

The Effect of Heat Lamp Usage on the Performance of Piglets Shortly after Birth

By

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**THE EFFECT OF HEAT LAMP USAGE ON THE PERFORMANCE OF
PIGLETS SHORTLY AFTER BIRTH**

BY

JOANNE WONG LI

**A Thesis/Practicum submitted to the Faculty of Graduate Studies of The University
of Manitoba in partial fulfillment of the requirements of the degree
of
Master of Science**

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Abstract

Heat mats have been shown to be more energy efficient than traditional heat lamps for creep heating in swine farrowing facilities. However, many swine producers insist on using both heat mats and heat lamps for the first two days after farrowing due to their concern that heat mats alone cannot prevent the chilling caused by the evaporation of birth fluid. The use of a dual heating system leads to a higher capital cost and a greater energy consumption. The primary question that was addressed was whether the use of heat lamps for the first two days after farrowing was necessary.

Six in-barn tests were conducted to determine the performance, health status, and behavior of newborn piglets between the two heating regimes, namely heat mats only vs. the heat mat plus heat lamp combination for the first two days after farrowing. Studies indicated that the overall mass gain and mortality rate were not statistically significant ($P>0.05$) using a two-sample equal variance Student's t-test. Behaviour observations revealed that a greater percentage of the newborn piglets preferred the warmth given off by the heat mats than the heat lamps when given a choice. Behaviour observations also revealed that as the piglets aged, they tend to avoid the warmth of the heat mat.

Two piglet-drying tests were also conducted to determine the amount of birth fluid and mucus dry matter present on the skin of newborn piglets. These experiments were conducted to estimate the amount of supplemental heat required to compensate for the heat loss caused by evaporation of birth fluid. For a 1.21 kg piglet, the average birth fluid was found to be 18.55 g per pig and the average mucus dry matter was 0.85 g per pig. So for a 1.21 kg piglet under thermoneutrality, the heat available for evaporating the birth fluid is estimated to be 0.91 W under calm conditions. For metabolic heat alone, it would take approximately 14 h to evaporate all the birth fluid.

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1. INTRODUCTION

Pigs first arrived in Manitoba in 1819 when the first settlers of Selkirk, Manitoba brought approximately 70 pigs (Manitoba Pork, 2000). Currently, the pig production industry in Manitoba continues to grow. The number of pigs in Manitoba increased more than sevenfold from 870,000 in 1975 to 6.3 million currently (Manitoba Pork, 2002) which makes Manitoba the third largest pork-producing province in Canada (Statistics Canada, 2001). In addition to the growth of the pork industry, a trend towards fewer but larger pig farms is expected to continue (Manitoba Pork, 2002).

Most commercial swine production in Manitoba takes place within structures that provide a year-round controlled environment for the pigs (Manitoba Pork, 2002). The various stages of production within these controlled structures include gestation, farrowing, nursery, growing, and finishing. Of particular interest is the farrowing stage of pig production in terms of heating. As the industry continues to grow, this growth requires the development of more energy efficient methods of warming the newborn piglets.

The microenvironment in swine farrowing crates plays a critical role for the well being of newborn piglets. Swine farrowing barns are usually kept at a lower room temperature for the comfort of the sows and localized heating is used for the piglets for their survival and growth (Zhang and Xin, 1999). Examples of common localized heating systems include radiant heaters, heat lamps, hovers, and heat mats (Johnston et al., 1991). The range of temperatures where we see optimum animal performance and efficiency is known as the thermoneutral zone. The upper limit of the thermoneutral zone is known as the upper critical temperature (UCT) and the lower limit is known as the lower critical

temperature (LCT). Since the sow's UCT is much lower than the piglet's LCT, the need for an ideal microenvironment for the piglets is needed to ensure optimum health and growth (Bale, 2000).

Research conducted in the early 1990s, over a four year period by Manitoba Hydro and the Brandon Research Centre of Agriculture and Agri-Food Canada showed that keeping newborn piglets warm in farrowing crates with either heat mats or heat lamps made no difference in weight gain or mortality (Manitoba Hydro, 2001). This agreed with the results from another study conducted by MacDonald et al. (2000). Despite these findings, some farmers are still reluctant to switch from heat lamps to heat mats. This is due to the primary concern that heat mats alone cannot avoid chilling caused by the evaporation of birth fluid from newborn piglets.

Some farmers have installed heat mats alongside their existing heat lamp systems. However, more than 75% of these farmers insist on using heat lamps for the first one or two days after farrowing in addition to the heat mats (Boris, 2000). The operation of two heating systems in a barn results in higher capital cost and greater energy consumption. The question is whether this practice of using heat lamps for the first one or two days after farrowing is necessary. The objectives of this research were:

1. To compare the performance, health status, and behaviour of piglets between the two heating regimes, namely, heat mats only vs. heat mats plus heat lamps for the first two supplemental days after farrowing; and
2. To determine the amount of birth fluid (mucus) on the skin of newborn piglets and to estimate the rate of heat loss caused by the evaporation of the birth fluid.

2. LITERATURE REVIEW

2.1 Swine Physiology

2.1.1 Heating Needs of a Newborn Piglet

Newborn piglets are vulnerable to physiological and environmental challenges. Birthing is an abrupt process where the piglet must overcome respiratory, immunological, digestive, nutritional, and thermoregulatory obstacles in order to survive (Herpin et al., 2002). Of particular concern is the ability of a newborn piglet to thermoregulate its own body temperature (Herpin et al., 2002). This is particularly stressful for a piglet because upon its birth, the piglet experiences a sudden 15-20°C decrease in ambient temperature (Herpin et al., 2002), resulting in a 2°C fall in body temperature (Mount, 1968; Berthon et al., 1993; cited by Herpin et al., 2002). This is a concern as the temperature requirements of a newborn piglet range between 32 to 35°C (Zhang and Xin, 1999).

Although newborn piglets are born with all the necessary mechanisms to help them stay warm, the ability to conserve heat is very limited. This is due to the fact that the piglet is virtually hairless, devoid of brown adipose fat, has low reserves of glycogen and fat, and is wet with birth fluid (Herpin et al., 2002). Being virtually hairless is detrimental to piglets because the greater the amount of hair covering the skin, the less susceptible they are in losing heat to the environment (Herpin et al., 2002). The lack of brown fat is also detrimental to a newborn piglet because brown fat is a source of heat production (Herpin et al., 2002). Lastly, due to the fact that a newborn piglet has a very low capacity to oxidize protein before 5-7 days of life (Marion and Le Dividich, 1999), the limited body energy reserves at birth of glycogen and fat are vital in metabolizing and generating heat (Herpin et al., 2002).

Small piglets are particularly at risk because the newborn piglet has a greater surface to body mass ratio, which results in greater heat loss. Although cold exposure induces vasoconstriction and a slight decrease in skin blood flow in hypothermic piglets (Williams et al., 1979), the impact of these factors on thermal insulation is very limited (Herpin et al., 2002). Due to the challenges that a newborn piglet must face, provision of adequate environmental temperature and freedom from drafts is essential to ensuring the thermal comfort of piglets.

Heating a farrowing barn is usually carried out in two ways. An attempt can be made to heat the whole farrowing barn so that the requirements of the piglets can be met, or more commonly, only part of the barn is heated so that localized areas for the comfort of the piglets are created. Traditionally during Manitoba winters, a combination of the methods are employed in the form of background room heating together with a heated creep area (Connor, 2000). In typical farrowing barns, low room temperatures (18 to 21°C) are maintained for the comfort of the sows and a supplemental heat source (32 to 35°C) is provided to the newborn piglets for their survival and growth (Zhang and Xin, 1999). However, the concern that still exists despite using supplemental heat is the birth fluid which, when evaporated by body heat, may cause a potential chilling effect to the piglets.

2.1.2 Heating Needs of Sows and its Effect on Piglets

Energy reserves of the newborn piglet are low which emphasizes the importance of colostrum as an energy source (Herpin et al., 2002). Colostrum consumption provides the piglet with large amounts of fat (30-40% of the total energy of colostrum) thereby increasing the availability of energy substrates for thermoregulation (Herpin et al., 2002).

In fact, studies conducted by Le Dividich and Seve (2000) found that at 5 days of life, total body glycogen stores are about three times lower while total body fat stores are about four times higher than at birth.

High colostrum and milk production by the sow is also essential for the growth of pre-weaning piglets during the first two or three weeks of life (Whittemore, 1998) and for reducing piglet mortality (Valros et al., 2003). As starvation or its combination with crushing are among the main causes of piglet mortality (Algers et al., 1990) mortality can be reduced effectively, not taking into account the confinement of the sow, by ensuring adequate nutrition of the piglets (Weary et al., 1996). Studies have shown that piglets consuming a lower amount of colostrum and milk are subjected to a less favourable acquisition of passive immunity and a low nutritional status (Quiniou et al., 2002). Therefore, the growth rate and health status of newborn piglets are highly dependent on the ability of the sow to produce large quantities of milk.

However, the production of milk is dependent on the comfort of the sows. The sow prefers cooler temperatures than the newborn piglets. If the conditions are too warm for the sow, she will reduce feed intake and milk output (MacDonald et al. 2000). Specifically, studies conducted by Quiniou and Noblet (1999) and Johnston et al. (1999) found that high ambient temperatures (temperatures greater than the upper comfort range of 18 to 21°C) experienced by the sow caused a decrease in voluntary feed intake by 20-55%. In other words, for every 1°F rise in temperature, there is a 0.2 lb per day decrease in feed intake (Black et al., 1993; cited by Johnston, 1999). In addition, a reduction of blood flow to the mammary system is also observed when sows are exposed to warm conditions. This also contributes to the reduction in milk (Laspiur and Trottier, 2001).

2.1.3 Diseases of Piglets

Although the majority of pre-weaning losses are due to non-infectious causes, such as with management practices, deaths due to disease do occur (Lay et al., 2001). As with all mammals, the piglet is lacking immunity at birth and it depends on the transfer of antibodies from the sow to provide it with protection against disease (English et al., 1984). Therefore, the ingestion of colostrum, the antibody-rich milk that is produced maximally by 12 h after farrowing (Lay et al., 2001) is critical for piglet survival (English et al., 1984). It is particularly important for the newborn piglet to take in colostrum shortly after birth as after 48 h of life, the piglet gut is not longer able to absorb these protective antibodies (Lay et al., 2001).

Disease organisms are present at low levels in most swine units the majority of the time (Whittemore, 1998). These do not always present a problem because the immunity of animals can develop naturally. However, when a disease does exist, it is important to distinguish between disease contracted within the womb and disease contracted at or just after birth (English et al., 1984). Several classification schemes have been proposed in the categorization of neonatal diseases (English et al., 1984). The most widely used classification scheme categorizes diseases of the fetus and newborn as follows:

- Fetal diseases - refers to diseases contracted within the womb which may lead to genetic and developmental abnormalities. Examples include prolonged gestation, congenital defects, abortion, fetal death and mummification;
- Parturition diseases - refers to disease processes associated with a slow or difficult labour or delivery and include severe hypoxia, and injury to the skeleton or soft tissues;

- Postnatal diseases - refers to disease processes occurring within the first month of neonatal life (Whittemore, 1998). Typically, environmental and behavioural factors play a role in these type of diseases (English et al. 1984). Postnatal diseases are further classified as:
 - a) Early postnatal disease - those occurring within 48 hours after birth. These include malnutrition due to poor mothering, hypothermia, and navel infection.
 - b) Delayed postnatal disease - those occurring within the first week after birth. These include starvation following desertion by the sow or mammary incompetence and infections.
 - c) Late postnatal disease - those occurring from 1 to 4 weeks of age. Examples include non-specific diarrhea, and diseases caused by enterotoxins and malnutrition.

On the whole, any factor that decreases colostrum intake, such as cold stress, can predispose the piglet to disease due to its lack of protection. A cold-stressed piglet is more lethargic (Stephens, 1971), hence, it is a struggle for the newborn piglet to quickly stand and become active, to locate the udder, compete with littermates for teat access, and withdraw a good supply of colostrum (Edwards, 2002). Therefore, provision of a comfortable atmosphere will help to ensure that the piglet will seek the udder. In addition, certain preventative measures can be adopted to help prevent the spread of diseases. Examples include adopting a closed herd system, buying from one source only, adopting an 'all-in-all-out' policy with room vacancy and disinfection between farrowings, improving hygiene within the barn, and increasing the herd immunity (Whittemore, 1998).

2.2 Swine Environment

The use of year-round controlled environment structures for pig production is important in providing protection from the elements of wind, sun, precipitation, and varying outdoor temperatures for the pigs in their health and growth. Housing pigs in controlled environments also allows handlers to provide specialized care and attention for the sow and the piglets.

2.2.1 Temperature

Sows and young nursing piglets require different temperatures. A newborn piglet needs a dry, draft-free environment at a temperature of 32 to 35°C (Zhang and Xin, 1999; Whittemore, 1998) for the first few days of their lives. As the piglet grows bigger, the ambient temperature requirements drops (Table 1) (Whittemore, 1998). In contrast, a nursing sow is most comfortable between 16 to 21°C (Zhang and Xin, 1999; Whittemore, 1998). The ambient temperatures at which pigs are comfortable are strongly related to its body weight (Whittemore 1998). That is, the greater the weight of the pig, the lower the comfort temperature.

Table 1. Comfort Temperatures for Pigs of Different Body Weights

Stage of Pig Life Cycle	Liveweight of Pig [kg]	Comfort temperature [°C]
Suckling pigs	Up to 2	32
	2 - 5	28
Weaner pigs	5 - 8	28
	8 - 10	26
	10 - 15	22
Growers	15 - 30	20
Finishers	30 - 60	18
	60 - 120	16
Pregnant sows	Feed restricted	18
	In groups on straw	15
Lactating sows		16
Boars		18

When dealing with temperature requirements in a swine farrowing barn, one must also consider the effects of conduction, convection, and radiation. The contact of the pig with the floor surface is an example of heat transfer through conduction. All substances have some degree of thermal resistance. Flooring with a low thermal resistance has a high ability to draw heat away, whereas flooring with a high thermal resistance has a low ability to draw heat away. Table 2 (Whittemore, 1998) shows the thermal resistance of different flooring materials in comparison to air.

Table 2. Thermal Resistance of Flooring Materials in Comparison to Air

Material	Thermal Resistance*
Air	100
Deep straw bed	500
Wooden slats	200
Wire-mesh floor	100
Concrete slats	50
Solid, wet concrete floor	25

* Values of thermal resistance for select materials are presented as a percentage relative to air.

The values show that the heat loss through deep bedding will occur at a much slower rate than through a concrete floor. Piglets making contact with a heat mat is another form of conduction where heat is transferred to the piglets via the heat mats.

Convective heat transfer in a swine farrowing barn is affected by the speed at which the air moves across the surface of the animal body. At low air speeds, this effect is not great, but at higher air speeds (drafts) of above approximately 0.5 m/s, the rate at which heat will be transferred from the body surface to the air increases (Whittemore, 1998). Therefore, if the conditions are too hot for the pigs, you will want to increase the ventilation rate (volume and speed). If the conditions are too cold for the pigs, you will want to decrease the ventilation rate.

Radiant heat transfer deals with the exchange of thermal radiation energy between two or more bodies (Incropera and DeWitt, 1990). Thermal radiation arises as a result of a temperature difference between two bodies. In a swine farrowing barn, the radiant heat transferred from the heat lamp to the piglet is a function of several components. These include the surface area of the piglet, its temperature, and geometric orientation with respect to other thermally participating objects (Whittemore, 1998).

2.2.2 Ventilation

Good ventilation in swine farrowing barns is vital. Air movement must occur so that evaporative moisture losses from the lungs do not cause a build-up of relative humidity and condensation. In addition, good ventilation ensures that the air is kept fresh and free of noxious gases, and lastly, air movement is necessary in helping pigs lose heat from their bodies as required.

Natural ventilation relies upon the breeze that is drawn in through the inlets of the farrowing room. These inlets may be manually or automatically controlled. In 'controlled ventilation' rooms, air movement is usually achieved by electric fans, which are activated according to the temperature of the room. Usually a minimum ventilation rate of around 0.2 m^3 per hour per kilogram pig liveweight is needed in pig houses (Whittemore 1998), even when the exterior temperature is low. Maximum ventilation rates for warmer weather in temperate climates require being around 2.0 m^3 per hour per kilogram liveweight of pig (Whittemore 1998). For hotter climates, even more than this rate of air movement may be needed at the peak temperature. The air speeds across the body of pigs (including piglets) are normally maintained between 0.1 to 0.5 m/s (English et al. 1984).

2.3 The Farrowing Pen

The farrowing pen components that must be considered in providing the necessary conditions for the sow and her newborn piglets are:

- farrowing crate
- piglet creep area
- pen size
- floor surface
- heating systems for both the sow and piglets

2.3.1 The Farrowing Crate

The major role of crushing in piglet mortality led to the development of systems to control sow movement and the widespread introduction of the farrowing crate (Edwards, 2002). In addition to providing restraint for the sow, the farrowing crate is beneficial in that it allows better environmental provision to be made for the newborn piglet. That is, supplementary heat can be provided close to the site of birth to minimize the risk of chilling (Morrison et al., 1983). Furthermore, the farrowing crate allows for easy and safe human intervention in assisting the farrowing process and the establishment of weaker piglets. Such human interventions have been shown to reduce mortality by as much as 44% (White et al., 1996).

The farrowing crate (Figure 1) provides a degree of protection for the piglets from crushing because it helps control the movements of the sow in such a way that she is forced to lie down on her belly before rolling over on either side. Typically, most crushing injuries and death occur from sows flopping directly onto either side from the standing position trapping unsuspecting piglets (English et al., 1984). Studies have repeatedly shown improved piglet survival in systems providing sow restraint (Edwards and Frasier, 1997).

The critical height and lateral spacing of the horizontal bars of the crate further aid in assisting the sow in controlling her descent from the standing position, which helps to minimize the risk of crushing. The risk of crushing can be reduced even further by fitting farrowing cradles to the crate (English et al., 1984) and anti-crush bars that force the sow to lie straight down. In lying down, the sow normally lowers her front end first and then carefully lowers her hind-quarters. Without farrowing cradles, some sows tend to lose control and their hind-quarters can 'flop' down suddenly during the last part of the descent. This sudden 'flop' can put at risk any piglets in this danger area at the time and newly-born piglets are particularly vulnerable as they wander somewhat aimlessly around the area adjacent to the site of birth, seeking contact with the sow and her udder (English et al., 1984).

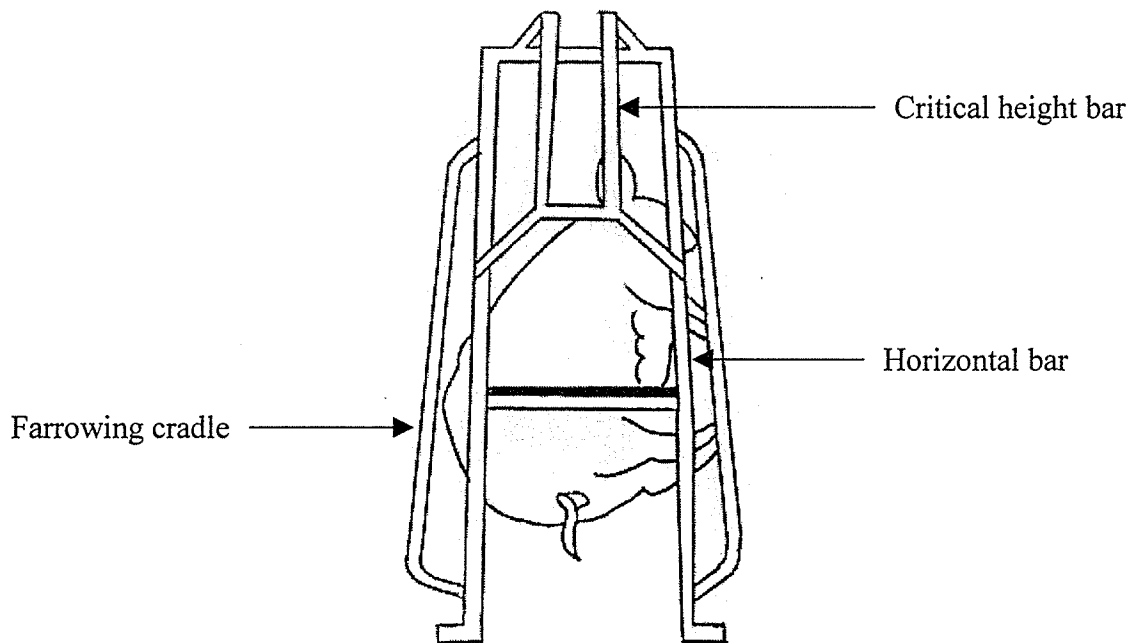


Figure 1. Farrowing Crate Design (Adapted from: English et al., 1984)

2.3.2 The Piglet Creep Area

The piglets' creep area (Figure 2) should provide a warm, draft-free environment for the newborn piglets. Because of the high cost of heating and in order to minimize the effect of convection currents and drafts, the creep area should be well protected by providing an enclosed area that can be more easily heated while providing adequate access to the sow. However, the most current method in use, as in Figure 2, the creep is not enclosed. It is also important that the heated creep area be adjacent to the udder of the sow at the start since piglets have a strong instinct to lie as close to the udder of the sow as possible in the early hours of life (Edwards, 2002).

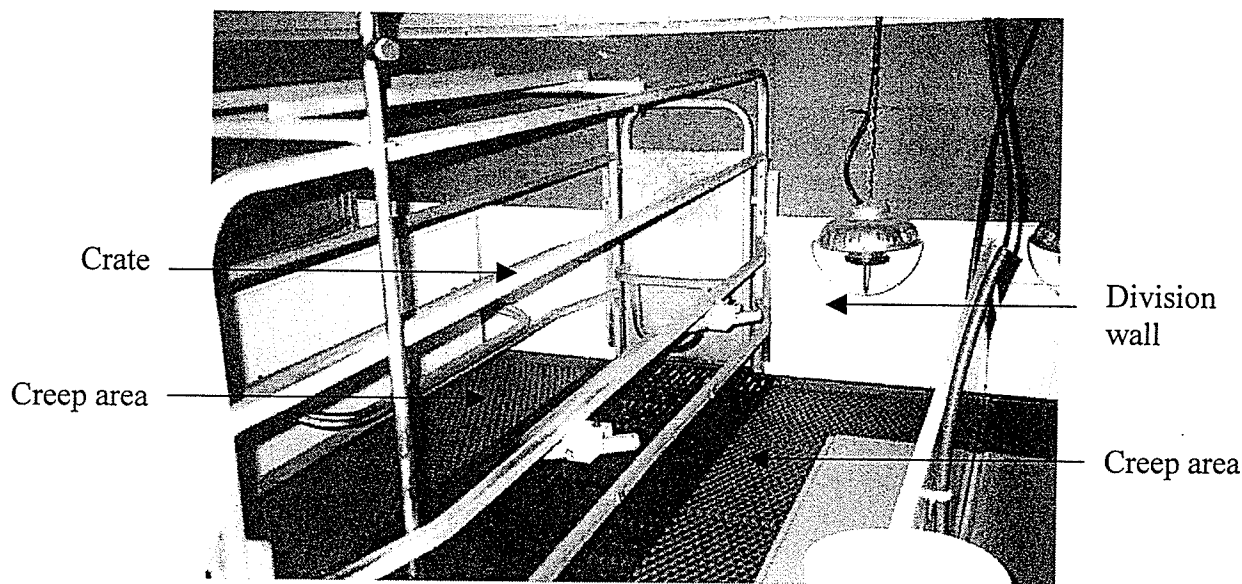


Figure 2. Farrowing Pen Layout

2.3.3 Pen Size

The size of the pen is dependent on the age at which the piglets will be transferred from the farrowing pen to the weaning pen. The minimum desirable width for a farrowing pen is 1.6 and 1.8 meters respectively for pens with side creeps. The minimum desirable

lengths for pens with side creeps are 2.1 and 2.7 meters respectively (English et. al 1984). The size of the pen is of importance to the piglets' health and growth. If the pens are too cramped, this could cause more aggression within the group as more competition for space occurs and creep feeding is more difficult (Kennedy, 2001). As well, a small pen relative to the piglet's increasing body size will more likely increase the chances of piglets getting injured or crushed by the sow.

2.3.4 Pen Flooring

There are many factors that must be considered in providing flooring for a farrowing pen. For example, the floor surface must ensure good mobility for the piglets, and a good foothold for the sow. In some types of flooring for the piglets (commonly plastic coated expanded metal), the gap size is too big in relation to the size of the piglets' feet, which could lead to the piglets getting their feet stuck (Whittemore, 1998). In general, the gap width should not exceed 10 mm (Midwest Plan Service, 1991).

The type of flooring material used by the sow is typically cast iron. By using cast iron under the sow, it provides a cooler surface and is less attractive to the piglets. Providing a good foothold for the sow is also important, as she is less likely to slip and flop down suddenly. As well, a good foothold provides added comfort for the sow (Whittemore, 1998). While lying down, comfortable flooring will encourage the sow to expose effectively all teats on the lower row of the udder at suckling (Connor, 2000).

