0	0	0
8/12/2010	PPZ	03:00 PM	03:00 PM	Mike	Unknown	1.5	2	30	0	0	0	6.93	23.87	61.93	7.27	0
8/12/2010	PPZ	03:16 PM	03:00 PM	Jilly	Unknown	0	2	30	0	0	67.33	0	0	30	2.67	0
8/12/2010	PPZ	04:00 PM	04:00 PM	Mike	Unknown	10	2	29	0	0	0	36.53	34	28.33	1.13	0
8/12/2010	PPZ	04:16 PM	04:00 PM	Jilly	Unknown	7.5	2	29	84.2	0	0	7.47	0	2.67	5.67	0
8/12/2010	PPZ	05:00 PM	05:00 PM	Mike	Unknown	0	2	31	0	0	0	2	40.53	50.87	6.4	0.2
8/12/2010	PPZ	05:00 PM	05:00 PM	Jilly	Unknown	0	2	31	0	0	11.53	0.2	34.67	49.2	3.53	0.87
8/13/2010	PPZ	09:00 AM	09:00 AM	Mike	Unknown	0	2	24	0	0	0	1.53	55.8	38.33	4.33	0
8/13/2010	PPZ	09:15 AM	09:00 AM	Jilly	Unknown	1	2	24	0	0	7	0	27.13	62.87	2.33	0.67
8/13/2010	PPZ	10:03 AM	10:00 AM	Mike	Unknown	1.5	2	26	0	0	0	0	0	97.13	2.53	0.33
8/13/2010	PPZ	10:19 AM	10:00 AM	Jilly	Unknown	3	2	26	0	0	19.87	0.67	2.13	76.67	0.33	0.33
8/13/2010	PPZ	11:00 AM	11:00 AM	Mike	Unknown	8.5	1	28	0	0	0	3.87	0	91.2	4.73	0.2
8/13/2010	PPZ	11:15 AM	11:00 AM	Jilly	Unknown	4	1	28	49	0	6	26.33	0.87	14.13	3.67	0
8/13/2010	PPZ	12:00 PM	12:00 PM	Mike	Unknown	8	1	29	98.33	0	0	0	0	0	1.67	0

Table 14 (cont.)

Date	Zoo	Time	Block	Otter	Meals	Vstr	Wthr	Tmp (^{o}C)	Rst	Eat	Stp	Mnt	Soc	Loc	Inv	Otr
8/13/2010	PPZ	12:15 PM	12:00 PM	Jilly	Unknown	11.5	1	29	16.87	0	30.8	0.67	1	49.13	0.87	0.67
8/13/2010	PPZ	01:00 PM	01:00 PM	Mike	Unknown	0	1	30	0	0	0	0.53	0	83.27	14	2.2
8/13/2010	PPZ	01:17 PM	01:00 PM	Jilly	Unknown	1.5	2	30	0	0	12.2	1.8	0	59.67	21.33	5
08/13/10	PPZ	02:04 PM	02:00 PM	Mike	Unknown	1.5	2	30	7.47	0	0	89.2	0	0	3.33	0
8/13/2010	PPZ	02:20 PM	02:00 PM	Jilly	Unknown	0	2	30	100	0	0	0	0	0	0	0
8/13/2010	PPZ	03:00 PM	03:00 PM	Mike	Unknown	8.5	2	30	0	0	0	0	0	86	14	0
8/13/2010	PPZ	03:15 PM	03:00 PM	Jilly	Unknown	5	2	30	0	0	58	0.87	0	40.47	0.67	0
8/13/2010	PPZ	04:12 PM	04:00 PM	Mike	Unknown	2.5	2	30	0	0	0	11.2	0	83.13	5.67	0
8/13/2010	PPZ	04:28 PM	04:00 PM	Jilly	Unknown	0	2	30	0	0	0	0	71.67	23.67	4.67	0
8/13/2010	PPZ	05:00 PM	05:00 PM	Mike	Unknown	0	2	30	61.93	0	0	37.2	0	0	0.87	0
8/13/10	PPZ	05:00 PM	05:00 PM	Jilly	Unknown	0	2	30	55.73	0	0	13.33	0	23.73	7.2	0

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