The floor surface should also eliminate the risk of injury to the piglets and the udder of the sow. Some types of slats have sharp edges and this can result in lacerations in the feet of the piglets and teats of the sow (English et al., 1984). These types of

lacerations can lead to an infection. Lastly, the floor surface should be easy to clean, it should be durable, and of low cost (Whittemore, 1998).

2.3.5 The Heating Systems

The heating system in a swine farrowing barn is often required to provide a compromise between the comfort of the sow and the heating needs of her piglets (Zhang and Xin, 1999). This is due to the temperature differential needed for the sow and her piglets. The common method employed in farrowing barns in Manitoba is to provide background room heating together with a heated creep area (Connor, 2000). The amount of supplementary heat required to maintain the background room temperature depends primarily on the temperature desired and on the ventilation rate (Whittemore, 1998). Background room heating is achieved by gas or electric-powered furnaces (Phillipe, 2000a) while localized heating is accomplished by various methods. These include using radiant heaters, hovers, and heat mats (Johnston et al., 1991).

2.4 Localized Heating Systems in Swine Farrowing Barns

Localized heating is necessary in order to provide the required thermal environment for piglets without the need to heat the whole room. Another advantage of localized heating is that it encourages the newborn piglets to lie away from the sow so that the risk from crushing is decreased (Edwards, 2002). Gas and electric radiant heaters, such as heat lamps, are traditionally the more common types of heating provided to newborn piglets (Boris, 2000). However, localized heat can also be supplied by means of a heat mat that can be laid on the floor of the creep area.

2.4.1 Radiant Heaters

Supplying supplemental heating to newborn piglets by radiant heating is a very common practice (Boris, 2000). Radiant heat works by travelling outward, striking objects in its path. These objects then conduct heat to the surrounding air, and convection currents distribute heat throughout the space as it rises (Incropera and DeWitt, 1990). That is, when radiant heat passes through the air and when it hits the pig, the energy is absorbed and piglet is warmed (Midwest Plan Service 1983, cited by Bale 2000). Radiant heaters work well in creep and sleeping areas because they allow the piglets to find comfort by moving closer to or farther from the heater (Whittemore, 1998).

2.4.2 Hovers

Hovers are simple, three-sided box-like solid partition enclosures that can be placed in the farrowing crate or pen to which piglets have free access (Figure 3).

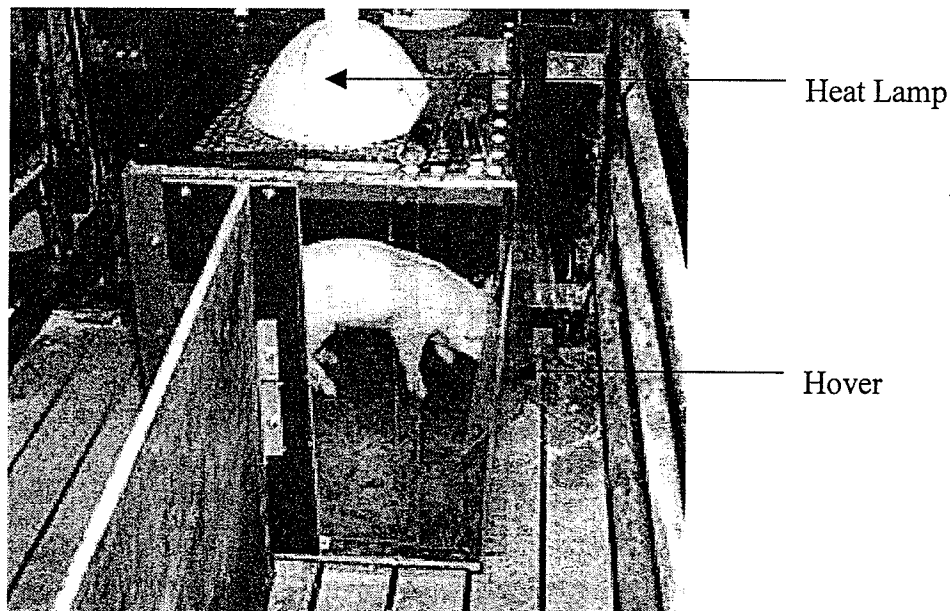


Figure 3. A Typical Farrowing Crate Hover (From: Jacobson and Johnson, 1994).

Plywood, fiberglass, and rigid board plastic are the common building materials for hovers, with synthetic materials being the most popular due to its ease of cleaning (Jacobson and Johnson, 1994). In some cases, the hovers can be used with a heat mat or with a heat lamp shining down through a hole cut on the top (Bale 2000). The function of hovers is to provide a small resting area for the piglet to rest that can be easily heated (Bale, 2000).

2.4.3 Heat Mats

The use of heat mats for creep heating in swine farrowing barns is increasing (Boris, 2000). Although the initial cost of heat mats compared with the other localized heating systems is more expensive, there are significant energy savings gained, allowing a quick cost recovery (Bale, 2000). The following section discusses the advantages of heat mats.

2.5 Heat Mats

2.5.1 Advantages of Heat Mats

An estimated 85% of Manitoba swine producers now use infrared heat lamps suspended above the farrowing crate to provide the extra warmth required (Manitoba Hydro, 1997). However, most producers with new barns are now using heat mats instead of heat lamps because of the advantages heat mats offer (Manitoba Hydro, 2000). Heat mats provides a large comfort area so that piglet piling is minimal (Manitoba Hydro, 2000). In comparison, heat lamps cover a smaller area, creating competition for space (Zhang and Xin, 1999). The heat mats further protect the piglets by blocking drafts rising

through the grated floor of the farrowing crates (Manitoba Hydro, 2000). This reduces another potential threat to the piglet's health (Boris, 2000). Lastly, of the 85% Manitoba swine producers that currently use heat lamps, approximately 75% of them use heat lamps rated at 175 W (Boris, 2000). This accounts for relatively high power consumption when compared with the 66 W heat mats.

2.5.2 Temperature Distribution of Heat Mats

The thermal performance of heat mats depends on the uniformity of the temperature distribution throughout the mat. Uniform temperature distribution would result in less crowding and crushing deaths by the piglets struggling for heat. Studies conducted by Zhang and Xin (1999) showed that regions occupied by the piglets can become excessively hot (hotter than 43°C). This reduces the usable mat area for the piglets. The ability to control the mat surface temperature may decrease the number of hot spots, thereby increasing the usable mat area.

In 1995, de Baey-Ernsten et al. (cited by Zhang and Xin 1999) compared 10 localized heating systems and concluded that surface (floor) heating provided more uniform temperature in the piglet rest area than overhead (radiant) heating. Based on that study, laboratory tests were conducted by Bale (2000) and Wong Li (2001) on a double-sized Hog Hearth® heat mat to evaluate the uniformity and controllability of heat mat surface temperatures under constant environmental conditions. Results of those studies revealed that the temperature distribution along both the length and the width directions of the heat mat decreased from the center towards its edges. The manufacturing process may have caused this particular temperature trend. In manufacturing the mats, the heating elements are first hand-sewn onto a carbon-based mesh. The completed mesh is then

placed between two pieces of fiberglass insulation and glued together with a liquid binder. Finally, the fiberglass-mesh-fiberglass combination is placed inside the plastic casing and is fastened together. Since the heating elements are sewn onto the mesh by hand, and the liquid binder shears the elements, slight temperature variations are apparent across the surface of the heat mat. It should be noted that each heat mat is unique, so that the temperature distribution observed in the experiments conducted by Bale (2000) and Wong Li (2001) are specific to the particular heat mat used (Loewen, 2001).

3. MATERIALS AND METHODS

3.1 Piglet Drying Tests

Two piglet drying tests were conducted at a commercial swine farm, Crocus Country Pork in Mather, Manitoba. The first test was conducted in July, 2000 and the second test was conducted in August, 2001. The average room temperature for the July, 2000 farrowing was 29.7°C and the average room temperature for the August, 2001 farrowing was 30.3°C. Birth fluid (BF) collection kits were prepared prior to the on-farm measurements. Each collection kit consisted of five sheets of dry Bounty™ paper towels, a pair of latex surgical gloves, and a plastic Ziplock™ bag as described by Xin and Zhang (2000). Each BF collection kit was identified with a number and then weighed on a mass balance to determine the initial dry mass of the BF kit. Two operators were involved during the sample collection. Upon the birth of a piglet, one operator, wearing the pair of surgical gloves from the BF kit, held the piglet up and thoroughly collected its BF with the paper towels (Figure 4). The used paper towels along with the used pair of surgical gloves were placed inside the Ziplock bag. The other operator was responsible for opening and sealing the Ziplock bag. The purpose of using two operators for the collection process was to ensure that any BF present on the surgical gloves of the operator responsible for collecting the samples would not be rubbed off while opening and sealing the Ziplock bag. The BF-laden sample kits (wet mass of the BF kit) were then weighed and placed in an insulated cooler for transportation back to the laboratory at the University of Manitoba. Once delivered to the laboratory, each of the Ziplock bags were unsealed and placed inside a convective drying oven along with their respective BF-laden paper towels and kept at 50°C for 48 h. The BF sample kits were weighed again. This was the final dry

mass of the BF kit. The difference between the wet mass and final dry mass of the BF kit yielded the amount of birth fluid per pig. The difference between the final dry mass and the initial dry mass of the BF collection kit yielded the amount of mucus dry matter.

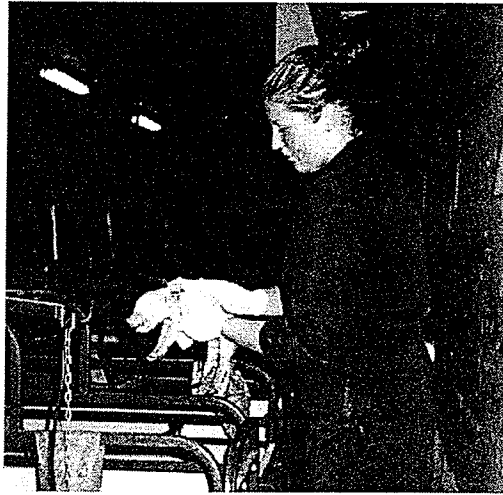
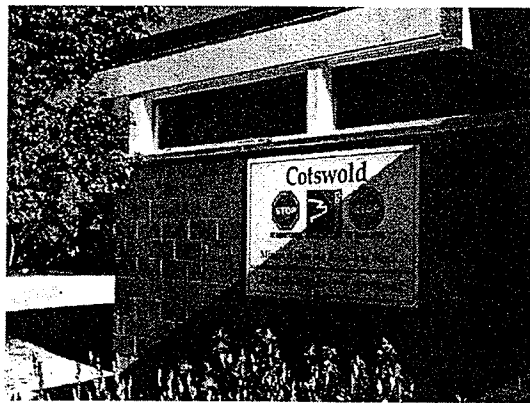
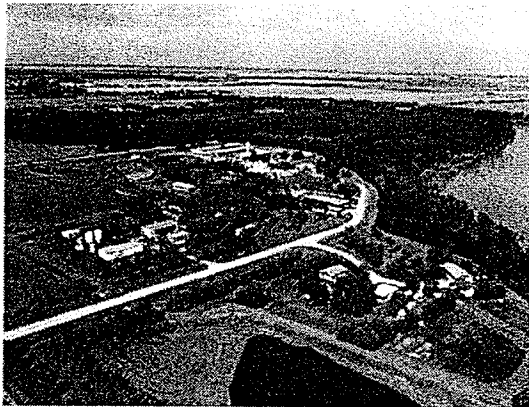


Figure 4. Operator Collecting Birth Fluid from Piglet

3.2 Heat Mat and Heat Lamp Comparison Tests

3.2.1 Experimental setup

Six in-barn tests were conducted at the Swine Unit at the University of Manitoba's research farm, Glenlea Research Station (Figures 5a and 5b).



Figures 5a and 5b. Glenlea Research Station and Glenlea Research Swine Unit

One farrowing room, with a total of 36 crates, was divided up into four sections (Sections A, B, C, and D) as shown in Figure 6. Each section contained one master mat that controlled the surface temperature of the slave mats within that section. While both the master and slave heat mats have embedded heating elements, only the master mats have additional temperature sensors. The sensors work by detecting an increase/decrease in the temperature of the master mat, as it became occupied/unoccupied with piglets. The sensors detecting this change in temperature would send a signal to the controller which would reduce/increase the power input to the master mat, which in turn controls the temperature of the slave mats (Figure 7).

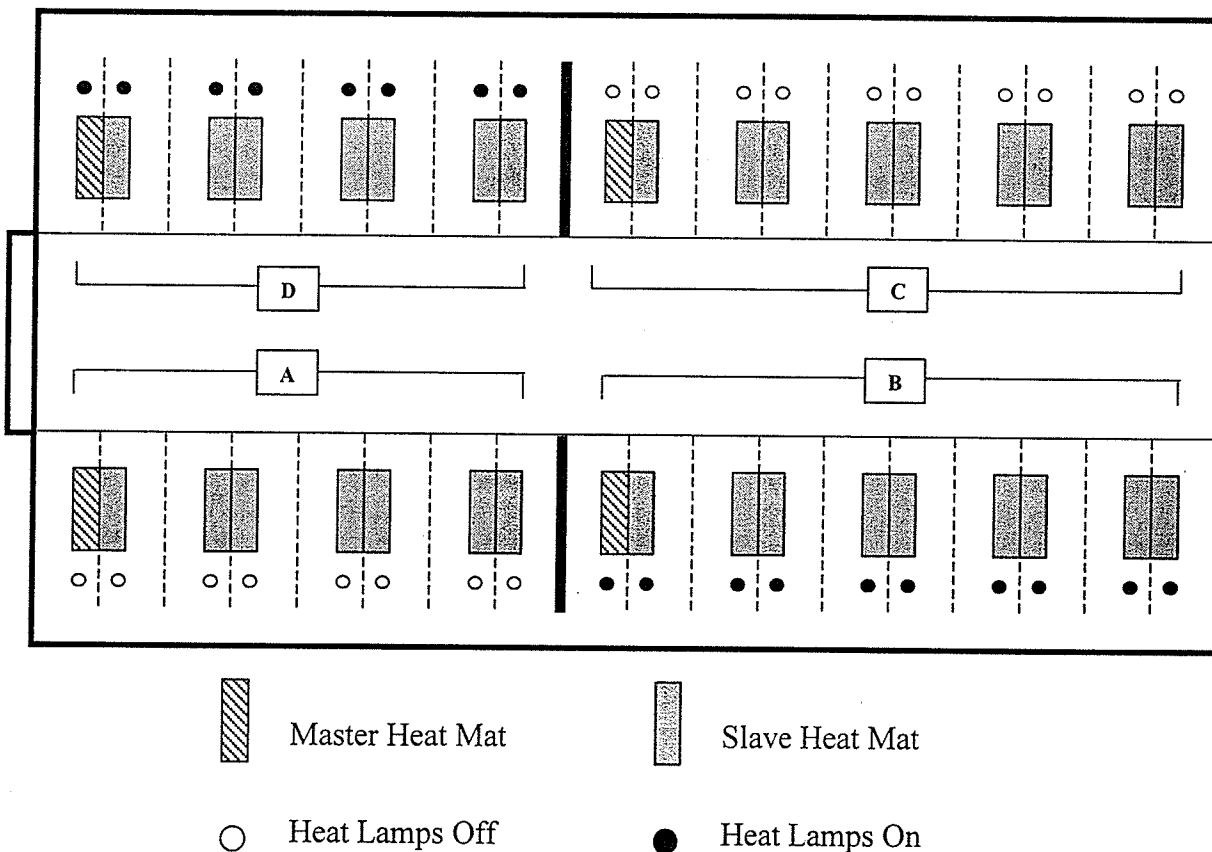


Figure 6. Experimental Setup of Farrowing Barn

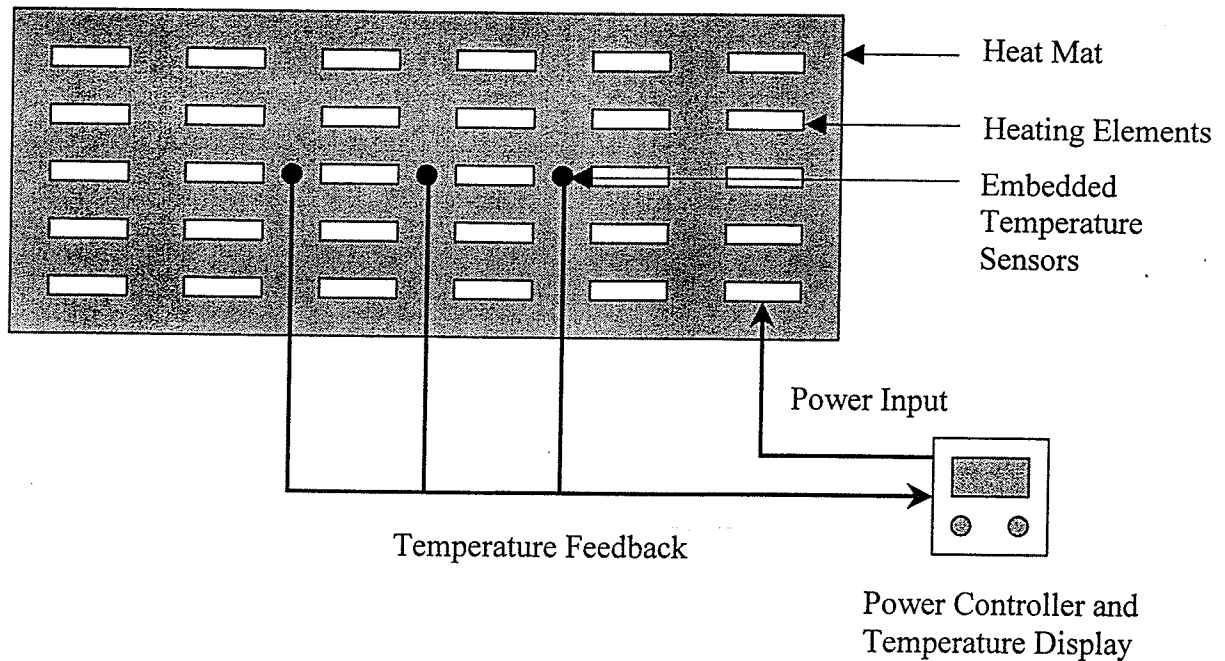


Figure 7. Structure of a Typical Electric Heat Mat with Temperature Feedback Control (Adapted from: Zhang and Xin, 1999)

All 36 crates were equipped with a single-sized Hog Hearth™ electrical heat mat with a rated capacity of 66 W and the dimensions of 120 cm long and 30 cm wide (4 ft long and 1 ft wide) (Hog Hearth™, Alternative Heating Systems Inc., Oak Bluff, Manitoba). Each crate was also equipped with a Phillips™ heat lamp with a rated capacity of 100 W (Figure 8).

The power input to the four master heat mats was regulated through four independently operated controllers. Two metering recorders recorded the power consumption in the front and back of the farrowing barn (Figure 9). A master mat setpoint temperature of 37°C was selected based on an acceptable mat surface temperature range of 34 to 43°C (Zhang and Xin 1999). This temperature setting was used for the entire test period.

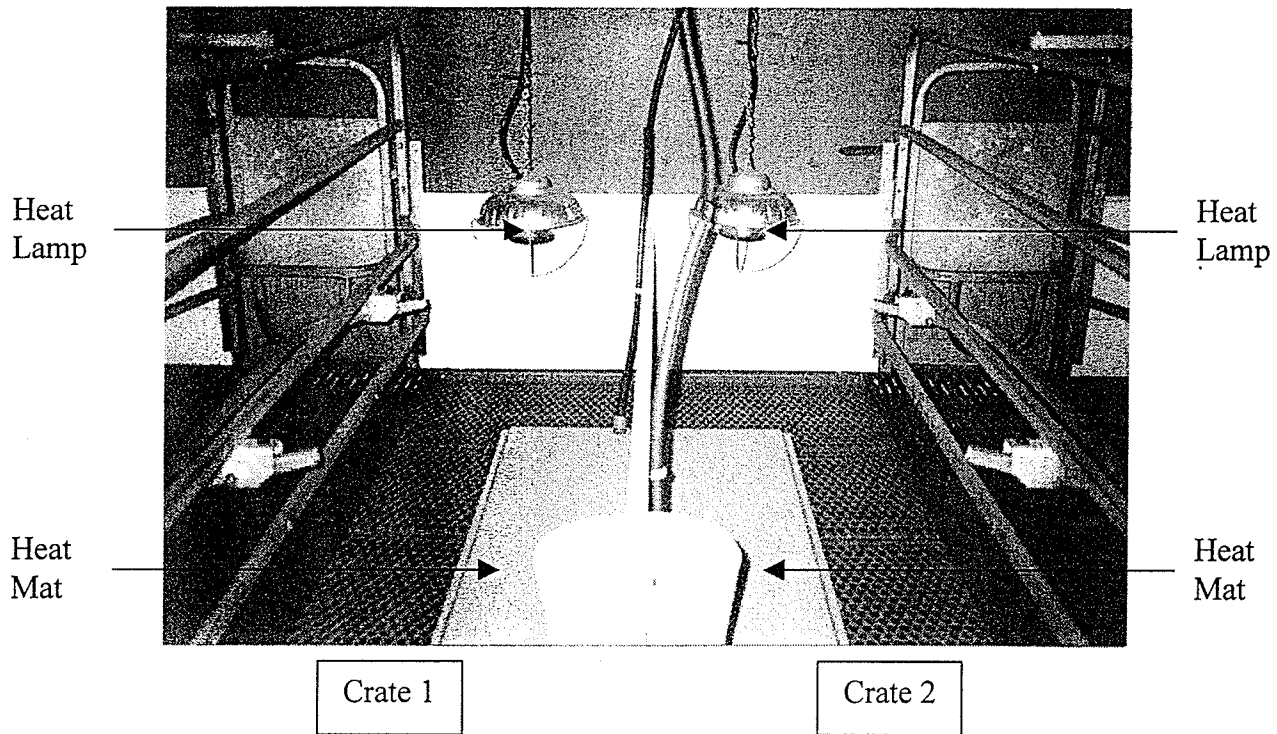


Figure 8. Two Side-by-Side Farrowing Crates with Heat Mats and Heat Lamps

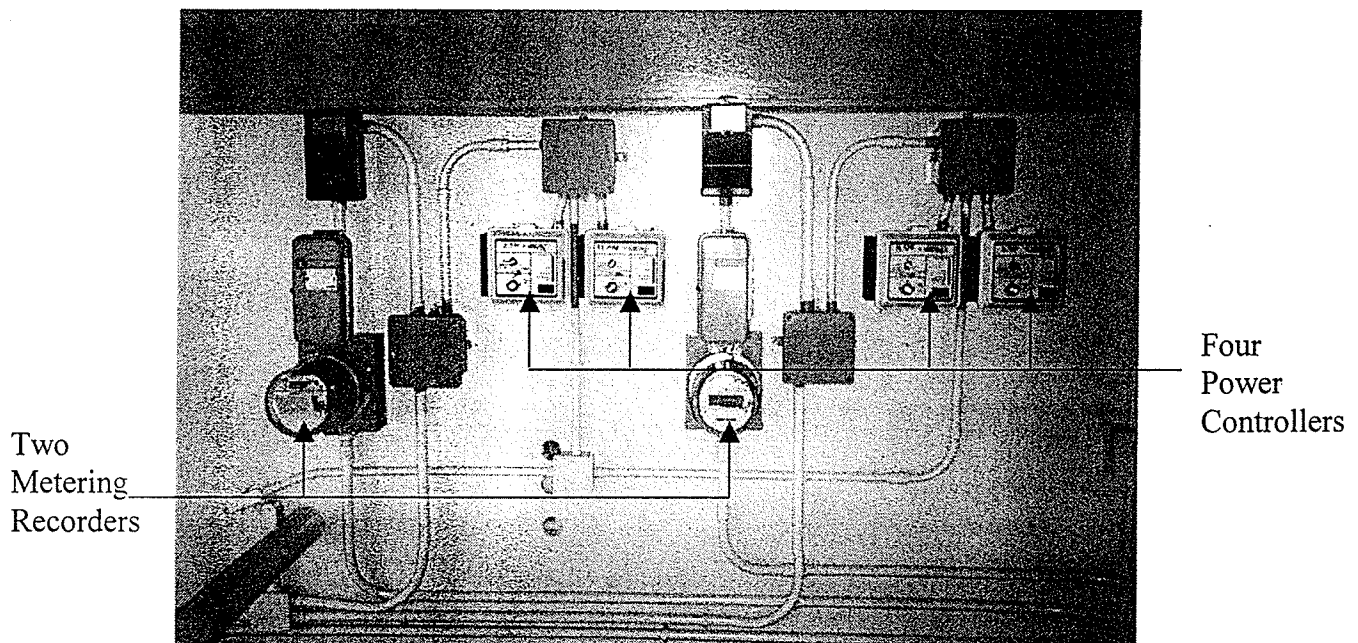


Figure 9. Four Power Controllers and Two Metering Recorders used to Monitor Heat Mat Surface Temperature and Power Consumption of Heat Mats and Lamps

The room temperature of the farrowing barn (Figure 10) was controlled and regulated by two thermostats (Figure 11). For the first farrowing (October 2000), the room temperature was initially set for 21°C by the staff at Glenlea. Upon various visits to the barn during the trial period, it was noted that the thermostat had been adjusted to a higher temperature. That is, the room temperature was re-set for 24°C. The actual average room temperature recorded during this time period was 25.9°C as measured by two HOBO® dataloggers (Figure 12). After the first trial, it was determined that the 24°C temperature setting was too high so for subsequent trials, the room temperatures were lowered to 21°C. Table 3 shows the average temperatures recorded for the six farrowings.

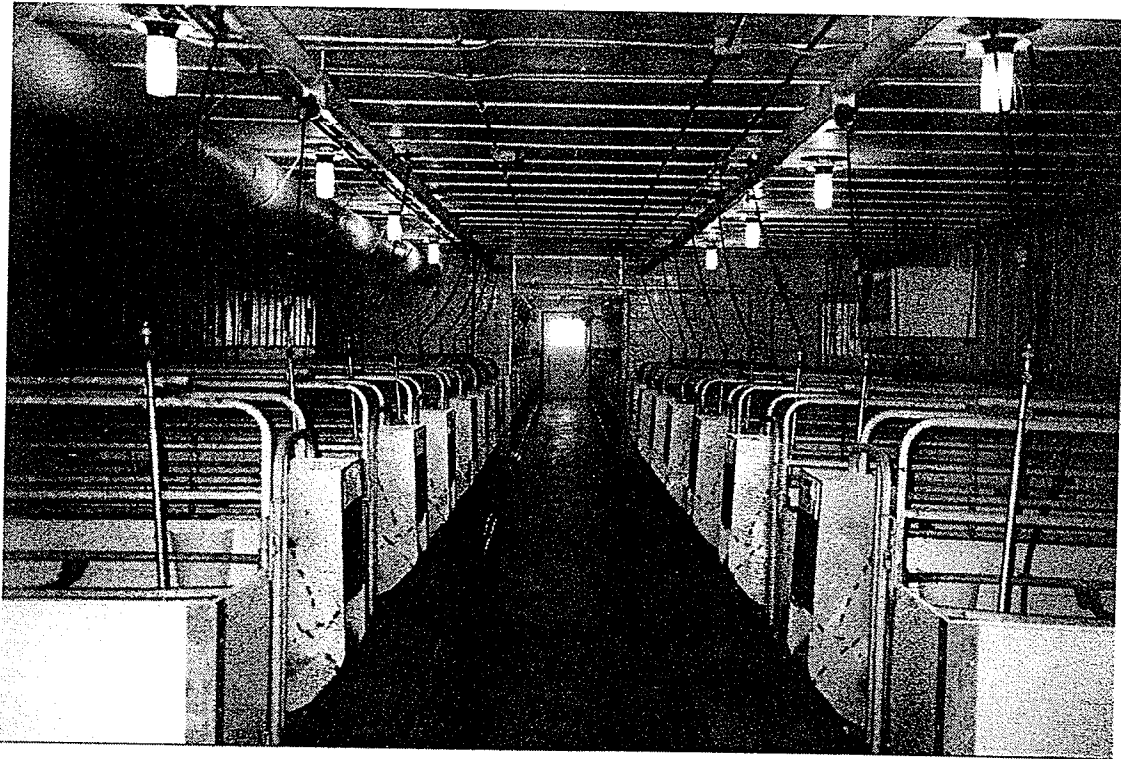


Figure 10. Front View of Farrowing Barn

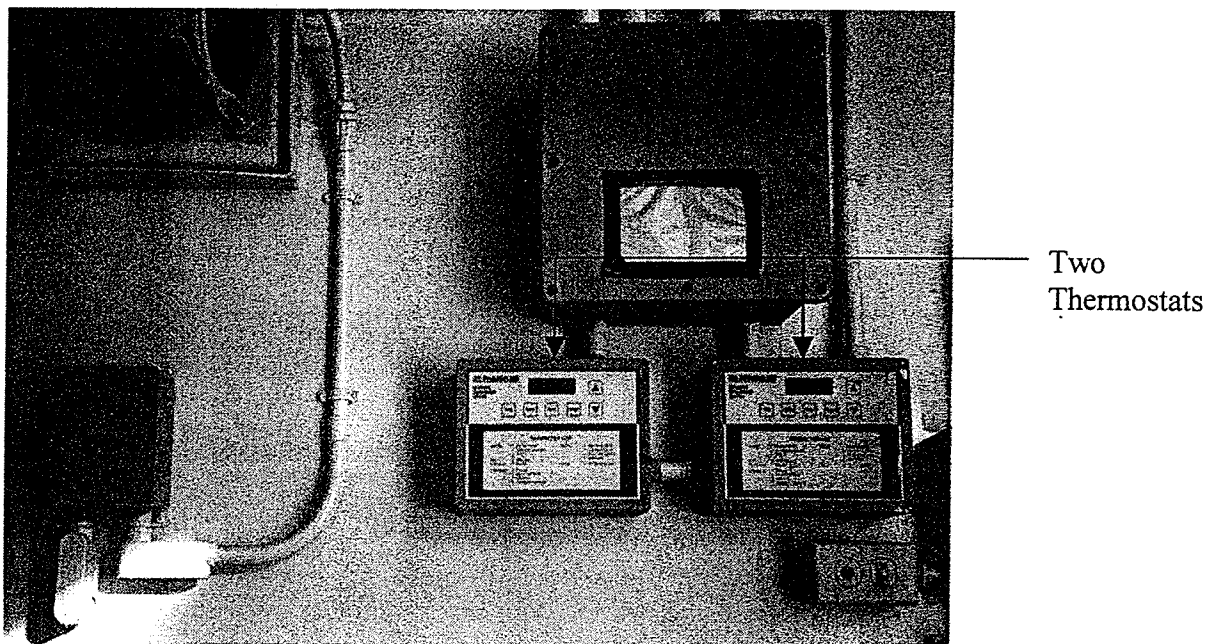


Figure 11. Two Thermostats Used to Monitor the Front and Back Room Temperatures of the Farrowing Barn

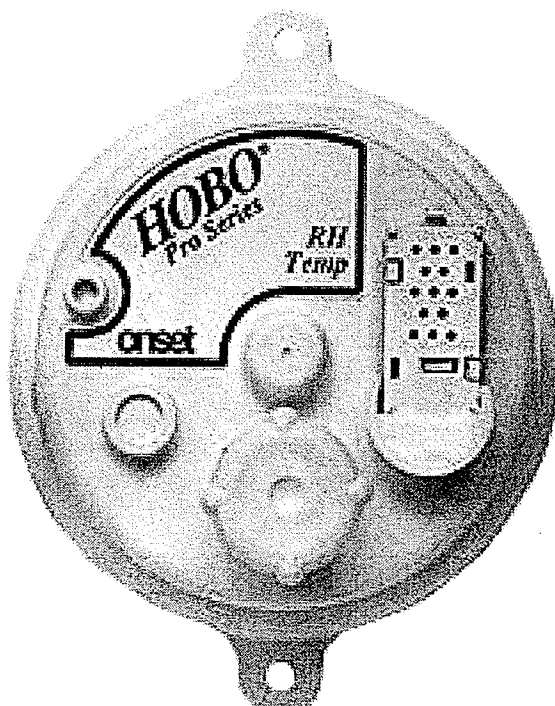


Figure 12. HOBO® Relative Humidity and Temperature Datalogger

Table 3. Average Room Temperatures and Relative Humidity for Six Farrowings

Farrowing Year	Average Front Room Temperature [°C(°F)]	Average Back Room Temperature [°C(°F)]	Average Front & Back Room Temperature [°C(°F)]	Average Front & Back Room RH [%]
Fall 2000	26.5 (79.7)	25.3 (77.5)	25.9 (78.6)	48.2
Winter 2000	24.7 (76.5)	24.1 (75.3)	24.4 (75.9)	43.9
Spring 2001	22.2 (71.9)	21.0 (69.8)	21.6 (70.8)	46.1
Summer 2001	24.0 (75.2)	24.0 (75.2)	24.0 (75.2)	59.7
Winter 2001	21.1 (70.0)	20.7 (69.3)	20.9 (69.7)	42.8
Spring 2002	22.9 (73.3)	22.8 (73.2)	22.9 (73.3)	49.1

The litters were divided into two groups, the treatment group and the control group. Piglets in the treatment group were exposed to both heat mats and heat lamps for the first 2 d after farrowing, and the piglets in the control group were exposed to the heat mat only. For the first farrowing (October 2000), the treatment group was housed in Sections A and C, whereas the control group was housed in Sections B and D (Figure 6). For the next farrowing (December 2000), the treatment group was housed in Sections B and D and the control group was housed in Sections A and C. Alternating the barn sections for the treatment and control groups was carried out for all six farrowings (Table 4). The method of splitting the farrowing room in this fashion was done to compensate for slight deviations in temperature and drafts coming from natural and mechanical ventilation

and heating systems. In other words, it statistically removes variation due to location in the room and barn.

Table 4. Layout for Six Farrowings

Farrowing	Heat Lamps on in Sections A and C	Heat Lamps on in Sections B and D
Fall Farrowing 2000	Yes	No
Winter Farrowing 2000	No	Yes
Spring Farrowing 2001	Yes	No
Summer Farrowing 2001	No	Yes
Winter Farrowing 2001	Yes	No
Spring Farrowing 2002	No	Yes

3.2.2 Heat Mat Surface and Creep Area Air Temperature Measurements

The surface temperatures of the heat mat, the air temperature underneath operating heat lamps, and other locations within the creep area were measured using a hand-held thermocouple indicator (Omega HH-23, Resolution 0.1°C). The heat mat surface temperatures were determined by placing the sensor end of the thermocouple directly onto the surface of the mat at three specific locations (2 near the edge of the heat mat and 1 at the center of the heat mat). The creep area air temperatures were made by placing the sensor end of the thermocouple approximately 25.4 mm (1 inch) above the grating floor. This practice was also adopted for measuring the air temperature underneath an operating heat lamp. Two crates were chosen in Section A (Crate 1 as it contains the master mat, and a randomly-selected crate within Section A containing a slave mat) and two crates were chosen in Section D (Crate 36 as it contains the master mat, and a randomly-selected

crate within Section D containing a slave mat) for each of the six farrowings. The air speed within those selected crates was also measured using a hot-wire anemometer (Airflow TA-300, Low scale range 2 m/s). This was accomplished by placing the sensor end of the anemometer at random heights from 0 cm to 20 cm above the grating floor. The purpose of conducting these measurements was to determine localized environmental conditions experienced by the piglets within the creep area.

3.2.3 Piglet Management and Measurements Conducted by Glenlea Staff

Within the first 18 h of life, staff at Glenlea Swine Unit individually weighed the piglets, clipped their teeth, docked their tails, injected them with iron, and identified with ear notches. The newborn piglet has eight needle teeth located on the sides of the upper and lower jaws (Johnston, 1999). The purpose of clipping these teeth is to reduce the chance of piglets lacerating each other and/or the sow's udder.

Sometimes, piglets will try to bite or chew on the tail of their penmates. Tail biting leads to injury, possible infections, reduced animal comfort, and potentially compromised growth performance of pigs (Johnston, 1999). Tails are docked to practically eliminate tail biting.

Supplemental iron is necessary for piglets born in confinement as confinement-reared piglets are born with very low body stores of iron (Johnston, 1999). Unfortunately, the sow's colostrums and milk do not provide enough iron to satisfy the piglet's needs for rapid growth. Non-supplemented piglets become anemic very rapidly after birth. Iron injection products are available in both 100 and 200 mg of iron/cm³ concentrations. Iron dextran is one of the most common products used. A single injection of 200 mg of iron

before three days of age is sufficient to prevent anemia. Iron injections should be administered in the neck muscle behind the ear (Johnston, 1999).

The staff at Glenlea also equalized the litter size by cross-fostering within 48 h after farrowing. Around 7 days of age, males were castrated and all piglets received another dose of iron. The weaker animals were orally administered a colostrum from a syringe at birth, and pigs dying during lactation were identified and weighed. At weaning, all piglets were individually weighed (Phillipe, 2000a).

3.2.4 Performance and Health Status Tests

The piglet body weight (BW) can vary enormously at birth (Herpin et al., 2002). The initial birth weight and the subsequent weight gain till weaning is a good indication of the health status of the piglet (Edwards et al., 2002). The combination of small BW and high within-litter BW variation is often reported as a major cause of perinatal mortality (Le Dividich et al., 1991; Leenhouders et al., 1999) as smaller piglets are less competitive at the udder than their heavier littermates (Herpin et al., 2002). In addition, smaller piglets have an increased risk of dying by asphyxia during delivery (Herpin et al., 1996). Runt piglets (weighing less than 800 g) have a reduced level and activity of respiratory enzymes at birth (Hayashi et al., 1987; cited by Herpin et al., 2002). For these reasons, piglets in the treatment and control groups were weighed at birth, at 3 d, and at weaning, which was at 16 or 17 d (Figure 13).

Mortality was recorded from birth to weaning for both groups and blood samples were taken from five male piglets of low, medium, and high weights in each group. Male piglets were chosen over female piglets for the blood sampling because they tend to gain weight faster (Connor, 2001). Blood collection was done by jugular venapuncture (Figure 14) of which 7 mL was collected. Analysis of blood samples may be an important indicator of the health status of newborn piglets. This was evidenced by studies conducted by English and Smith (1975). The authors found that piglets dying before 3 weeks of age had a 25% higher blood lactate level at birth. This was indicative of prenatal hypoxia. However, due to budget constraints, the analysis of these samples was not performed.

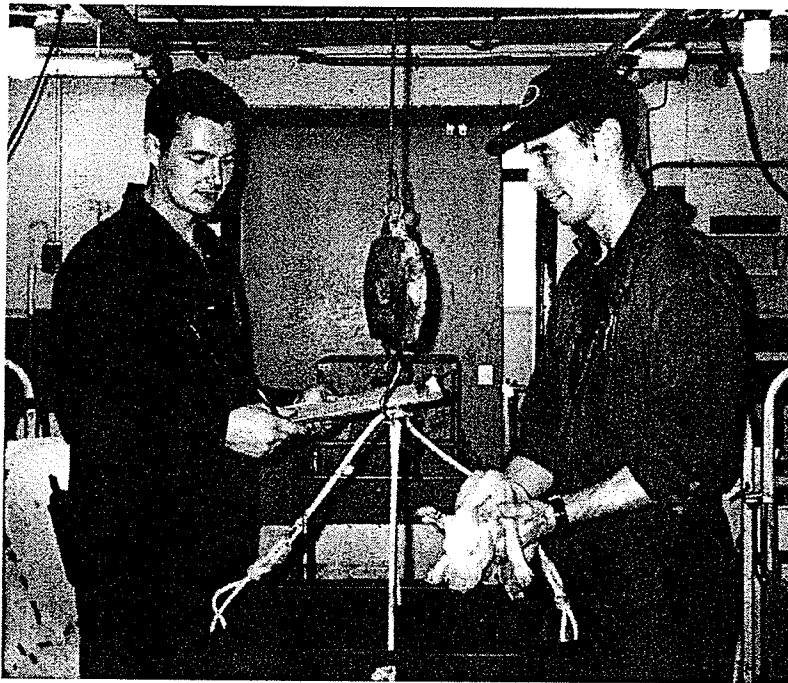


Figure 13. Two Operators Weighing Newborn Piglet



Figure 14. Two Operators Collecting Blood Samples from Piglet

3.2.5 Behaviour Observations

Behaviour observations were conducted to determine the location preference and activity of the piglets. Four crates were selected from the treatment group, and four crates were selected from the control group. Observations were made by standing behind the selected crates and then marking down the position and activity of the sow, as well as the position and activity of all the piglets within the crates. The behaviour observations for both the treatment and control groups were conducted on the day of birth of the piglets, at 3 d, 7 d, and at weaning. Observations were made every half an hour for half a day. The

total time period of the observations was 3 h. For some tests, observations were conducted from morning till noon (08:30 to 12:00) and for other tests, observations were conducted from noon till late afternoon (12:00 to 16:30). Detailed responses of the behaviour of both the sow and the piglets were recorded on a sample sheet as shown in Figure 15.

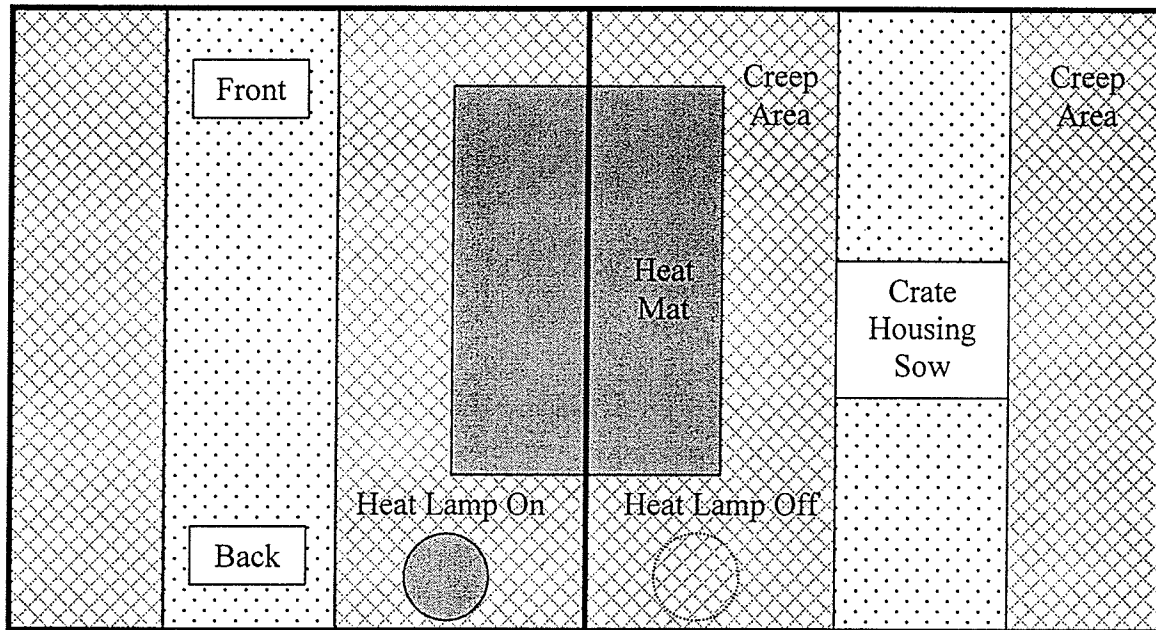


Figure 15. Top View of Farrowing Crate Layout for Behaviour Observations

Table 5 shows the symbols used to denote the positions or activity of the sow housed in the farrowing crate and the location of the piglets within the creep area. For clarification, the position of the sow (facing left or right) is always used in conjunction with either lying down flat on her side, or with nursing. That is, if the sow is facing left while she is nursing, her teats are facing the left-hand side of the farrowing crate, with respect to the observer (Figure 16). When the sow is standing, she is using all four legs for support and when the sow is sitting, her hind legs are not being used for support.

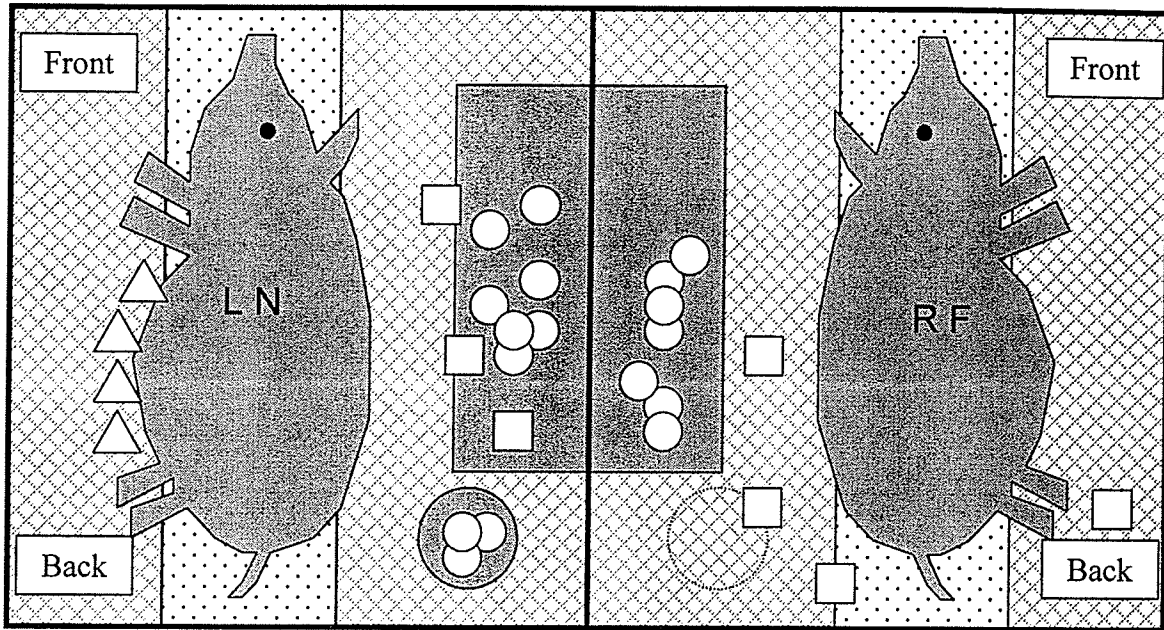


Figure 16. Sample Behaviour Observation Showing Position of Sows and Piglets

Table 5. Symbols Used for Denoting Sow Activity and Piglet Location

Symbol (Sow)	Description (Sow)	Symbol (Piglet)	Description (Piglet)
L	Sow Facing Left	○	Piglet Lying Down
R	Sow Facing Right	□	Piglet Standing
ST	Sow is Standing	△	Piglet Nursing
SIT	Sow is Sitting		
N	Sow is Nursing		
F	Sow is Lying Flat		
E	Sow is Eating		

The analyses of the positions of the piglets do not include the incidences when the piglets were either nursing or standing. Calculations were based on incidences when the piglets were lying down only (Figure 17). This was done because the position of a piglet that was nursing or standing around is independent of its preference between the heat mat and the heat lamp. For example, a nursing piglet (Figure 18) is located at a particular area of the creep due to the position of the teats of the sow. And, a piglet standing in a particular area of the creep is not a good representation of its heating preference due to the fact that the piglet was only located at that particular position for no more than a couple of minutes. That is, the piglet was usually en route to another location within the creep.



Figure 17. Sample Picture of Piglets Lying Down on Heat Mat and Creep Area



Figure 18. Sample Picture of Piglets Nursing

3.2.6 Statistical Analysis

The primary goal of the statistical analysis was to determine whether there were any differences between piglets housed in the treatment group (mat and lamp combination, ML) and those housed in the control group (mat only, MO). The room temperature effect was not considered to be a variable in the analysis.

Data for the weight gains and mortality for both the ML and MO group for all six farrowings was entered into a Microsoft Excel 97 spreadsheet. The ML and MO groups were taken to be data set 1 and 2, respectively. A two-sample equal variance Student's t-test was used. A t-test analysis is used to determine whether two sample means are equal. The particular t-test form used for this study assumes that the means of both data sets are equal and it is referred to as a homoscedastic t-test. As we had no reason to believe that the ML group should be more or less than the MO group prior to beginning the experiments, an a-priori comparison between the six farrowings was adopted.

4. RESULTS AND DISCUSSION

4.1 Birth Fluid and Heat of Evaporation

4.1.1 Birth Fluid

The mean birth fluid (BF) and mucus dry matter (DM) content values of the newborn piglets measured in both BF collection studies are presented in Table 6. Thirty on-farm samples were taken for the first study in July 2000, however, it was determined that four of these samples were not properly sealed and so they were eliminated from the sample size. For the second study conducted in August 2001, twenty on-farm samples were taken. The BF samples were taken from approximately 35 different litters. There was variation in BF amongst the piglets, as shown from the SD values in Table 6.

Table 6. Mean Birth Fluid and Mucus Dry Matter of Newborn Piglets

	Body Mass	Birth Fluid		Mucus Dry Matter	
	[kg/pig]	[g/pig]	[g/kg]	[g/pig]	[g/kg]
Mean	1.21	18.55	15.45	0.85	0.74
Maximum	2.04	32.63	15.99	4.03	1.97
Minimum	0.23	3.13	13.60	0.04	0.17
SD	0.37	7.42	5.04	0.82	0.74

Note: SD = Standard Deviation

The large variation in BF between and within litters could simply be due to the nature of the pigs. That is, larger piglets born will have a larger body mass, hence greater surface area for the BF to be present. In addition, it may likely be attributed to the uncertainty of the exact time of birth of the piglets. That is, if the operator responsible for collecting the BF was present at the exact moment of birth of a piglet, then it is likely that most of the BF on the skin of the piglet was collected. However, if the operator was

unable to catch the precise moment of the birth of a piglet, an assumption had to be made as to whether that particular piglet was born in a short enough time period so that most of the BF would still be present on its skin. For example, the longer the time period between the birth of a piglet and the subsequent collection of birth fluid, the greater the likelihood that some of the birth fluid was rubbed or dried off of the piglet. Between the two farrowings, approximately half of the samples were collected at the precise moment of birth.

4.1.2 Heat of Evaporation

The average body weight of piglets that were tested for their BF was 1.21 kg (standard deviation SD = 0.37 kg). The mean BF content was 18.55 g/pig (SD = 7.42) (Table 6). Assuming that BF behaves like water (i.e., heat of evaporation = 2450 J/g at pig body temperature), the amount of heat required to evaporate BF for a piglet would be 45.4 kJ/pig. That is:

→ Heat required to evaporate BF = Mean BF Content * Heat of Evaporation

→ Heat required to evaporate BF = $18.55 \frac{\text{g}}{\text{pig}} * 2450 \frac{\text{J}}{\text{g}} = 45,447.5 \frac{\text{J}}{\text{pig}} = 45.4 \frac{\text{kJ}}{\text{pig}}$

The main heat sources for drying off the piglets in a farrowing barn include the metabolic activities of the piglet and supplemental heating provided by heat mats or heat lamps. In a worse case scenario, the piglet has to use its own metabolic heat to evaporate all of the BF from its skin. The total metabolic heat production rate of a piglet under thermoneutrality is related to its metabolic body mass by the following equation (Sallvik and Pedersen, 1999):

$$Q_t = 7.4 M^{0.66} + (1 - K_y)(\Phi_d - \Phi_m) \quad (1)$$

where:

Q_t = total heat production rate [W]

M = body mass [kg]

K_y = coefficient of efficiency at weight gain, $K_y = 0.47 + 0.003 M$

Φ_d = daily feed energy intake [W], $\Phi_d = n \Phi_m$ (For $n = 1$, $\Phi_d - \Phi_m = 0$)

Φ_m = heat dissipation due to maintenance [W]

For the average body weight of 1.21 kg, the total heat production rate would be 8.39 W for feedings at 1 × maintenance, as newborn piglets have not yet started feeding (Zhang, 2003a).

Metabolic heat is dissipated to the environment through: (1) latent heat from the respiratory tract (Q_e), (2) sensible heat (conduction, convection and radiation) (Q_s), and (3) evaporation of BF (Q_{BF}). The latent heat of respiration could be estimated by the following equation (Bruce and Clark, 1979):

$$Q_e = 0.09 (8.0 + 0.07M) M^{0.67} \quad (2)$$

where:

Q_e = latent heat production rate [W]

The latent heat for a 1.21 kg piglet would be therefore be $Q_e = 0.8267$ W.

The sensible heat transfer rate (Q_s) is calculated as follows:

$$Q_s = A_e(T_s - T_a)/R_c \quad (3)$$

where:

Q_s = sensible heat dissipated to environment [W]

A_e = exposed surface area of piglet [m^2]

A_t = total surface area of a piglet = $0.097 M^{0.63}$ [m^2]

T_s = surface temperature of pig [$^{\circ}C$]

T_a = ambient temperature [$^{\circ}C$]

R_c = combined thermal resistance of cover layer [$^{\circ}C \cdot m^2/W$]

The exposed area, A_e is taken to be 80% that of the total area, A_t , assuming that the piglets are lying on the mat by itself and without contact with other piglets (Zhang, 2003c).

The cover layer resistance could be estimated as follows (Bruce and Clark, 1979):

$$R_c = \frac{1}{5.3 + 15.7 \frac{u^{0.6}}{M^{0.13}}} \quad (4)$$

where:

u = air speed [m/s]

If the air speed was assumed to be under calm conditions, $u = 0.05$ m/s, the thermal resistance of the cover layer is $R_c = 0.1275$ °C·m²/W. From Xin and Zhang, (2000), the surface temperature of a BF-laden piglet is estimated to be 29.7 °C and the total surface area of a piglet is approximately 0.1093 m², which makes the exposed surface area 0.08744 m². If the ambient temperature of the farrowing barn was 20 °C, then the sensible heat dissipated to the environment is $Q_s = 6.65$ W.

The heat available for evaporating BF is the total metabolic heat production less the latent heat production rate and the sensible heat dissipated to the environment:

$$Q_{BF} = Q_t - Q_e - Q_s \quad (5)$$

So for a 1.21 kg piglet under thermoneutrality, the heat available for evaporating BF is estimated to be 0.91 W under calm conditions. For metabolic heat alone, it would take approximately 14 h to evaporate all the BF.

Therefore, the use of a heat lamp at birth is beneficial in helping the piglets get dried off quickly as there is an increase in the effective or microenvironment temperature. It should also be noted that the BF-laden piglets may rub off some of their BF on the surface of the heat mat, and the heat from the mats would evaporate the BF. So by making direct contact with the heat mat shortly after birth, the mat would also aid in removing BF from the newborn piglets.

4.2 Heat Mat and Heat Lamp Comparison Results

4.2.1 Litter Size

The total and average litter size, the number of piglets born alive, and the number of stillborns are shown in Tables 7 and 8. The litter size of each sow from the six farrowings varied between 4 and 20 piglets (stillborn and alive piglets). Mummies were not taken into account in the calculations. Referring to Table 7, the Summer 2001 farrowing had a higher number of stillborns than the other five farrowings and the Winter 2001 farrowing had the lowest number of stillborns. From English and Edwards (1996; cited by Edwards, 2002), stillbirths generally account for 4 to 8% of all pigs born, with 60 to 70% of them being deaths during or soon after birth (Herpin et al., 2002). The results of our study showed that the percentage of stillborns was slightly higher (9.8% and 10.9%) for two of our farrowings. Phillippe (2001) had stated that in some instances, piglets might have been diagnosed as stillborns, when in fact, they may have been born alive, but by the time the handlers had a chance to check up on them, the piglets had already died. This could be one reason why the percentage of stillborns was slightly higher for two farrowings. Also, inducing farrowing or prolonged farrowing can increase the number of stillborns.

The incidences of stillborns could be linked to several factors, such as maternal genetic effects (Fraser, 1990; cited by Edwards, 2002). Examples include gestational factors that might affect the viability of the piglet. Pre-farrowing factors that might influence the duration of birth and piglet hypoxia is another example. Also, it is known that acute and chronic stressors, such as extreme disturbance or fear of humans, can prolong the farrowing process (Lawrence et al., 1992). However, the disposition of the

sows and the handling procedures employed in the unit make the latter unlikely causes in this case.

Table 7. Total Number of Piglets Born for Six Farrowings

Farrowing	Number of Piglets		
	Total Born	Born Alive	Stillborn
Fall 2000	366	346	20
Winter 2000	355	320	35
Spring 2001	371	348	23
Summer 2001	431	384	47
Winter 2001	339	324	15
Spring 2002	438	400	38
Total	2300	2112	78
Average	383	352	13

Table 8. Average Litter Size of Six Farrowings

Farrowing	Number of Piglets		
	Average Born	Average Born Alive	Average Stillborn
Fall 2000	11.1	10.5	0.6
Winter 2000	11.5	10.3	1.1
Spring 2001	11.6	10.9	0.7
Summer 2001	12	10.7	1.3
Winter 2001	10.3	9.8	0.5
Spring 2002	12.2	11.1	1.1

4.2.2 Birth Weight and Weight Gain

The mean weight (mass) gain for all six farrowing groups are shown in Table 9.

The overall mass gain for all six farrowings were not statistically different ($P > 0.05$)

using a two-sample equal variance Student's t-test. Data was analyzed using a t-test

analysis function found in Microsoft Excel 97.

Table 9. Body Mass (Weight) Gain for Six Farrowing Groups

Farrowing	Total Number of Piglets ^a	Treatment ^b	Weight Gain Birth to 3 d [kg]	Weight Gain 3 d to Wean ^c [kg]	Weight Gain Birth to Wean [kg]
Fall 2000	165	ML	0.48	4.98	5.46
	181	MO	0.47	4.85	5.32
		P-value	0.9487	0.8193	0.8147
Winter 2000	147	ML	0.46	5.72	6.19
	173	MO	0.53	3.52	4.05
		P-value	0.3161	0.0192	0.0265
Spring 2001	185	ML	0.51	4.51	5.02
	163	MO	0.46	5.05	4.47
		P-value	0.3867	0.2152	0.1094
Summer 2001	193	ML	0.49	2.96	3.45
	191	MO	0.54	4.03	4.45
		P-value	0.3524	0.0575	0.0570
Winter 2001	183	ML	0.50	7.02	7.52
	141	MO	0.50	7.48	7.98
		P-value	0.9227	0.2429	0.2592
Spring 2002	214	ML	0.50	6.62	7.12
	186	MO	0.51	6.27	6.78
		P-value	0.8199	0.4793	0.5046
Overall	1087	ML	0.49	5.30	5.79
	1035	MO	0.50	5.07	5.51
		P-value	0.3886	0.7597	0.7667

^a Total number of piglets born alive

^b ML = Mat + Lamp combination, MO = Mat Only

^c Average weaning age was 16 d

The overall mean weight gain from birth to 3 d, from 3 d to weaning, and from birth to weaning were not statistically different ($P > 0.05$), but the weight gain from 3 d to weaning and the weight gain from birth to weaning for the Winter 2000 farrowing were statistically different ($P < 0.05$). Specifically, the heat mat and heat lamp combination yielded a higher weight gain than heat mats alone. It is difficult to speculate why this was

the case. Studies conducted by Quiniou et al. (2002) suggests that the higher the initial birth weight was, the higher the body weight gain due to the ability of heavier piglets to get the best teats, to drain, and to stimulate the teat, which induces a greater milk flow. Conversely, the lighter the piglets are at birth, the less likely they are to gain weight as smaller piglets have lower energy reserves which makes them less competitive at the udder. However, upon inspection of the data, there was no statistical difference between the initial birth weights of the piglets in the control group (MO) of the Winter 2000 farrowing as compared to the other treatment groups of the remaining five farrowings.

Environmental conditions, specifically the ambient room temperature surrounding the control group (MO) may have been a contributing factor as it was determined by the staff at Glenlea that there were cold drafts leaking in from certain areas of the barn (Phillipe, 2000b). The areas where the leakage was particularly bad was at the corner of Section C where a part of the control group was housed during the trial period. This air leakage may have caused a particularly cold ambient temperature surrounding that section of the barn. This in turn may have caused the piglets to seek the warmth of the heat mat over nursing, hence the lower weight gain. It should be noted that the draft problem was corrected for the trials that followed.

4.2.3 Mortality

The percentage mortality of the piglets for all six farrowings is shown in Table 10. Most of the mortality also occurred within 3 days of birth of the piglets, when piglets are more vulnerable to environmental factors and infectious agents. The overall mortality for

all six farrowings were not statistically different ($P > 0.05$), using a two-sample equal variance Student's t-test.

Table 10. Mortality Rates for Six Farrowings

Farrowing	Total Number of Piglets ^a	Treatment ^b	Number of Deaths from Birth to 3 d	Number of Deaths from 3 d to Wean ^c	Deaths from Birth to 3 d [%]	Deaths From 3 d to Wean [%]
Fall 2000	177	ML	8	10	4.5	5.6
	189	MO	10	6	5.2	3.1
		P-value	0.7426	0.3339		
Winter 2000	166	ML	7	1	4.2	0.6
	189	MO	7	3	3.7	1.5
		P-value	0.7560	0.4022		
Spring 2001	201	ML	5	0	2.4	0
	170	MO	22	1	12.9	0.5
		P-value	0.0329	0.2635		
Summer 2001	215	ML	13	5	6.0	2.3
	216	MO	11	4	5.0	1.8
		P-value	0.7151	0.7684		
Winter 2001	187	ML	6	6	3.2	3.2
	152	MO	4	3	2.6	1.9
		P-value	0.7313	0.5363		
Spring 2002	229	ML	16	6	6.9	2.6
	209	MO	9	7	4.3	3.3
		P-value	0.2533	0.7636		
Overall	1175	ML	55	28	4.6	2.3
	1125	MO	63	24	5.6	2.1
		P-value	0.5311	0.6666		

^a Total number of piglets born and not the total number of piglets born alive

^b ML = Mat + Lamp combination, MO = Mat Only

^c Average weaning age was 16 d

However, for the Spring 2001 farrowing, there was a statistical difference ($P < 0.05$) in mortality from birth to 3 d. Inspection of the data revealed the high number of deaths for the heat mat only group was mainly due to a high number of crushing deaths (10 deaths for MO compared to 2 deaths for ML). As well, the low viability of the piglets in the MO group was higher than that of the ML group (5 compared to 2). Typically, the high incidence of crushing is due to the piglet's instinct to seek the warmth of the sow (Edwards, 2002), thereby increasing its chances of being crushed. That is, the piglets may have been predisposed to this outcome through failure of achieving regular and adequate intake of food. Piglets which are malnourished or are of low viability due to chilling spend more time in the proximity of the sow (Weary et al., 1996) and hence more at risk to be crushed. As well, it has been speculated that the piglet is attracted to the red light given off by the heat lamps (Zhang, 2000). Without a red light to attract the piglets to the localized heating, the piglets may opt instead to seek the warmth of the sow.

The predisposing factors of mortality as diagnosed by the handlers includes low viability, crushing, starvation, sickness (scours), savagery by the sow, poor access to the milk line, ruptured, spraddle, and trauma. Poor access to the milk line refers to the likelihood that the piglet was probably too small and was not getting enough milk, so it was removed from the farrowing crate and put on a milk replacer. The piglet subsequently died, likely due to starvation. Ruptured means that the piglet had a hernia, which often follows a castration or an umbilical cord hernia. In the case of an umbilical cord, if this happens and it does not retract back into the body cavity, the umbilical cord may get injured by another piglet. Therefore, the piglet may have to be euthanized. Spraddle is when the pubic bone splits and the hind legs spraddle. This makes standing up

difficult, unless the legs are bound together (which is the common practice adopted by the handlers at Glenlea). Unfortunately, the situation may leave the piglet vulnerable and weak, and may therefore subsequently die. Lastly, trauma refers to situations where the piglet gets hurt, such as getting caught between the crate bars.

Amongst the deaths of liveborn piglets, typical commercial results suggests that crushing is by far the major cause (Easicare, 1995; cited by Edwards, 2002). The results of our study showed that low viability was the leading cause of mortality, followed by crushing. Figure 19 shows a comparison of the causes of mortality between our data and that of Easicare (1995) whose data size was approximately 140,000 records (458 commercial herds). With respect to the Glenlea data, the predisposing factors of mortality listed as "other" includes those that were not stated, ruptured, spraddle, and trauma. But mostly these factors occur after 3 d. Mortalities for piglets diagnosed under milk line were added to starvation, as that was the likely cause of death. Lastly, the piglets diagnosed as runts were added to low viability. A comparison of the causes of mortality between the mat and lamp group (ML) with the mat only group (MO) is shown in Figure 20.

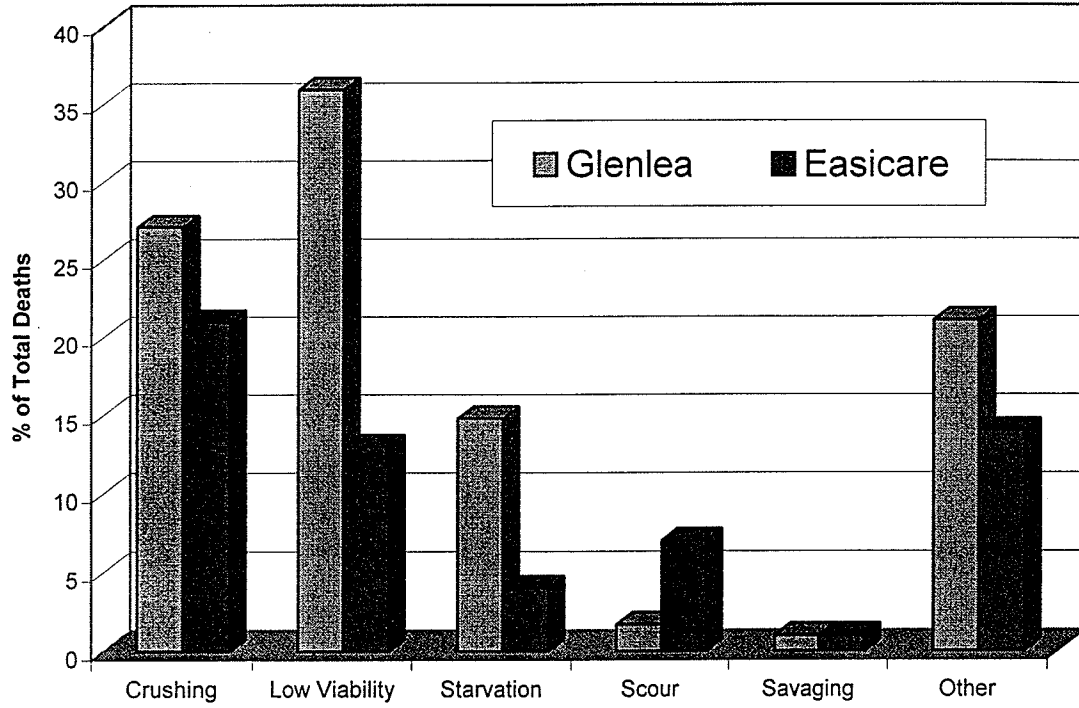


Figure 19. Causes of Mortality of Liveborn Piglets

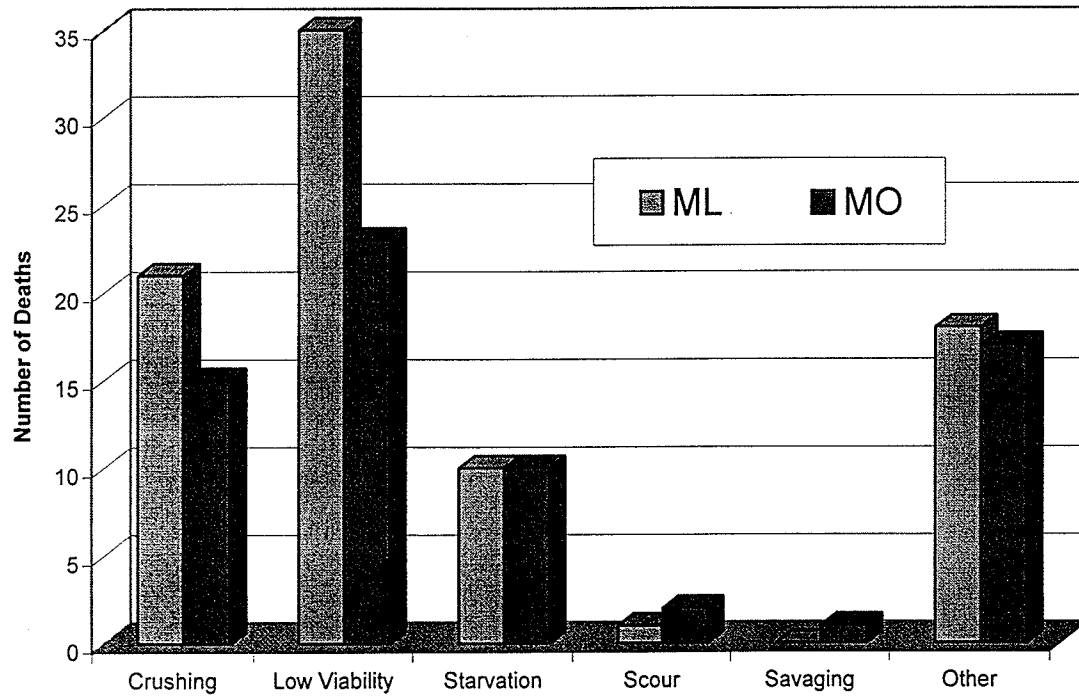


Figure 20. Comparison of Mortality from Birth to 3 d Between ML and MO

4.2.4 Behaviour Observation

The behaviour observations revealed that when the piglets were given a choice between the heat mat and heat lamp, more piglets (71%) preferred the heat mat surface. This average represented the first or second day after farrowing for all six farrowings of the treatment group. The numbers also show that when the piglets were only given the heat mat as the supplemental heat source for the first day or two after farrowing, 65% of them seemed to favour it over any other location within the creep area. Typically, piglets seem to prefer to lie close to the sow during the first 24 h of life (Edwards, 2002), however our observations reveals that the piglets preferred the localized heating source over the sow. In subsequent observations, it was determined that 71% of the piglets seem to prefer the heat mat over the other areas of the creep by Day 3. By Day 7, only 21% seem to favour the warmth of the heat mat, and only 10% of the piglets seeked it by Day 16. These observations demonstrate that as the piglets grows older, the heating requirements decrease. That is, the piglet is able to overcome thermoregulatory challenges by regulating its own body temperature (Herpin et al., 2002). In fact, within 48 h after birth, homeothermy is typically achieved (Mount, 1968; Berthon et al., 1993; cited by Herpin et al., 2002). In addition, colostrum and milk intake is known to play a key role in maintaining body temperature (Herpin et al., 2002). Colostrum consumption provides the piglet with large amounts of fat (30 to 40% of the total energy of colostrum) (Le Dividich and Seve, 2000) which provides the piglets with energy substrates for thermoregulation (Herpin et al., 2002). The ingestion of milk by the piglet results in metabolic heat production (Edwards, 2002). Therefore, the operators of the farm could lower the heat mat setpoint temperature throughout the birth to weaning cycle, i.e. as early as after 7 d.

Observations were also made in terms of piglet piling. For the purposes of this study, piling refers to any situation when a piglet is resting on top of another. For example, a head of one piglet resting on the body of another is considered piling. It is known that grouping and huddling together reduces the cold susceptibility of the piglets by decreasing the heat loss. This may be an instinctive reason as to why piglets pile on top of each other as they are trying to huddle and conserve heat.

On Day 1 of the observations, 49% of piglets in the treatment group were in some manner, piled on top of one another while resting on the heat mat while only 12% were piled on top of one another while resting underneath the heat lamp. A possible explanation as to why a greater percentage of piglets were piled on top of one another on the heat mat as opposed to the area underneath the heat lamp is that the heat mat provides a larger heated surface area for the piglets to rest on. Therefore, it is more likely that a greater number of piglets would be piled on the heat mats than under a heat lamp (which has a smaller heated area). In addition, it would be expected that piglets would prefer the evenly-distributed heat source given off by a heat mat over the localized heat source from a heat lamp. This further reinforces our explanation given above. However, it should be noted that a large heated area should result in less piling (Zhang, 2003b), as there is more room for the piglets to spread out. A possible explanation as to why a high percentage of piling on the heat mat existed was based on the definition of piling for this study.

Basically, any overlapping of body parts was taken as piling, when huddling would have been a more appropriate definition for situations when, for example, the head of one piglet is resting on the body of another. Perhaps a more stringent definition of piling could have been used. For example, it can be defined that one piglet is piled on top of another piglet

if the majority (i.e. greater than 50% surface area) of one piglet's body is resting on another and that the piglet is climbing on top of others.

Twenty-six percent of the piglets were spread out (not touching or overlapping with another piglet) on the heat mat and the remaining 13% represented the piglets that were spread out underneath the heat lamp. For the subsequent observation days, calculation of percentages was limited to the occurrences of piglets resting on the heat mat only. That is, piglets not resting on heat mats are not taken into consideration in the calculations. Table 11 shows the percentage of piglets piled on the heat mat and the percentages of piglet spread across the heat mat for Day 3, 7, and 16.

Table 11. Percentages of Piglet Piling and Spreading on Heat Mat

Observation Day	Percentage of Piglets Piled on Heat Mat [%]	Percentage of Piglets Spread Across Heat Mat [%]
Day 3	70	30
Day 7	46	54
Day 16	2	98

* The percentages are calculated for piglets in the control group (MO)

For instances where the heat mat was not completely occupied, calculation of percentages of when piglets were lying at the front half of the heat mat versus the back half was determined. These percentages are given in Table 12. As well, percentages of when piglets were lying at the front half of the farrowing crate versus the back half of the farrowing crate was determined for incidences when the heat lamp was not used. These percentages are given in Table 13.

Table 12. Percentages of Piglets Lying on the Front Half and Back Half of the Heat Mat

Observation Day	Percentage of Piglets Lying on Front Half of Heat Mat [%]	Percentage of Piglets Lying on Back Half of Heat Mat [%]
Day 1	56	44
Day 3	49	51
Day 7	27	73
Day 16	60	40

* The percentages are calculated for piglets in the control group (MO)

Table 13. Percentages of Piglet Lying on the Front Half and Back Half of the Farrowing Crate

Observation Day	Percentage of Piglets Lying on Front Half of Farrowing Crate [%]	Percentage of Piglets Lying on Back Half of Farrowing Crate [%]
Day 1*	26	74
Day 3	39	61
Day 7	55	45
Day 16	72	28

* The percentages are calculated for piglets in the control group (MO)

The preference of the piglets, as shown in Table 12, does not follow any specific trend. That is, Days 1 and 16, the piglets seemed to prefer the front half of the heat mat while Days 3 and 7, the piglets seemed to prefer the back half of the heat mat. Although there may be slight deviations in the temperature distribution of the heat mats, these behaviour observations reveal that there does not seem to be preference between the front half or the back half of the heat mat.

There appears to be a preference of the piglets for the back half of the farrowing crate (Table 13) for the first 3 d after farrowing. A reason why this may be is due to the tendency of the newborn piglet to find a resting area closest to the birth opening of the

sow. However, as the piglet grows older and stronger, it becomes more mobile, enabling it to move all over the crate area.

Lastly, the percentage of time that the piglets were resting on the heat mat compared to any other incidences, such as nursing or standing during the three hour observation period was calculated and presented in Figure 21.

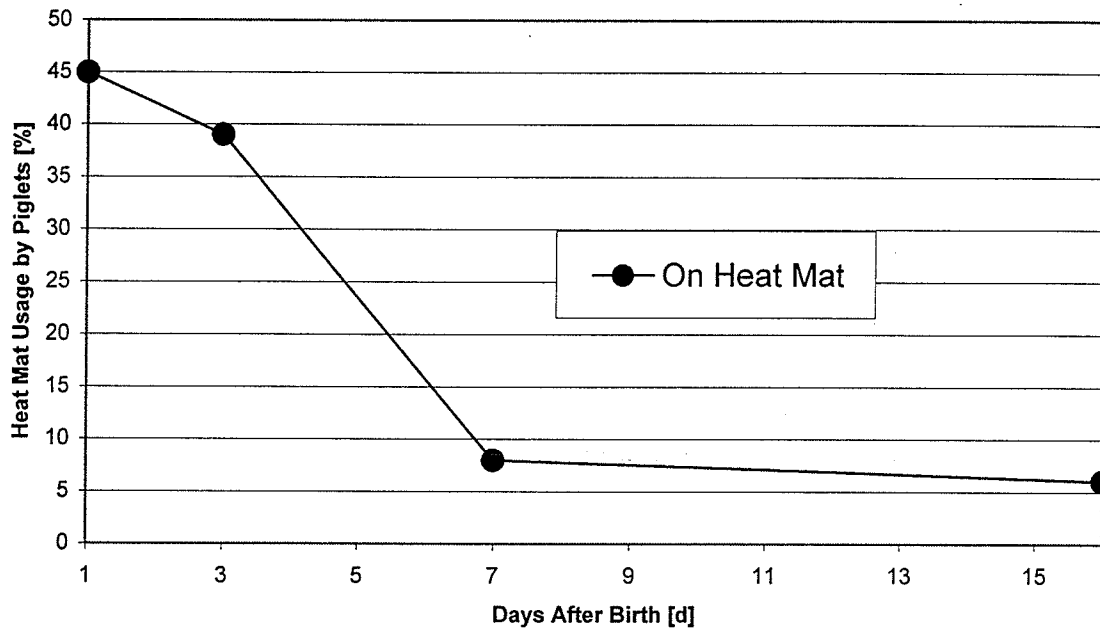


Figure 21. Piglet Resting Patterns over a 3 hr Period

The behaviour observations show that the percentage of the time that the piglets sought the supplemental heat provided by the heat mat was greatest during the first 3 d of life, and this percentage dropped sharply by day 7 and by weaning. However, studies conducted by Zhang and Xin (2001) found that the first day usage of the heat mat was only 4%, and increased to 19% for the second day. The usage of the heat mat continued to increase up to 3 d of life, and then the usage dropped to approximately 3% by weaning. It

should be noted that these studies involved both heat mats and heat lamps, therefore the piglets had a choice. In our study, the resting pattern of the piglets over a 3 hr period was limited to heat mats only. Overall, both studies show the necessity of localized heating for the first few days of life. In addition, these behaviour observations reveal that as the piglet grows older, its heating requirements are less, therefore, they tend to avoid the supplemental heat source.

4.2.5 Heat Mat and Heat Lamp Surface Temperature Measurements

The surface temperatures of the heat mat and the creep area underneath the heat lamp were measured with a hand-held thermocouple indicator. The air speed within those selected crates was also measured using a hot-wire anemometer. A summary of the average surface temperatures for all six farrowings is shown in Tables 14 and 15 with locations denoted in Figure 22.

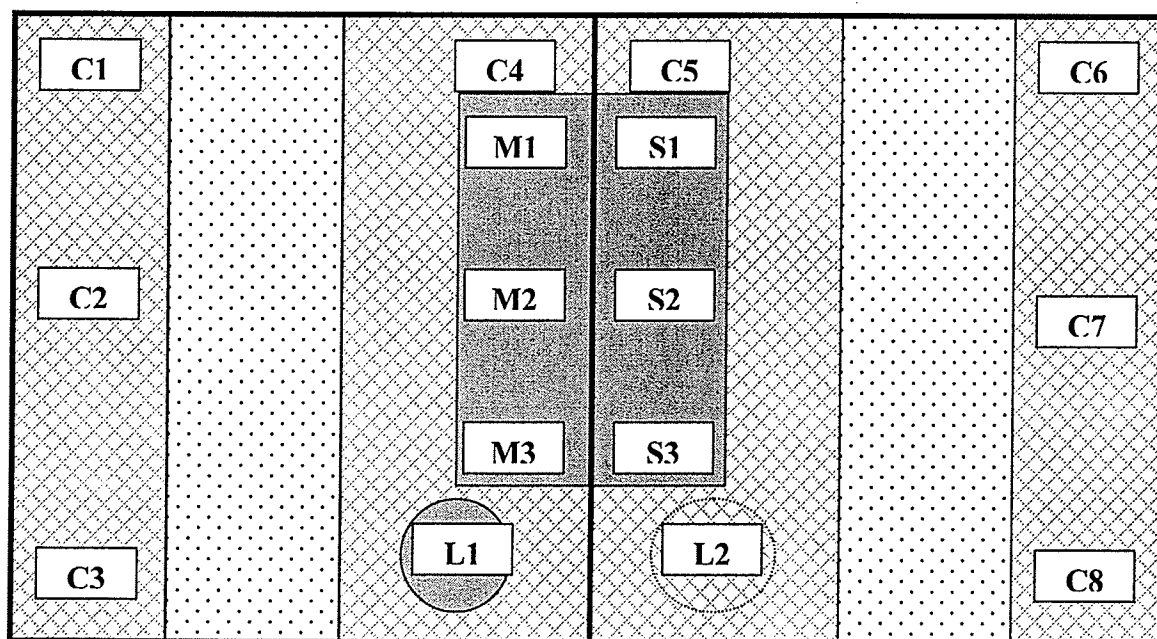


Figure 22. Location of Surface Temperature Measurements

Table 14. Average Air Temperature Measurements

	Average Air Temperatures [°C]					
	Fall 2000	Winter 2000	Spring 2001	Summer 2001	Winter 2001	Spring 2002
C1	21.7	21.7	19.9	24.6	23.6	20.6
C2	21.7	22.0	20.4	23.4	23.7	20.7
C3	21.8	22.6	20.3	22.9	23.6	20.5
C4	20.9	22.9	19.8	23.4	22.8	20.4
C5	20.3	22.5	20.4	23.4	22.9	21.1
C6	19.7	22.9	20.4	22.9	22.9	21.1
C7	20.8	22.9	20.4	22.8	23.1	21.1
C8	20.9	22.7	20.3	22.7	23.2	21.2
P-value						

*Note: CX represents surface temperatures measured within the creep area
 LX represents temperatures measured within the creep area but underneath the heat lamp

The P-value was determined from comparing Sample 1 (C1, C2, C3, C4) with Sample 2 (C5, C6, C7, C8).

Table 15. Average Heat Mat Surface Temperature Measurements

	Average Heat Mat Surface Temperatures [°C]					
	Fall 2000	Winter 2000	Spring 2001	Summer 2001	Winter 2001	Spring 2002
M1	35.3	35.5	34.4	34.3	35.6	33.5
M2	36.5	37.7	35.3	35.4	35.7	34.5
M3	35.4	35.5	35.2	34.5	35.5	34.5
S1	35.2	34.8	33.4	34.5	35.2	35.1
S2	35.2	34.9	33.5	35.5	35.4	35.1
S3	35.1	34.9	34.4	35.4	35.5	34.7
P-value						

* Note: MX represents surface temperatures measured on the master heat mat surface
 SX represents surface temperatures measured on the slave heat mat surface

The P-value was determined from comparing Sample 1 (M1, M2, M3) with Sample 2 (S1, S2, S3).

Several points are noted from the surface temperature measurements. First of all, the air temperatures measured within the various locations of the creep area for each specific farrowing (from Fall 2000 to Spring 2002) differed. This was likely attributed to the different ambient temperatures of the farrowing room during that particular trial. Secondly, the heat mat surface temperatures between the master mat and the slave mats differ slightly. Lastly, the temperatures measured underneath the heat lamp area when the heat lamp was on (L1) were found to be slightly higher than those measured within the creep area (C1 to C8). The temperatures measured underneath the heat lamp area when the heat lamp was off (L2) were found to be similar to those measured within the creep area (C1 to C8). Because the air temperature under an operating heat lamp was heated, the air temperature 25.4 mm (1 inch) above the surface directly under the lamp was higher than other locations in the creep.

The air speed measured within various locations of the creep area with a hot wire anemometer was found to be barely detectable (between 0.0 and 0.01 m/s). This would indicate that there is very little or no draft coming through the grating floor from below. In addition, the partition walls surrounding each individual crate may also act as a draft barrier, which aids in minimizing the air circulation within the creep area from around the farrowing room. Finally, it should be noted that the resolution of the hot-wire anemometer used was between 0 to 2 m/s. The air speed measured was between 0 to 0.01 m/s which is below the air speed assumed under calm conditions of $u = 0.05$ m/s.

5. CONCLUSIONS

- The overall mass gain and mortality tests from all six farrowings were not statistically different ($P>0.05$) between the treatment and control groups. The use of heat lamps with heat mats in the first two days after birth did not affect body weight gain or mortality rate of piglets.
- The results of the behaviour tests showed that when given a choice, 24% of the piglets observed in all six farrowings seemed to prefer the warmth given off by the heat lamps, while 71% seemed to prefer the warmth given off by the heat mats. When heat mats were their only supplemental heat source, the piglets seemed to choose them (65%) over any other location within the creep area. Lastly, it was observed that the use of the heat mat from Day 3 till Day 16 decreased from 39% to 6% of the time. That is, a majority of the piglets tended to avoid the heat mat by weaning age.
- In terms of piglet piling, a greater percentage of piglets piled on top of one another while resting on a heat mat prior to the end of the first week of their lives. From that point on, when they were resting on the heat mat, the majority of the time they were spread out across the mat.
- The mean birth fluid and mucus dry matter content of a 1.21 kg newborn piglet was found to be 18.55 g/pig (15.45 g/kg) and 0.85 g/pig (0.74 g/kg), respectively. Metabolic heat produced by the piglets is not sufficient in drying off the birth fluid of newborn piglets. Therefore, the use of a supplemental heat source at birth is beneficial in helping the piglets get dried off quickly.

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Appendix A

Table A. Body Mass and Birth Fluid Samples for the 2000 and 2001 Trials

Sample Number	Body Mass [kg/pig]	Birth Fluid [g/pig]	Mucus Dry Matter [g/pig]
1	1.36	28.15	1.01
2	0.68	6.08	0.60
3	1.36	23.35	0.56
4	0.23	3.28	0.40
5	1.13	19.95	0.33
6	0.91	11.95	0.93
7	1.13	11.39	0.13
8	1.13	26.02	0.83
9	0.68	8.17	0.04
10	1.13	20.02	0.53
12	1.13	15.20	0.80
14	0.91	15.05	0.04
16	2.04	16.60	0.76
17	1.36	25.66	0.59
18	0.68	11.89	0.19
19	1.36	23.80	0.50
20	1.81	27.57	1.02
21	0.68	20.70	0.72
22	1.59	28.26	1.12
23	1.59	17.19	1.06
24	1.59	17.11	0.31
25	0.68	11.72	0.04
26	1.36	21.14	0.44
27	1.81	20.47	1.46
28	1.36	26.29	1.20
30	1.13	26.39	1.22
31	1.28	9.91	2.15
32	1.21	11.56	0.08
33	1.23	21.14	1.55
34	1.63	25.67	2.07
35	1.40	24.37	0.08
36	1.66	32.63	1.69
37	0.96	12.95	1.03
38	1.10	10.65	0.15
39	1.04	8.87	0.16
40	1.35	17.39	0.42
41	1.14	23.03	2.95
42	1.35	25.42	1.31
43	1.12	25.79	4.03
44	1.39	21.77	0.25
45	0.61	3.13	0.78
46	1.39	21.53	0.30
Mean	1.21	18.55	0.85
Maximum	2.04	32.63	4.03
Minimum	0.23	3.13	0.04
SD	0.37	7.42	0.82
CV	30.58	40.00	95.56

SD = Standard Deviation

CV = Coefficient of Variation

Appendix B

Table B1. Weight Gains Between ML and MO for Fall 2000 Farrowing

Fall 2000 Farrowing						
Crate Number	Treatment	Weight at Birth [kg]	Weight Gain from Birth to 3 d [kg]	Weight at 3 d [kg]	Weight Gain from 3 d to Weaning [kg]	Weight at Weaning [kg]
1	ML	1.8	0.6	2.4	4.4	6.8
2	ML	1.2	0.4	1.6	7.8	9.4
3	ML	1.6	0.5	2.1	6.7	8.8
4	ML	1.6	0.4	2.0	6.6	8.6
5	ML	1.9	0.4	2.3	2.4	4.7
6	ML	1.3	0.4	1.7	2.5	4.2
7	ML	1.9	0.8	2.7	3.9	6.6
8	ML	1.6	0.6	2.2	3.4	5.6
9	MO	1.3	0.2	1.5	4.5	6.0
10	MO	1.6	0.3	1.9	6.9	8.8
11	MO	1.5	0.1	1.6	3.2	4.8
12	MO	1.4	0.5	1.9	3.5	5.4
13	MO	1.5	0.6	2.1	3.5	5.6
14	MO	1.8	0.5	2.3	6.0	8.3
15	MO	1.9	0.7	2.6	8.8	11.4
16	MO	1.9	0.4	2.3	6.5	8.8
17	MO	1.4	0.6	2.0	4.3	6.3
18	MO	1.6	0.5	2.1	5.6	7.7
19	ML	1.6	0.4	2.0	4.9	6.9
20	ML	1.3	0.3	1.6	4.6	6.2
21	ML	2.2	-0.1	2.1	7.1	9.2
22	ML					
23	ML	1.5	0.6	2.1	4.4	6.5
24	ML					
25	ML	1.2	0.2	1.4	4.1	5.5
26	ML	1.2	0.3	1.5	4.6	6.1
27	ML	2.0	1.0	3.0	6.0	9.0
28	ML	1.8	0.6	2.4	6.3	8.7
29	MO	2.3	0.6	2.9	3.1	6.0
30	MO	1.6	0.5	2.1	3.7	5.8
31	MO	1.6	0.4	2.0	6.6	8.6
32	MO	1.6	0.6	2.2	3.2	5.4
33	MO	2.0	0.4	2.4	5.9	8.3
34	MO	1.8	0.4	2.2	2.6	4.8
35	MO					
36	MO	1.9	0.7	2.6	4.5	7.1
Total Average Weight		1.65	0.48	2.12	4.91	7.03
Average Weight of ML		1.61	0.48	2.07	4.98	7.05
Average Weight of MO		1.69	0.47	2.16	4.85	7.01

Note: Blank entries represent open crates.

Table B2. Weight Gains Between ML and MO for Winter 2000 Farrowing

Winter 2000 Farrowing						
Crate Number	Treatment	Weight at Birth [kg]	Weight Gain from Birth to 3 d [kg]	Weight at 3 d [kg]	Weight Gain from 3 d to Weaning [kg]	Weight at Weaning [kg]
1	MO	1.7	0.6	2.3	7.2	9.5
2	MO	1.7	0.5	2.2	8.2	10.4
3	MO	1.5	0.5	2.0	3.7	5.7
4	MO	1.7	0.4	2.1	3.8	5.9
5	MO	1.8	0.6	2.4	2.9	5.3
6	MO	1.7	0.5	2.2	3.9	6.1
7	MO	1.3	0.5	1.8	3.5	5.3
8	MO	1.5	0.6	2.1	4.0	6.1
9	ML					
10	ML					
11	ML	1.6	0.5	2.1	6.6	8.7
12	ML	2.1	0.6	2.7	7.8	10.5
13	ML					
14	ML	1.2	0.4	1.6	7.9	9.5
15	ML	1.6	0.4	2.0	7.1	9.1
16	ML	1.7	0.6	2.3	1.6	3.9
17	ML	1.6	0.3	1.9	1.0	2.9
18	ML	2.3	0.1	2.4	1.9	4.3
19	MO					
20	MO	2.5	0.9	3.4	2.2	5.6
21	MO	2.0	0.5	2.5	5.8	8.3
22	MO	1.8	0.6	2.4	1.4	3.8
23	MO	1.4	0.3	1.7	0.8	2.5
24	MO	1.9	0.3	2.2	1.3	3.5
25	MO	1.6	0.3	1.9	1.0	2.9
26	MO	1.5	0.7	2.2	4.0	6.2
27	MO	1.9	0.6	2.5	1.4	3.9
28	MO	1.5	0.6	2.1	4.7	6.8
29	ML	1.9	0.7	2.6	7.2	9.8
30	ML					
31	ML	1.6	0.7	2.3	7.7	10.0
32	ML	1.4	0.5	1.9	3.9	5.8
33	ML	1.8	0.2	2.0	2.9	4.9
34	ML	1.8	0.7	2.5	9.4	11.9
35	ML	1.5	0.2	1.7	7.8	9.5
36	ML	1.4	0.6	2.0	7.3	9.3
Total Average Weight		1.69	0.50	2.19	4.51	6.71
Average Weight of ML		1.68	0.46	2.14	5.72	7.86
Average Weight of MO		1.71	0.53	2.24	3.52	5.75

Note: Blank entries represent open crates.

Table B3. Weight Gains Between ML and MO for Spring 2001 Farrowing

Spring 2001 Farrowing						
Crate Number	Treatment	Weight at Birth [kg]	Weight Gain from Birth to 3 d [kg]	Weight at 3 d [kg]	Weight Gain from 3 d to Weaning [kg]	Weight at Weaning [kg]
1	ML	1.3	0.3	1.6	3.8	5.4
2	ML	1.5	0.2	1.7	4.3	6.0
3	ML	2.0	0.2	2.2	4.8	7.0
4	ML	2.1	0.7	2.8	5.4	8.2
5	ML	1.9	0.6	2.5	6.1	8.6
6	ML	1.5	0.5	2.0	5.9	7.9
7	ML	1.9	0.8	2.7	4.3	7.0
8	ML	1.3	0.6	1.9	6.1	8.0
9	MO	1.7	0.4	2.1	3.8	5.9
10	MO	1.6	0.3	1.9	5.9	7.8
11	MO	1.8	0.4	2.2	4.4	6.6
12	MO					
13	MO					
14	MO	1.3	0.4	1.7	3.4	5.1
15	MO	1.7	0.6	2.3	4.3	6.6
16	MO	1.6	0.5	2.1	4.8	6.9
17	MO	1.9	0.6	2.5	4.5	7
18	MO	1.6	0.4	2	3.9	5.9
19	ML	1.9	0.8	2.7	4.9	7.6
20	ML	2.4	0.8	3.2	3.7	6.9
21	ML	1.7	0.6	2.3	4.2	6.5
22	ML	1.5	0.4	1.9	4.3	6.2
23	ML	2.1	0.5	2.6	5.1	7.7
24	ML	1.3	0.2	1.5	3.0	4.5
25	ML	1.9	0.5	2.4	3.7	6.1
26	ML	1.7	0.6	2.3	3.3	5.6
27	ML	1.4	0.3	1.7	3.6	5.3
28	ML	1.6	0.6	2.2	4.6	6.8
29	MO	1.6	0.3	1.9	6.5	8.4
30	MO	1.6	0.5	2.1	5.8	7.9
31	MO	1.6	0.5	2.1	7.3	9.4
32	MO					
33	MO	1.8	0.6	2.4	8.3	10.7
34	MO					
35	MO	1.6	0.3	1.9	3.7	5.6
36	MO	1.7	0.6	2.3	4.1	6.4
Total Average Weight		1.69	0.49	2.18	4.74	6.92
Average Weight of ML		1.72	0.51	2.23	4.51	6.74
Average Weight of MO		1.65	0.46	2.11	5.05	7.16

Note: Blank entries represent open crates.

Table B4. Weight Gains Between ML and MO for Summer 2001 Farrowing

Summer 2001 Farrowing						
Crate Number	Treatment	Weight at Birth [kg]	Weight Gain from Birth to 3 d [kg]	Weight at 3 d [kg]	Weight Gain from 3 d to Weaning [kg]	Weight at Weaning [kg]
1	MO	2.2	0.6	2.8	7.3	10.1
2	MO	1.5	0.8	2.3	6.4	8.7
3	MO	1.5	0.3	1.8	6.0	7.8
4	MO	1.7	0.4	2.1	5.4	7.5
5	MO	1.9	0.5	2.4	2.3	4.7
6	MO	1.6	0.6	2.2	1.9	4.1
7	MO	2.2	0.4	2.6	4.8	7.4
8	MO	1.7	0.5	2.2	2.1	4.3
9	ML	1.9	0.4	2.3	1.6	3.9
10	ML	1.4	0.3	1.7	1.3	3.0
11	ML	1.5	0.6	2.1	1.1	3.2
12	ML	1.2	0.5	1.7	1.7	3.4
13	ML	1.4	0.4	1.8	1.5	3.3
14	ML	2.1	0.6	2.7	3.9	6.6
15	ML	1.6	0.4	2.0	3.2	5.2
16	ML	1.6	0.5	2.1	4.3	6.4
17	ML	1.8	0.5	2.3	4.8	7.1
18	ML	1.8	0.5	2.3	4.4	6.7
19	MO	1.7	0.5	2.2	3.8	6.0
20	MO	1.7	0.6	2.3	1.6	3.9
21	MO	1.9	0.6	2.5	3.6	6.1
22	MO	1.8	0.7	2.5	4.6	7.1
23	MO	1.5	0.4	1.9	3.7	5.6
24	MO	2.2	0.2	2.4	2.1	4.5
25	MO	1.8	0.8	2.6	5.3	7.9
26	MO	1.8	0.6	2.4	3.8	6.2
27	MO	1.3	0.5	1.8	3.5	5.3
28	MO	1.8	0.7	2.5	4.3	6.8
29	ML	2.2	0.6	2.8	4.6	7.4
30	ML	1.6	0.2	1.8	1.3	3.1
31	ML	1.5	0.6	2.1	5.4	7.5
32	ML	1.7	0.7	2.4	2.3	4.7
33	ML	1.6	0.3	1.9	1.2	3.1
34	ML	2.1	0.6	2.7	5.0	7.7
35	ML	1.9	0.8	2.7	4.4	7.1
36	ML	1.7	0.3	2.0	1.3	3.3
Total Average Weight		1.73	0.51	2.25	3.49	5.74
Average Weight of ML		1.70	0.49	2.19	2.96	5.15
Average Weight of MO		1.77	0.54	2.31	4.03	6.33

Note: Blank entries represent open crates.

Table B5. Weight Gains Between ML and MO for Winter 2001 Farrowing

Winter 2001 Farrowing						
Crate Number	Treatment	Weight at Birth [kg]	Weight Gain from Birth to 3 d [kg]	Weight at 3 d [kg]	Weight Gain from 3 d to Weaning [kg]	Weight at Weaning [kg]
1	ML	1.4	0.6	2.0	6.4	8.4
2	ML	1.6	0.4	2.0	5.2	7.2
3	ML	2.6	0.4	3.0	8.1	11.1
4	ML	1.6	0.4	2.0	6.8	8.8
5	ML	1.6	0.4	2.0	7.5	9.5
6	ML	1.4	0.6	2.0	8.6	10.6
7	ML	1.9	0.4	2.3	7.6	9.9
8	ML	1.5	0.5	2.0	7.1	9.1
9	MO	1.8	0.5	2.3	6.5	8.8
10	MO	2.0	0.6	2.6	9.2	11.8
11	MO	2.2	0.6	2.8	8.6	11.4
12	MO	1.4	0.6	2.0	6.8	8.8
13	MO	1.2	0.5	1.7	7.0	8.7
14	MO	1.8	0.6	2.4	8.1	10.5
15	MO	2.0	0.5	2.5	7.4	9.9
16	MO					
17	MO	1.9	0.4	2.3	7.6	9.9
18	MO	2.1	0.2	2.3	6.8	9.1
19	ML	1.7	0.5	2.2	6.7	8.9
20	ML	1.9	0.6	2.5	8.4	10.9
21	ML	1.7	0.6	2.3	6.2	8.5
22	ML	1.5	0.5	2.0	6.9	8.9
23	ML	1.5	0.4	1.9	5.6	7.5
24	ML	1.7	0.6	2.3	5.4	7.7
25	ML	1.3	0.5	1.8	5.2	7.0
26	ML					
27	ML	1.7	0.6	2.3	7.7	10.0
28	ML	1.9	0.6	2.5	9.9	12.4
29	MO					
30	MO					
31	MO	2.0	0.5	2.5	7.7	10.2
32	MO	1.1	0.5	1.6	6.5	8.1
33	MO	1.4	0.6	2.0	7.6	9.6
34	MO	1.5	0.4	1.9	8.2	10.1
35	MO	1.7	0.6	2.3	6.9	9.2
36	MO	1.5	0.4	1.9	7.3	9.2
Total Average Weight		1.69	0.50	2.19	7.23	9.43
Average Weight of ML		1.68	0.50	2.18	7.02	9.20
Average Weight of MO		1.71	0.50	2.21	7.48	9.69

Note: Blank entries represent open crates.

Table B6. Weight Gains Between ML and MO for Spring 2002 Farrowing

Spring 2002 Farrowing						
Crate Number	Treatment	Weight at Birth [kg]	Weight Gain from Birth to 3 d [kg]	Weight at 3 d [kg]	Weight Gain from 3 d to Weaning [kg]	Weight at Weaning [kg]
1	MO	2.1	0.6	2.7	10.1	12.8
2	MO	1.5	0.4	1.9	5.9	7.8
3	MO	1.7	0.6	2.3	7.7	10.0
4	MO	1.8	0.3	2.1	4.6	6.7
5	MO	2.0	0.5	2.5	4.0	6.5
6	MO	2.0	0.5	2.5	5.1	7.6
7	MO	1.8	0.3	2.1	5.2	7.3
8	MO	1.7	0.5	2.2	6.9	9.1
9	ML	1.6	0.7	2.3	5.4	7.7
10	ML	1.8	0.5	2.3	7.1	9.4
11	ML	1.9	0.6	2.5	8.0	10.5
12	ML	1.8	0.6	2.4	6.8	9.2
13	ML	2.1	0.4	2.5	6.8	9.3
14	ML	1.5	0.1	1.6	3.8	5.4
15	ML	2.1	0.5	2.6	5.3	7.9
16	ML	1.7	0.6	2.3	7.1	9.4
17	ML	1.6	0.3	1.9	8.0	9.9
18	ML	2.1	0.6	2.7	9.3	12.0
19	MO	1.7	0.5	2.2	5.6	7.8
20	MO	1.8	0.5	2.3	4.4	6.7
21	MO	2.1	0.6	2.7	4.6	7.3
22	MO	1.4	0.5	1.9	9.0	10.9
23	MO	1.8	0.7	2.5	7.7	10.2
24	MO	1.6	0.7	2.3	4.7	7.0
25	MO	1.5	0.4	1.9	6.9	8.8
26	MO	1.6	0.5	2.1	6.9	9.0
27	MO	1.8	0.5	2.3	6.5	8.8
28	MO	1.6	0.6	2.2	7.1	9.3
29	ML	1.8	0.5	2.3	6.7	9.0
30	ML	1.4	0.2	1.6	7.2	8.8
31	ML	2.0	0.8	2.8	6.7	9.5
32	ML	1.7	0.6	2.3	6.0	8.3
33	ML	1.5	0.5	2.0	5.5	7.5
34	ML	1.6	0.5	2.1	5.5	7.6
35	ML	1.8	0.4	2.2	7.6	9.8
36	ML	1.5	0.6	2.1	6.4	8.5
Total Average Weight		1.75	0.51	2.26	6.45	8.70
Average Weight of ML		1.75	0.50	2.25	6.62	8.87
Average Weight of MO		1.75	0.51	2.26	6.27	8.53

Note: Blank entries represent open crates.

Appendix C

Table C1. Mortality for Fall 2000 Farrowing

Fall 2000 Farrowing						
Crate Number	Treatment	Number of Piglets	Deaths by 3 d	Reason for Death	Deaths by Weaning	Reason for Death
1	ML	9	0		0	
2	ML	9	0		0	
3	ML	9	0		1	S
4	ML	7	0		1	LO
5	ML	7	0		1	ML
6	ML	12	1	LV	0	
7	ML	10	0		0	
8	ML	8	2	LO	0	
9	MO	9	0		2	NS
10	MO	11	0		0	
11	MO	9	2	LV	0	
12	MO	10	0		0	
13	MO	9	2	LO/NS	0	
14	MO	9	1	LV	1	BI
15	MO	5	0		0	
16	MO	9	1	LV	0	
17	MO	10	1	LV	1	NS
18	MO	11	0		0	
19	ML	10	0		0	
20	ML	4	2	BI	3	2 LV/ST
21	ML	5	0		0	
22	ML					
23	ML	8	1	LO	1	NS
24	ML					
25	ML	7	0		1	BI
26	ML	8	2	LV	2	NS/ML
27	ML	9	0		0	
28	ML	9	0		0	
29	MO	4	0		0	
30	MO	11	0		0	
31	MO	11	1	LV	2	BI/NS
32	MO	10	1	LV	0	
33	MO	9	0		0	
34	MO	11	0		0	
35	MO					
36	MO	8	1	LV	0	
Total Mortality for ML		131	8		10	
Total Mortality for MO		156	10		6	
Total Mortality		287	18		16	

Note: Blank entries represent open crates.

Table C2. Mortality for Winter 2000 Farrowing

Winter 2000 Farrowing						
Crate Number	Treatment	Number of Piglets	Deaths by 3 d	Reason for Death	Deaths by Weaning	Reason for Death
1	MO	11	1	LV	0	
2	MO	6	1	ST	0	
3	MO	11	0		0	
4	MO	11	0		0	
5	MO	7	0		1	NS
6	MO	10	1	ST	0	
7	MO	10	0		0	
8	MO	10	0		1	NS
9	ML					
10	ML					
11	ML	8	0		0	
12	ML	8	0		0	
13	ML					
14	ML	10	2	LV	0	
15	ML	9	0		1	NS
16	ML	9	0		0	
17	ML	10	0		0	
18	ML	9	0		0	
19	MO					
20	MO	4	0		0	
21	MO	4	0		0	
22	MO	9	1	ST	0	
23	MO	9	2	ST/LO	0	
24	MO	10	0		0	
25	MO	7	1	LO	0	
26	MO	10	0		1	NS
27	MO	7	0		0	
28	MO	10	0		0	
29	ML	8	0		0	
30	ML					
31	ML	7	0		0	
32	ML	8	1	LO	0	
33	ML	10	0		0	
34	ML	9	0		0	
35	ML	8	3	2 LO/ST	0	
36	ML	11	1	ST	0	
Total Mortality for ML		124	7		1	
Total Mortality for MO		146	7		3	
Total Mortality		270	14		4	

Note: Blank entries represent open crates.

Table C3. Mortality for Spring 2001 Farrowing

Spring 2001 Farrowing						
Crate Number	Treatment	Number of Piglets	Deaths by 3 d	Reason for Death	Deaths by Weaning	Reason for Death
1	ML	11	0		0	
2	ML	13	1	LO	0	
3	ML	7	0		0	S
4	ML	3	0		0	LO
5	ML	9	0		0	ML
6	ML	9	0		0	
7	ML	6	0		0	
8	ML	10	0		0	
9	MO	11	2	LV	0	NS
10	MO	9	0		0	
11	MO	6	0		0	
12	MO					
13	MO					
14	MO	13	3	2 LV / ST	1	BI
15	MO	11	0		0	
16	MO	14	2	NS / SP	0	
17	MO	11	0		0	NS
18	MO	13	0		0	
19	ML	11	0		0	
20	ML	7	0		0	2 LV / ST
21	ML	12	0		0	
22	ML	15	2	LV	0	
23	ML	10	0		0	NS
24	ML	13	1	LV	0	
25	ML	14	1	LO	0	BI
26	ML	6	0		0	NS / ML
27	ML	14	0		0	
28	ML	12	0		0	
29	MO	13	2	LV / NS	0	
30	MO	12	1	LO	0	
31	MO	18	9	SP / 8 LO	0	BI / NS
32	MO					
33	MO	9	1	LV	0	
34	MO					
35	MO	11	2	SA / LO	0	
36	MO	7	0		0	
Total Mortality for ML		182	5		0	
Total Mortality for MO		158	22		1	
Total Mortality		340	27		1	

Note: Blank entries represent open crates.

Table C4. Mortality for Summer 2001 Farrowing

Summer 2001 Farrowing						
Crate Number	Treatment	Number of Piglets	Deaths by 3 d	Reason for Death	Deaths by Weaning	Reason for Death
1	MO	5	0		0	
2	MO	5	0		0	
3	MO	12	1	LO	0	
4	MO	14	1	LV	0	
5	MO	6	2	ST	0	
6	MO	15	2	LV/LO	0	
7	MO	7	0		0	
8	MO	13	2	LO	0	
9	ML	11	0		0	
10	ML	9	0		0	
11	ML	14	2	LV/LO	1	LV
12	ML	12	0		0	
13	ML	5	0		0	
14	ML	10	0		0	
15	ML	13	1	LV	0	
16	ML	12	2	LV	1	LV
17	ML	13	0		0	
18	ML	11	0		0	
19	MO	9	0		0	
20	MO	13	1	ST	2	S
21	MO	13	0		0	
22	MO	6	0		0	
23	MO	13	0		1	LO
24	MO	8	1	ST	0	
25	MO	10	0		1	LO
26	MO	12	0		0	
27	MO	12	1	LV	0	
28	MO	13	0		0	
29	ML	4	0		0	
30	ML	13	3	2 LO/LV	0	
31	ML	12	1	LV	0	
32	ML	12	2	LO	0	
33	ML	9	0		0	
34	ML	8	0		0	
35	ML	9	0		1	ST
36	ML	11	2	LV	2	LO/ST
Total Mortality for ML		188	13		5	
Total Mortality for MO		186	11		4	
Total Mortality		374	24		9	

Note: Blank entries represent open crates.

Table C5. Mortality for Winter 2001 Farrowing

Winter 2001 Farrowing						
Crate Number	Treatment	Number of Piglets	Deaths by 3 d	Reason for Death	Deaths by Weaning	Reason for Death
1	ML	10	0		0	
2	ML	4	0		0	
3	ML	8	0		1	ST
4	ML	11	2	LV/LV	0	
5	ML	10	1	LV	3	BI/LO/RU
6	ML	10	0		1	BI
7	ML	7	0		0	
8	ML	10	1	LV	0	
9	MO	9	0		0	
10	MO	4	0		0	
11	MO	5	0		0	
12	MO	10	0		0	
13	MO	10	0		0	
14	MO	10	0		2	LO/NS
15	MO	9	0		0	
16	MO					
17	MO	10	0		0	
18	MO	10	3	LV/LV/LV	0	
19	ML	11	0		0	
20	ML	6	0		1	ST
21	ML	9	0		0	
22	ML	10	1	SP	0	
23	ML	10	0		0	
24	ML	9	0		0	
25	ML	10	0		0	
26	ML					
27	ML	10	1	ST	0	
28	ML	6	0		0	
29	MO					
30	MO					
31	MO	9	0		0	
32	MO	9	0		0	
33	MO	11	1	RUNT	0	
34	MO	11	0		1	LO
35	MO	8	0		0	
36	MO	4	0		0	
Total Mortality for ML		151	6		6	
Total Mortality for MO		129	4		3	
Total Mortality		280	10		9	

Note: Blank entries represent open crates.

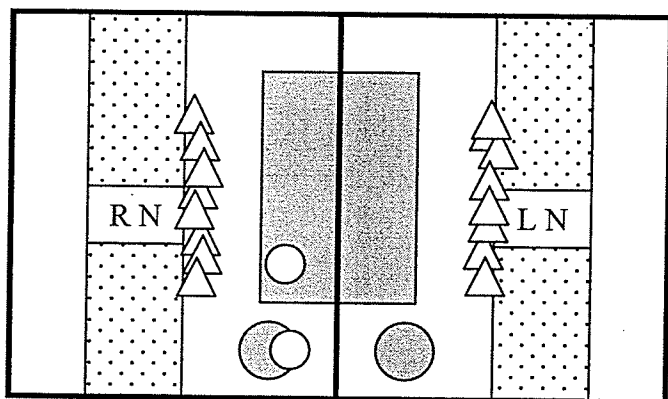
Table C6. Mortality for Spring 2002 Farrowing

Spring 2002 Farrowing						
Crate Number	Treatment	Number of Piglets	Deaths by 3 d	Reason for Death	Deaths by Weaning	Reason for Death
1	MO	9	0		1	LO
2	MO	10	0		0	
3	MO	7	0		1	ST
4	MO	10	0		0	
5	MO	6	0		0	
6	MO	7	0		1	RU
7	MO	13	3	NS/NS/LV	0	
8	MO	12	1	RUNT	2	TR/NS
9	ML	12	3	NS/LV/LV	0	
10	ML	11	0		0	
11	ML	11	1	LV	0	
12	ML	8	0		0	
13	ML	10	0		0	
14	ML	12	2	LO/LO	1	RUNT
15	ML	9	0		1	ST
16	ML	12	3	LV/LO/ST	0	
17	ML	10	0		1	LV
18	ML	9	0		0	
19	MO	11	2	LV/ST	0	
20	MO	10	0		0	
21	MO	9	0		0	
22	MO	6	1	LV	0	
23	MO	7	0		0	
24	MO	9	1	LO	0	
25	MO	12	1	NS	1	LO
26	MO	11	0		0	
27	MO	11	0		0	
28	MO	12	0		1	LO
29	ML	8	0		0	
30	ML	9	0		0	
31	ML	11	0		0	
32	ML	8	1	LV	0	
33	ML	12	2	NS/NS	1	NS
34	ML	11	2	LO/LV	1	NS
35	ML	7	0		0	
36	ML	11	2	LV/RUNT	1	LO
Total Mortality for ML		181	16		6	
Total Mortality for MO		172	9		7	
Total Mortality		353	25		13	

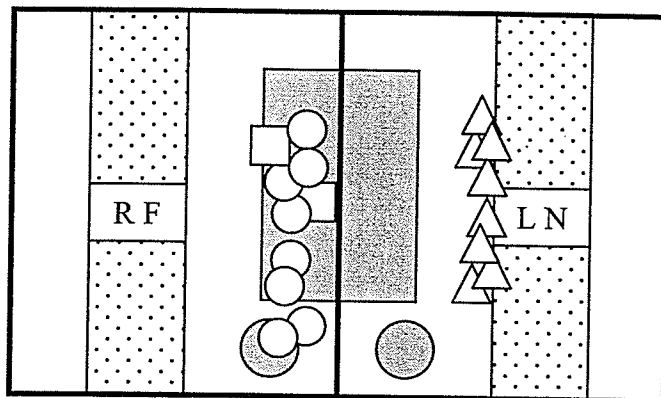
Note: Blank entries represent open crates.

Appendix D

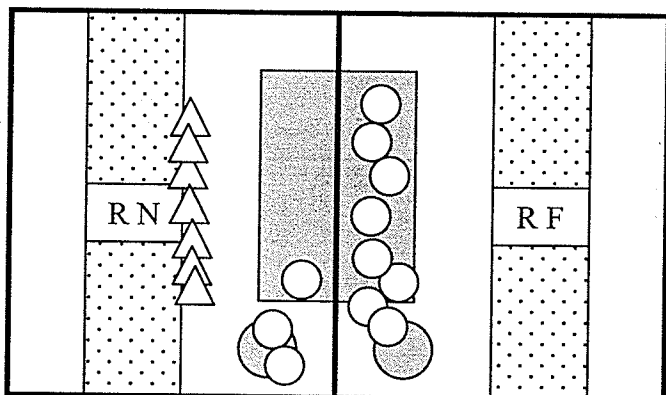
Behaviour Tests - Fall Farrowing 2000
 Day 1 - Section A (Heat Lamps On)
 October 13, 2000



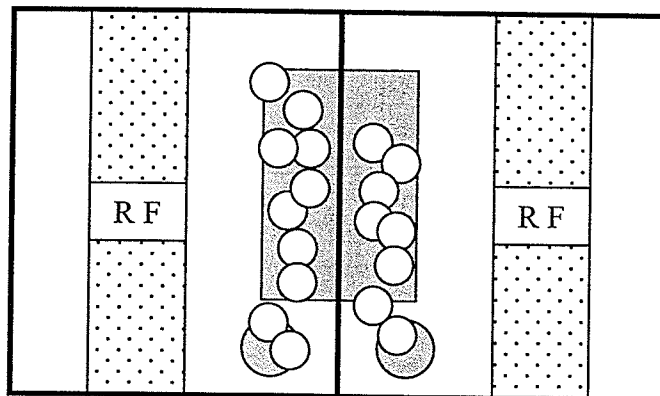
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 Time: 9:30 Time: 9:30



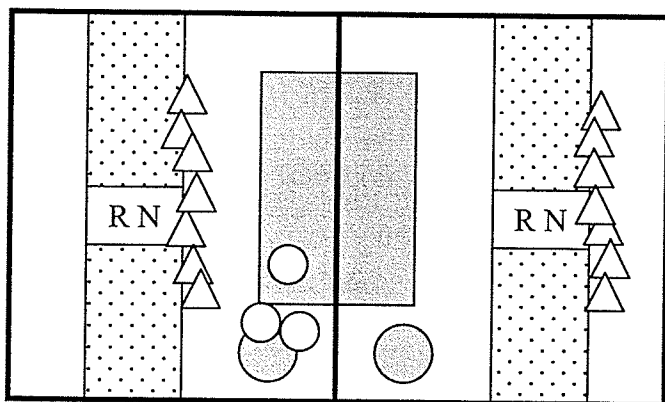
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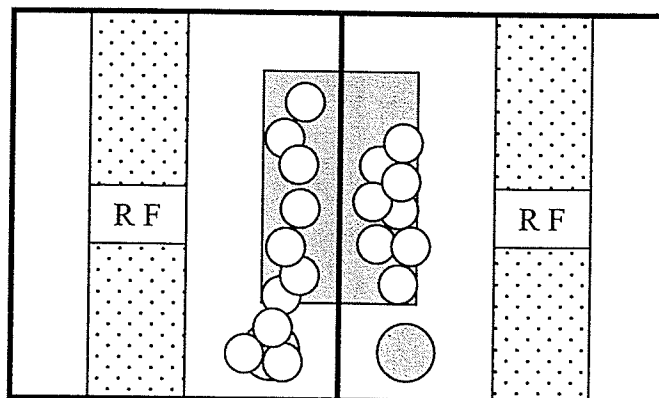
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Crate: 3 Crate: 4
 Time: 11:00 Time: 11:00



Crate: 3 Crate: 4
 Time: 12:00 Time: 12:00

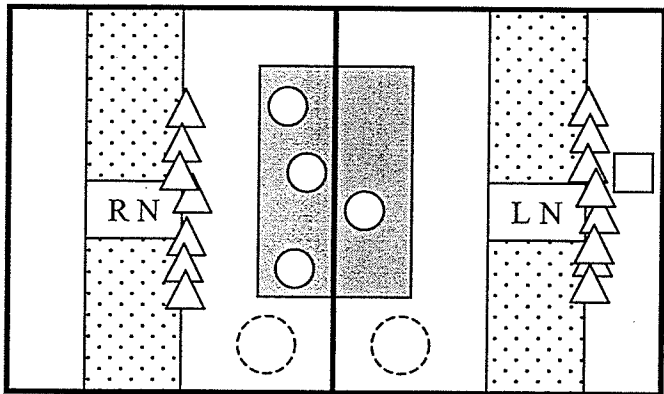


Crate: 3 Crate: 4
 Time: 12:30 Time: 12:30

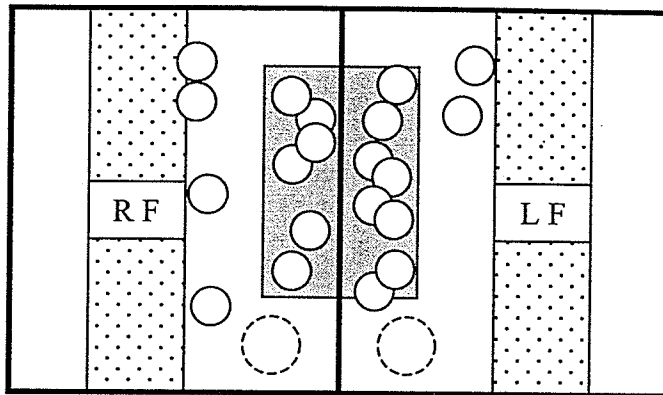
Behaviour Tests - Fall Farrowing 2000

Day 1 - Section B (Heat Lamps Off)

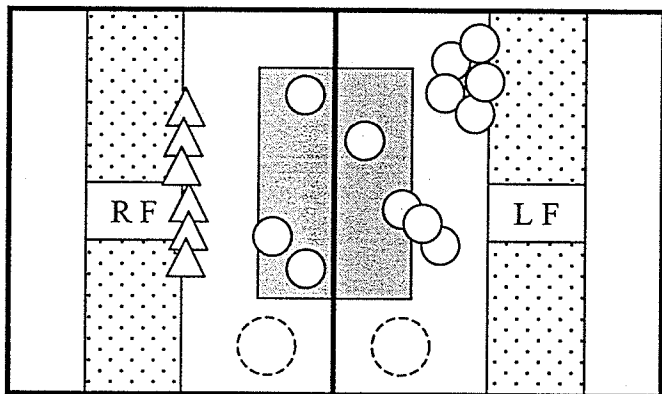
October 18, 2000



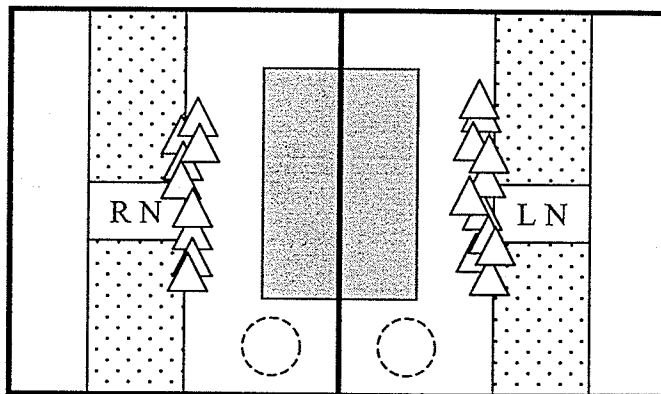
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 Time: 10:30 Time: 10:30



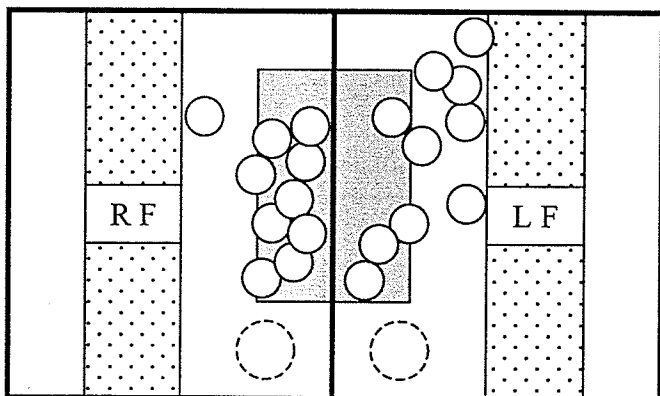
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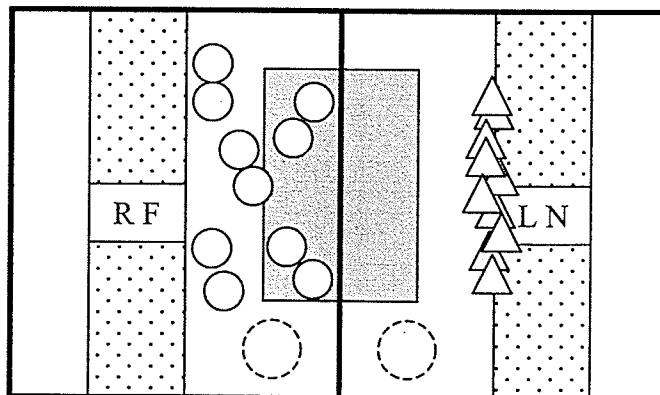
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 Time: 11:30 Time: 11:30



Crate: 11 Crate: 12
 Time: 12:00 Time: 12:00

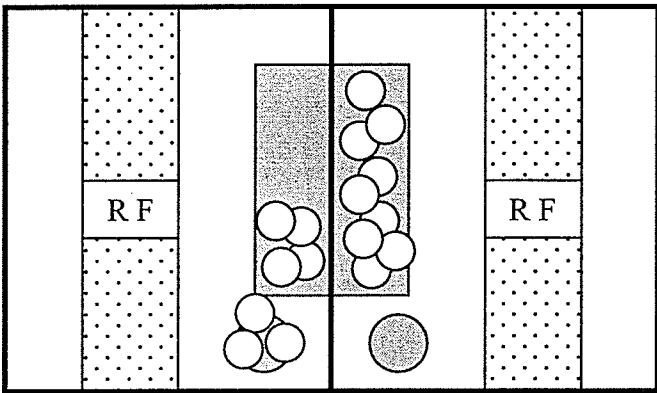


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 Time: 12:30 Time: 12:30

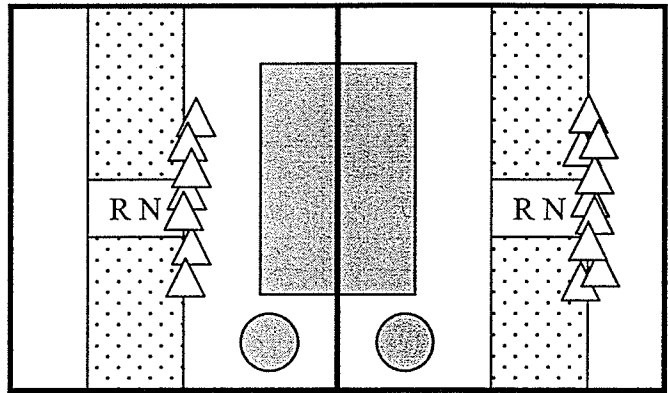


Crate: 11 Crate: 12
 Time: 1:00 Time: 1:00

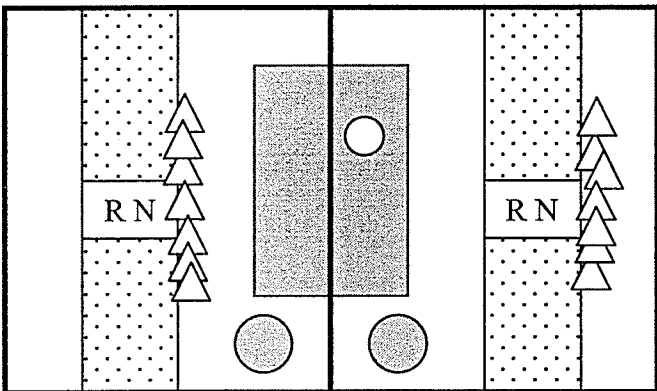
Behaviour Tests - Fall Farrowing 2000
 Day 1 - Section C (Heat Lamps On)
 October 25, 2000



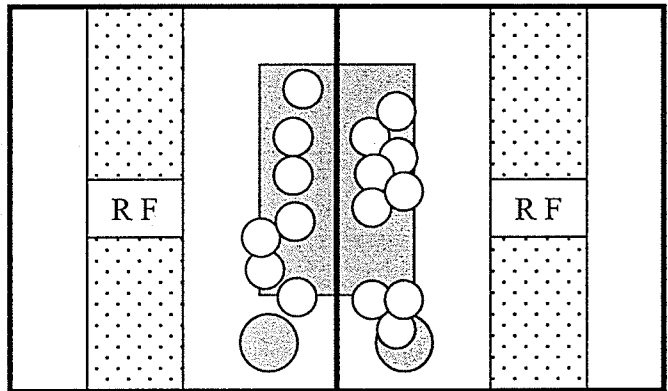
Crate: 25 Crate: 26
 Time: 9:00 Time: 9:00



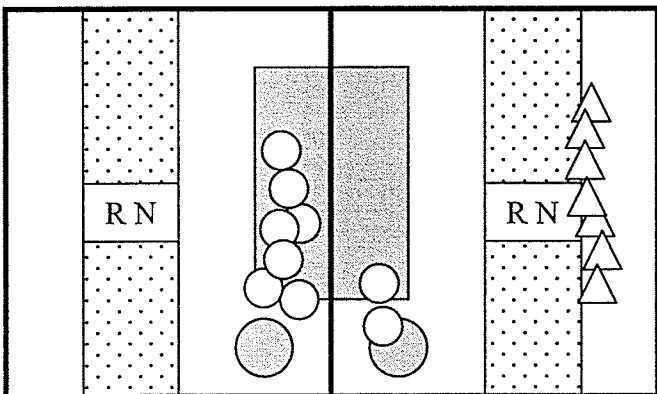
Crate: 25 Crate: 26
 Time: 9:30 Time: 9:30



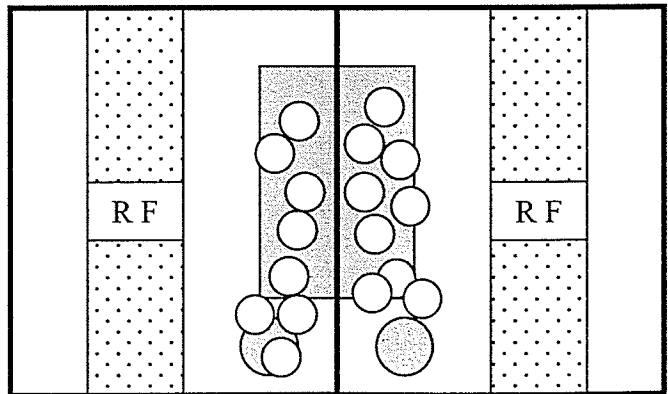
Crate: 25 Crate: 26
 Time: 10:00 Time: 10:00



Crate: 25 Crate: 26
 Time: 10:30 Time: 10:30

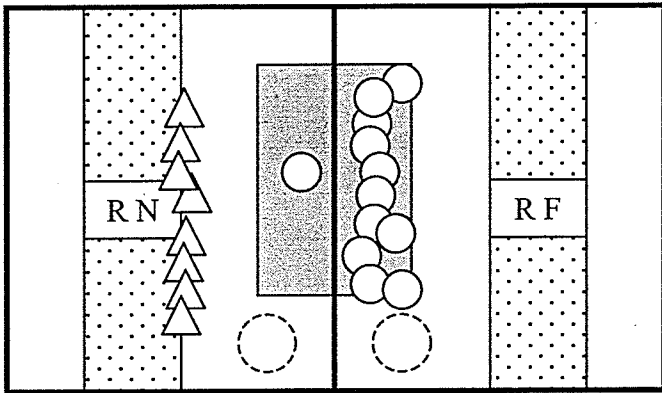


Crate: 25 Crate: 26
 Time: 11:00 Time: 11:00

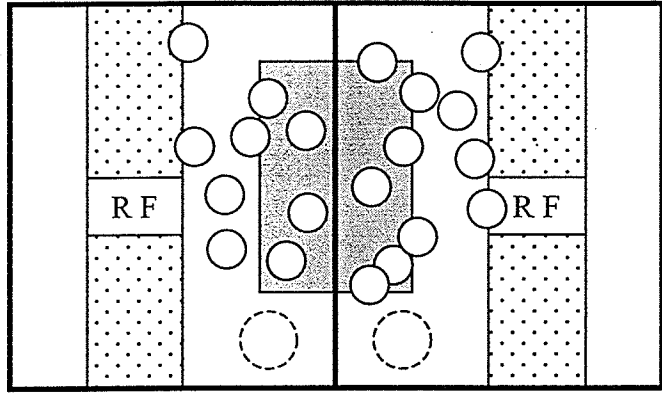


Crate: 25 Crate: 26
 Time: 11:30 Time: 11:30

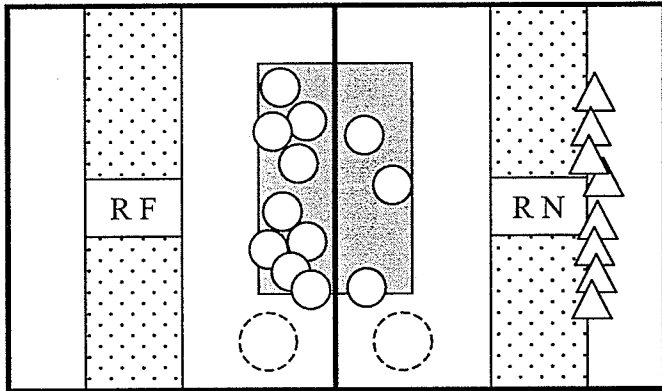
Behaviour Tests - Fall Farrowing 2000
 Day 1 - Section D (Heat Lamps Off)
 October 18, 2000



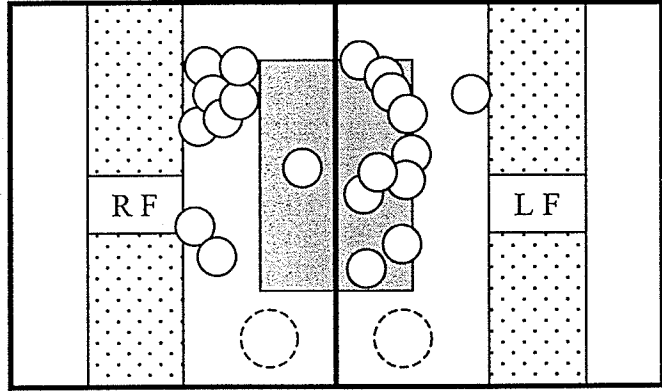
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 Time: 10:30 Time: 10:30



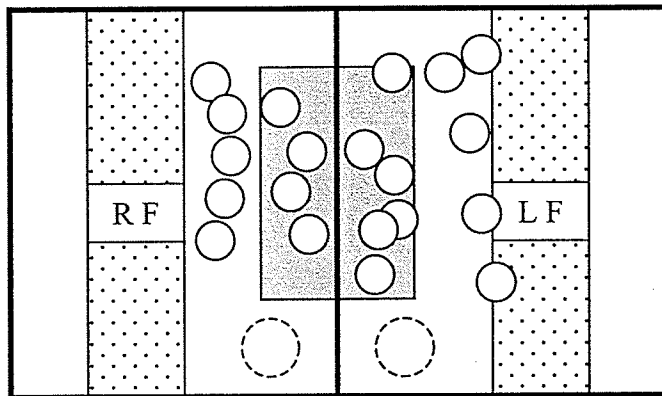
Crate: 33 Crate: 34
 Time: 11:00 Time: 11:00



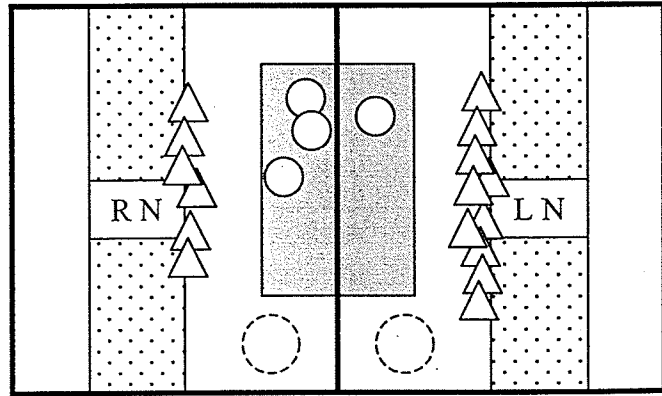
Crate: 33 Crate: 34
 Time: 11:30 Time: 11:30



Crate: 33 Crate: 34
 Time: 12:00 Time: 12:00



Crate: 33 Crate: 34
 Time: 12:30 Time: 12:30

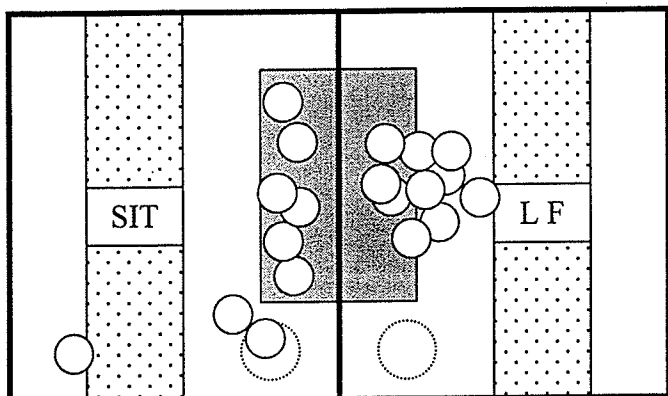


Crate: 33 Crate: 34
 Time: 1:00 Time: 1:00

Behaviour Tests - Fall Farrowing 2000

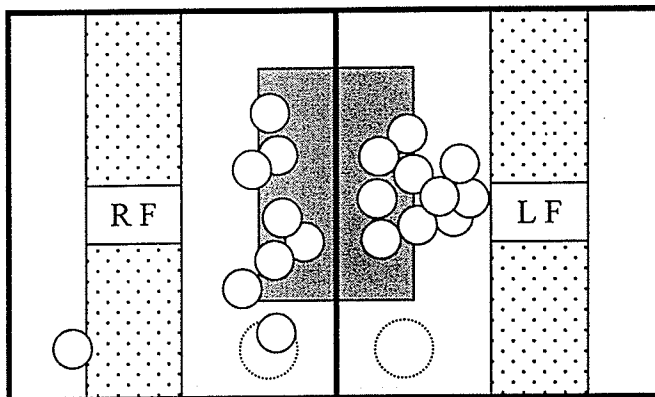
Day 3 - Section A (Heat Lamps Off)

October 15, 2000



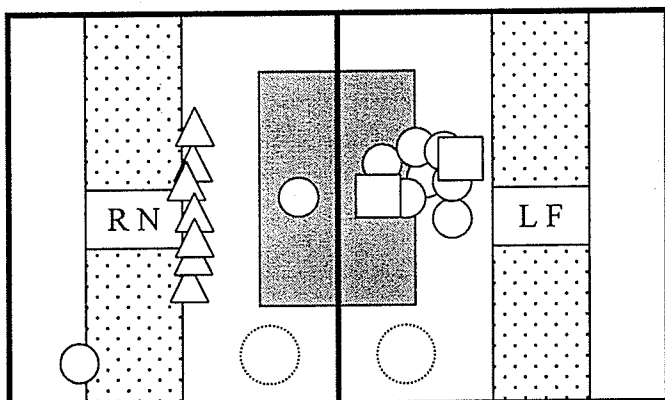
Crate: 3 Crate: 4

Time: 100 Time: 1:00



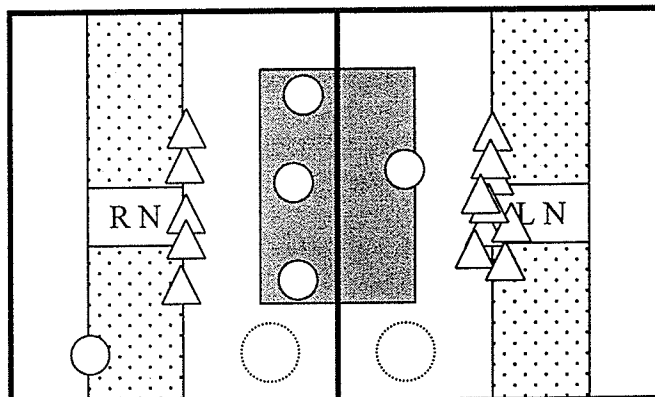
Crate: 3 Crate: 4

Time: 1:30 Time: 1:30



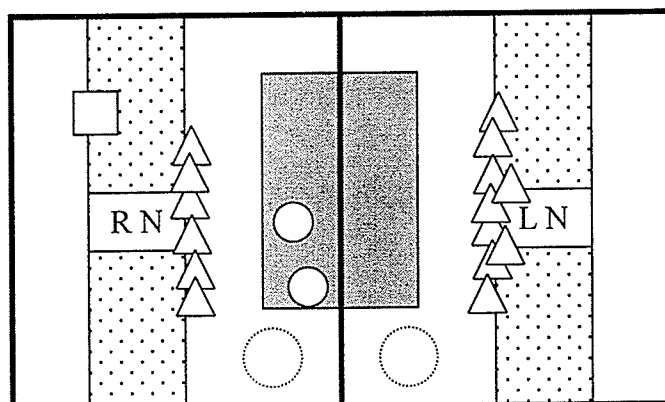
Crate: 3 Crate: 4

Time: 2:00 Time: 2:00



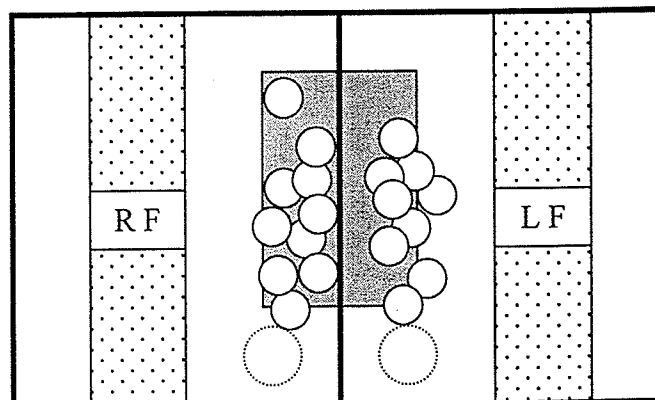
Crate: 3 Crate: 4

Time: 2:30 Time: 2:30



Crate: 3 Crate: 4

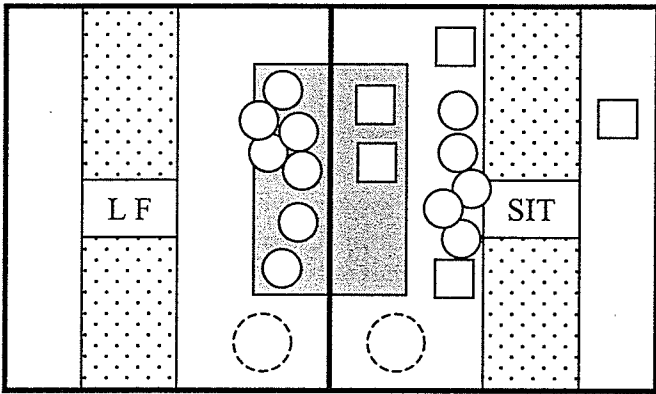
Time: 3:00 Time: 3:00



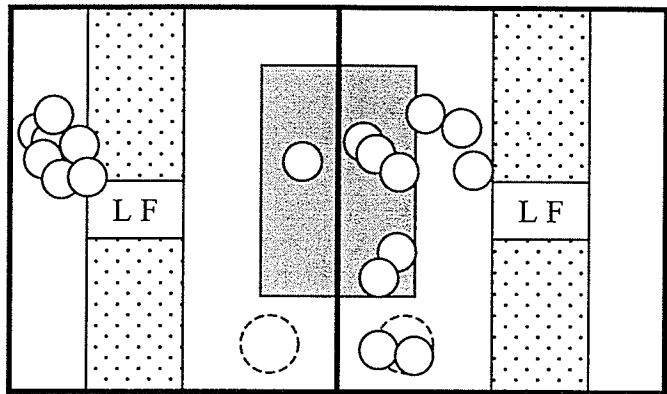
Crate: 3 Crate: 4

Time: 3:30 Time: 3:30

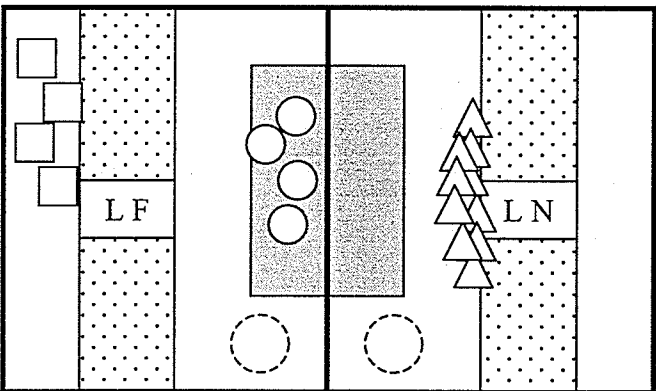
Behaviour Tests - Fall Farrowing 2000
 Day 3 - Section B (Heat Lamps Off)
 October 20, 2000



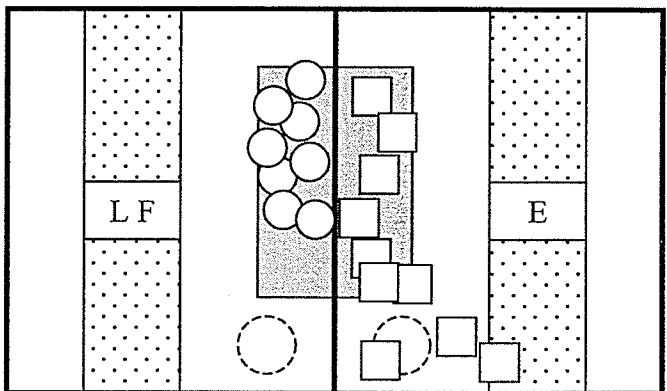
Crate: 11 Crate: 12
 Time: 10:00 Time: 10:00



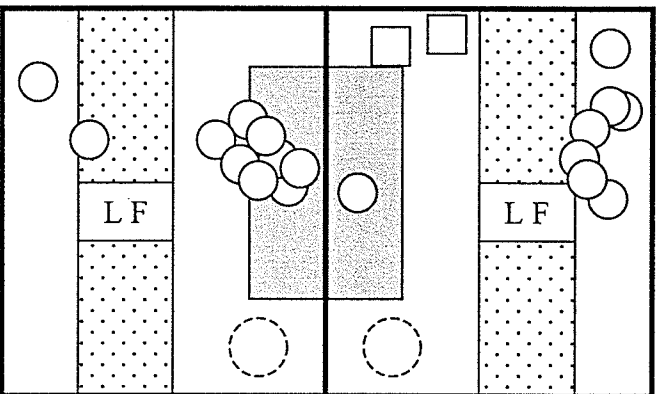
Crate: 11 Crate: 12
 Time: 10:30 Time: 10:30



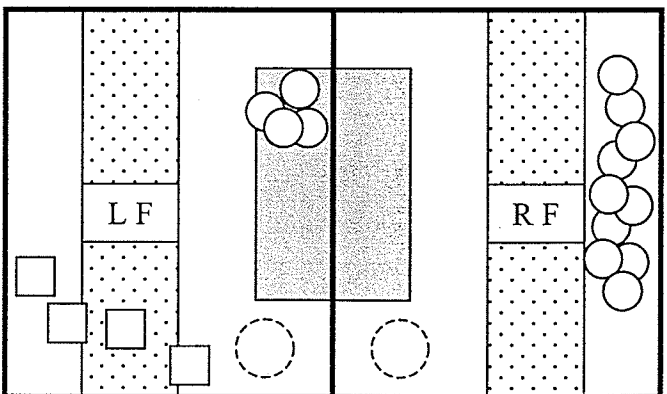
Crate: 11 Crate: 12
 Time: 11:00 Time: 11:00



Crate: 11 Crate: 12
 Time: 11:30 Time: 11:30

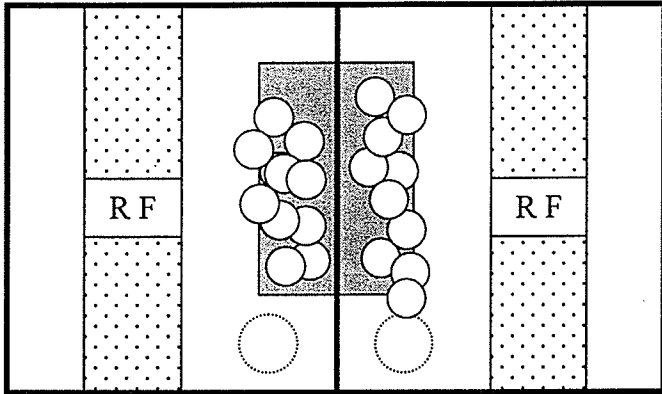


Crate: 11 Crate: 12
 Time: 12:00 Time: 12:00

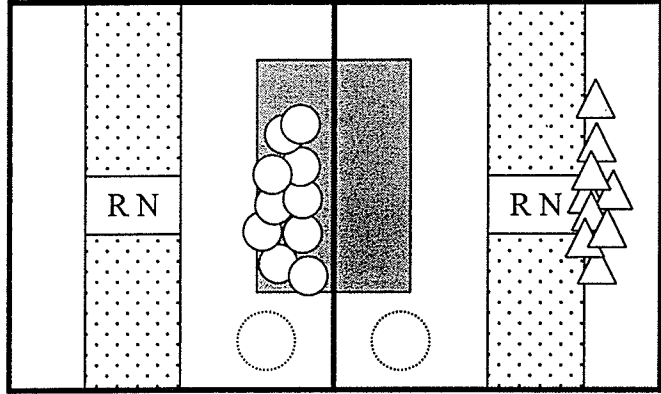


Crate: 11 Crate: 12
 Time: 12:30 Time: 12:30

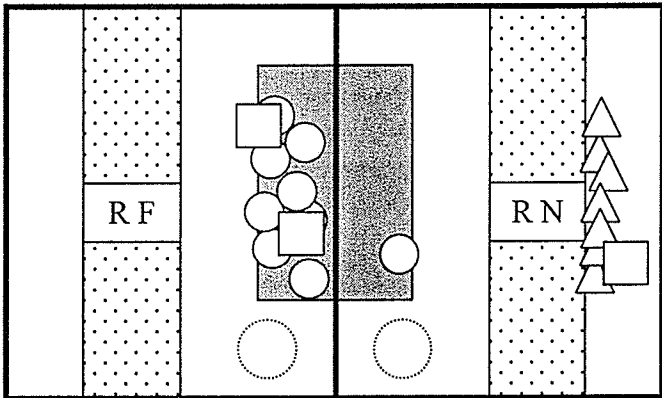
Behaviour Tests - Fall Farrowing 2000
 Day 3 - Section C (Heat Lamps Off)
 October 27, 2000



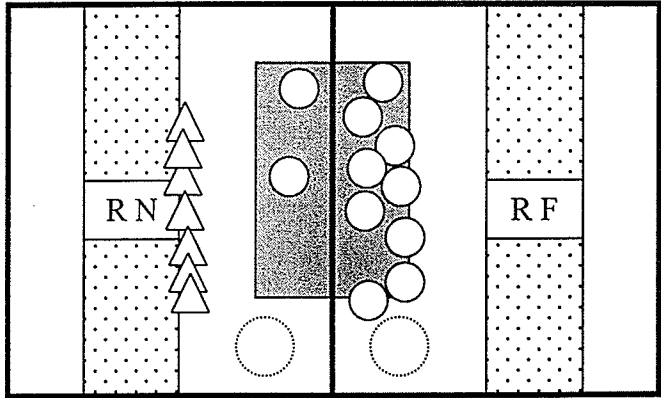
Crate: 25 Crate: 26
 Time: 9:00 Time: 9:00



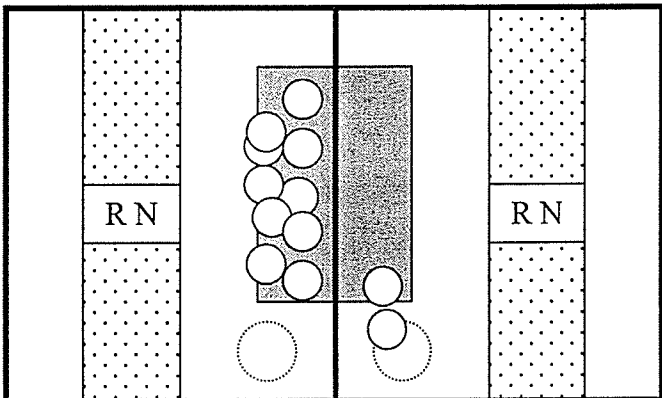
Crate: 25 Crate: 26
 Time: 9:30 Time: 9:30



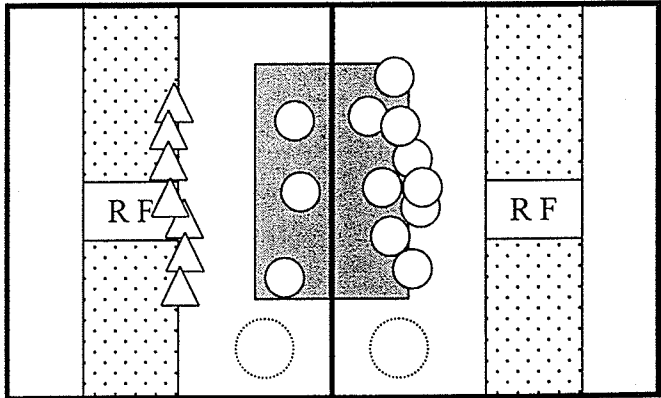
Crate: 25 Crate: 26
 Time: 10:00 Time: 10:00



Crate: 25 Crate: 26
 Time: 10:30 Time: 10:30

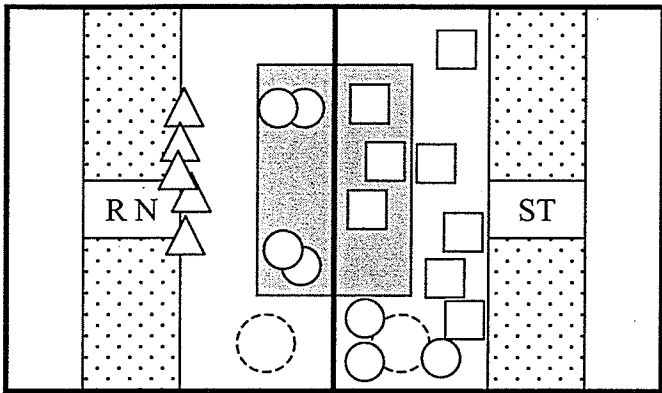


Crate: 25 Crate: 26
 Time: 11:00 Time: 11:00

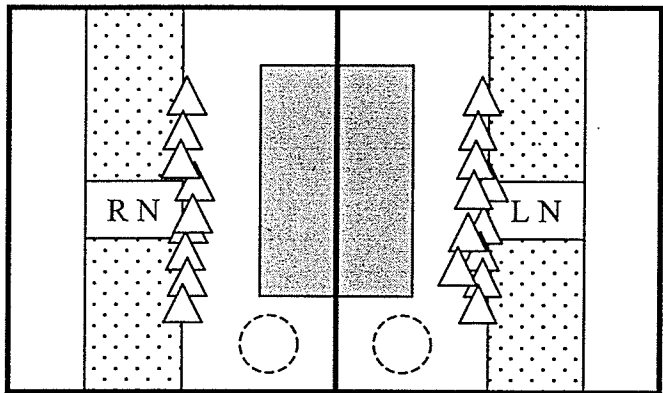


Crate: 25 Crate: 26
 Time: 11:30 Time: 11:30

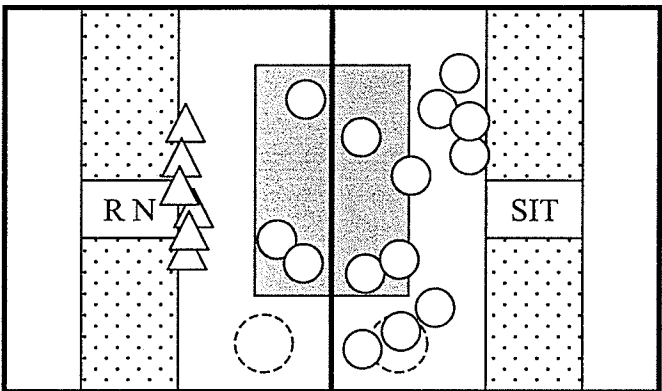
Behaviour Tests - Fall Farrowing 2000
 Day 3 - Section D (Heat Lamps Off)
 October 20, 2000



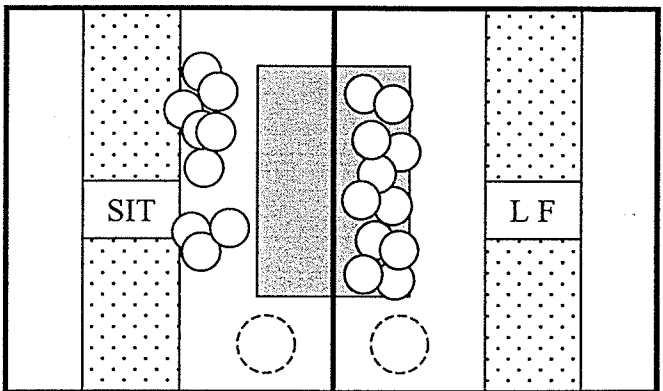
Crate: 33 Crate: 34
 Time: 10:00 Time: 10:00



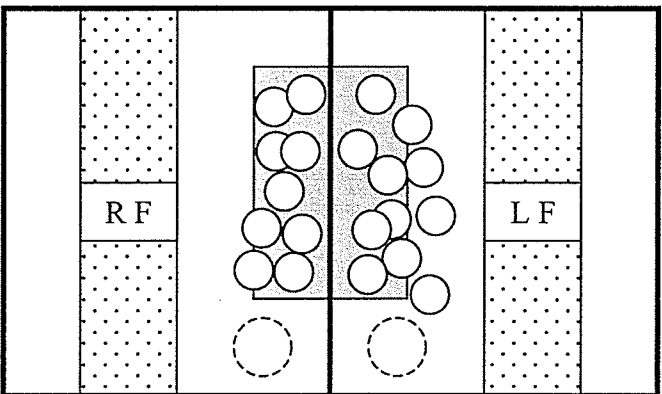
Crate: 33 Crate: 34
 Time: 10:30 Time: 10:30



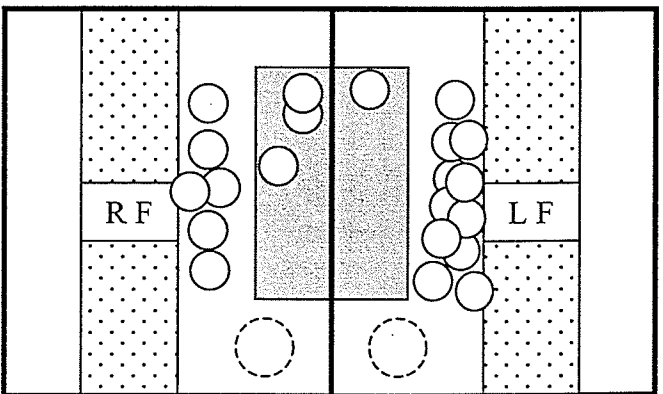
Crate: 33 Crate: 34
 Time: 11:00 Time: 11:00



Crate: 33 Crate: 34
 Time: 11:30 Time: 11:30

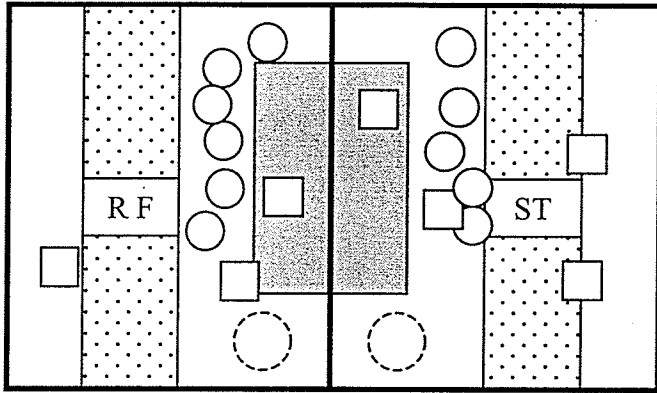


Crate: 33 Crate: 34
 Time: 12:00 Time: 12:00

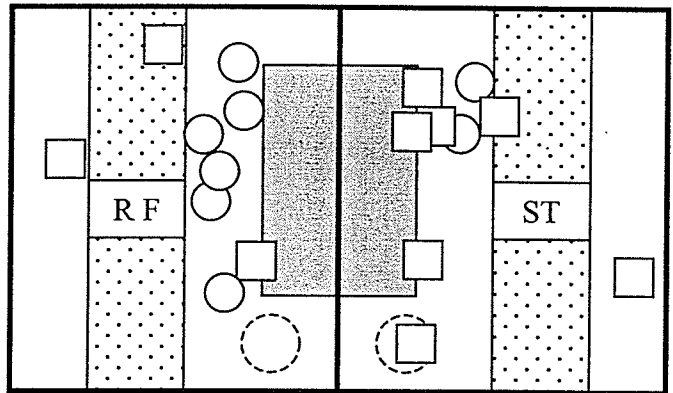


Crate: 33 Crate: 34
 Time: 12:30 Time: 12:30

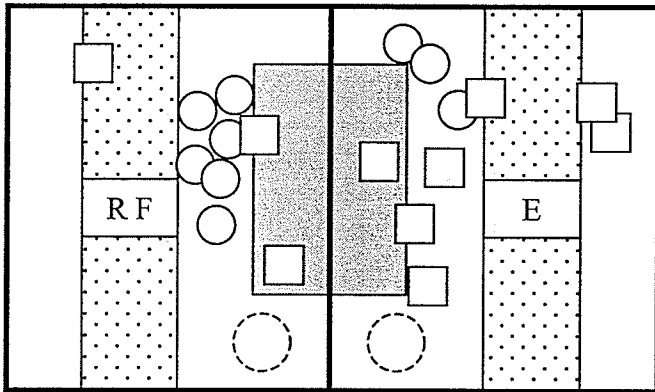
Behaviour Tests - Fall Farrowing 2000
 Day 7 - Section A (Heat Lamps Off)
 October 20, 2000



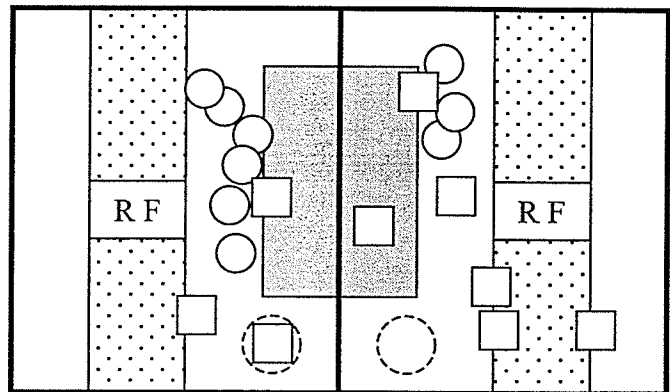
Crate: 3 Crate: 4
 Time: 1:00 Time: 1:00



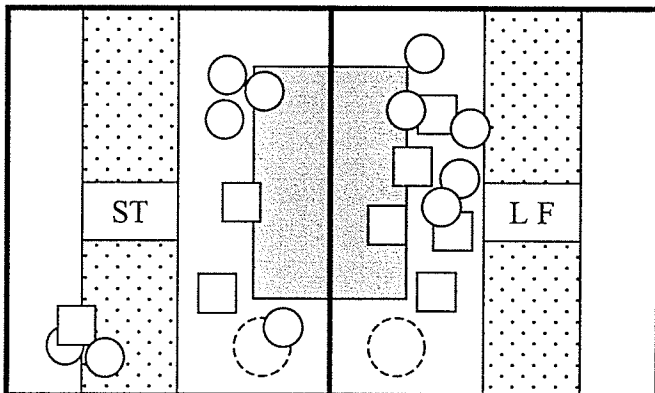
Crate: 3 Crate: 4
 Time: 1:30 Time: 1:30



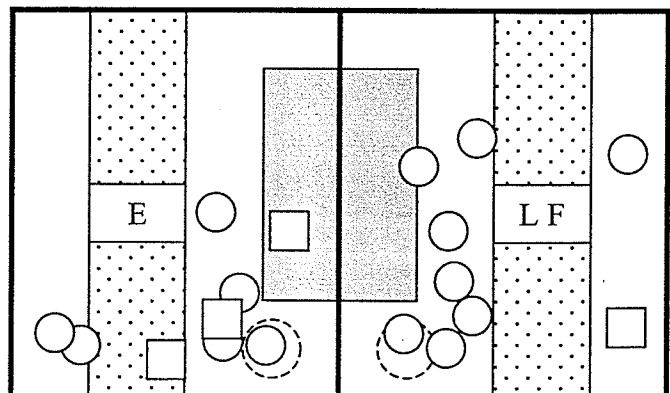
Crate: 3 Crate: 4
 Time: 2:00 Time: 2:00



Crate: 3 Crate: 4
 Time: 2:30 Time: 2:30

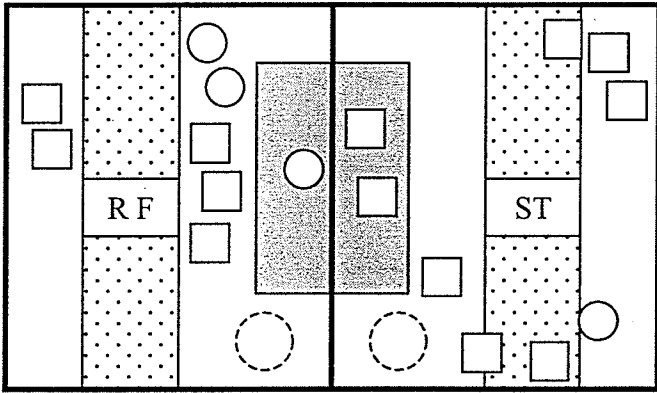


Crate: 3 Crate: 4
 Time: 3:00 Time: 3:00

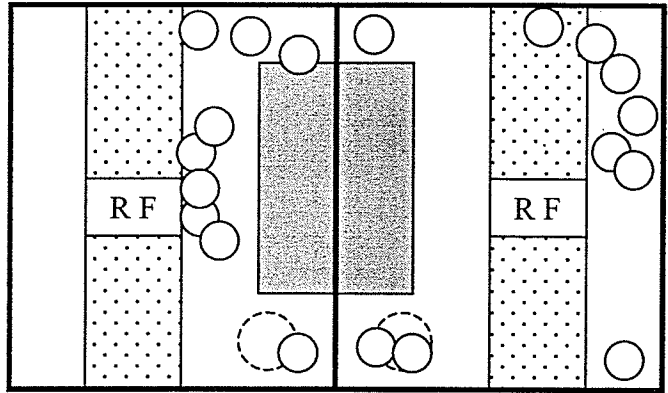


Crate: 3 Crate: 4
 Time: 3:30 Time: 3:30

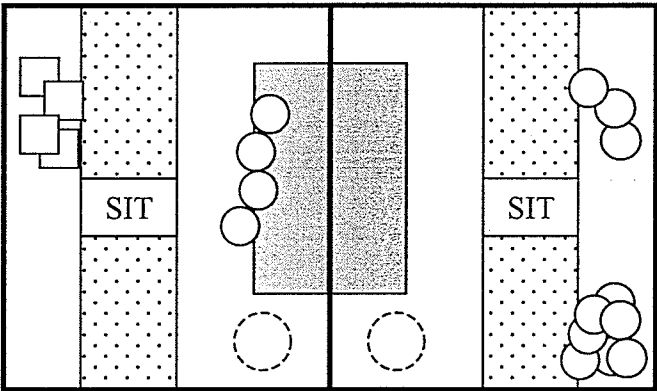
Behaviour Tests - Fall Farrowing 2000
 Day 7 - Section B (Heat Lamps Off)
 October 24, 2000



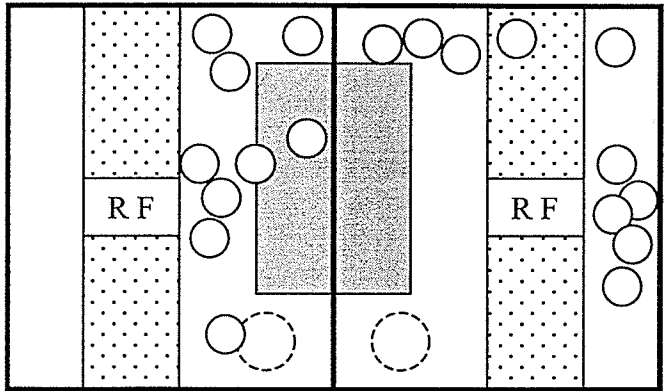
Crate: 11 Crate: 12
 Time: 9:30 Time: 9:30



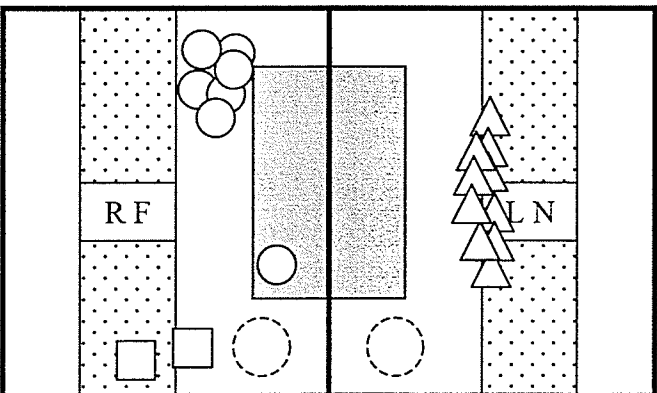
Crate: 11 Crate: 12
 Time: 10:00 Time: 10:00



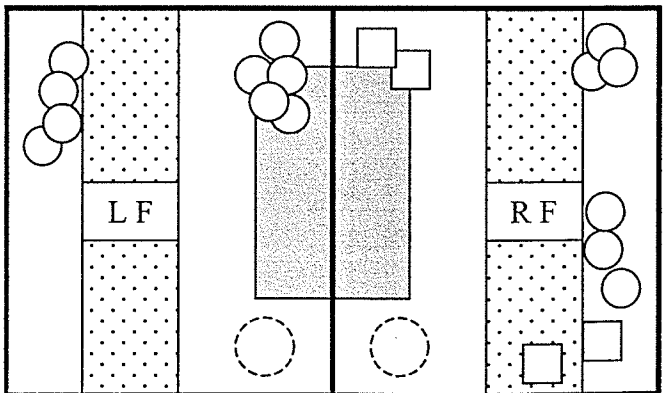
Crate: 11 Crate: 12
 Time: 10:30 Time: 10:30



Crate: 11 Crate: 12
 Time: 11:00 Time: 11:00

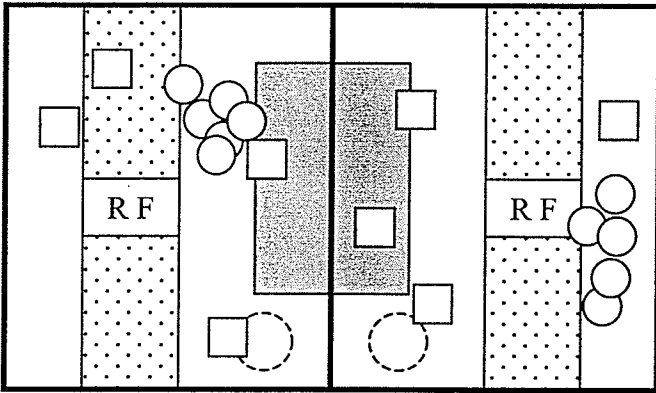


Crate: 11 Crate: 12
 Time: 11:30 Time: 11:30

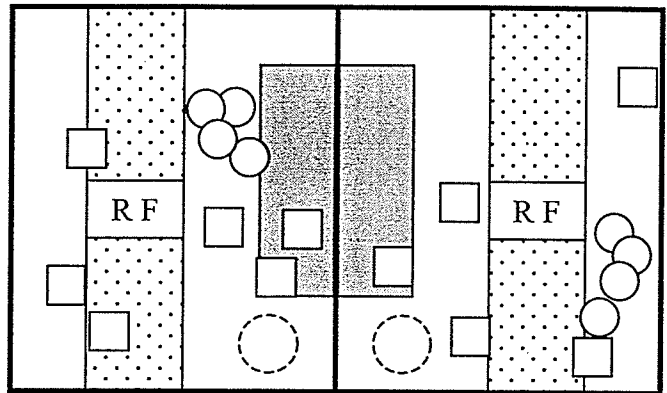


Crate: 11 Crate: 12
 Time: 12:00 Time: 12:00

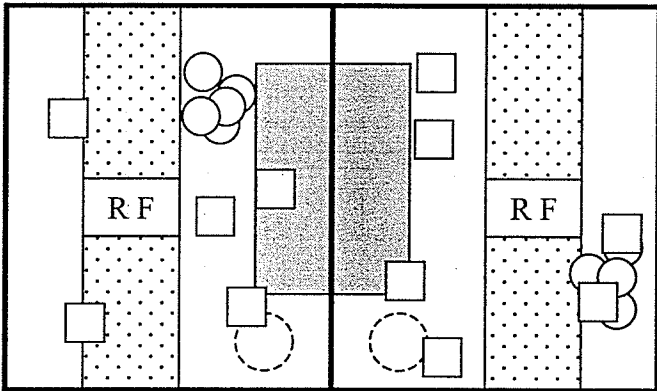
Behaviour Tests - Fall Farrowing 2000
 Day 7 - Section C (Heat Lamps Off)
 November 1, 2000



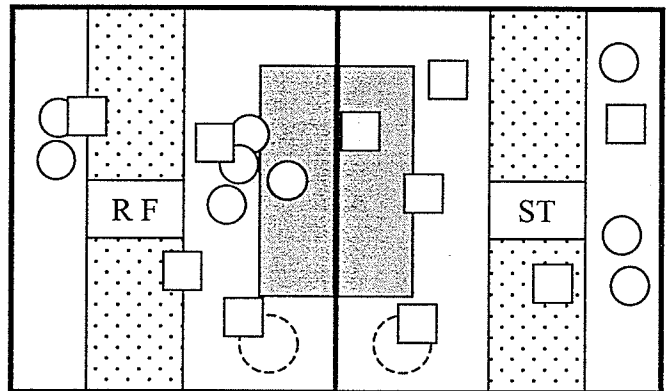
Crate: 25 Crate: 26
 Time: 1:00 Time: 1:00



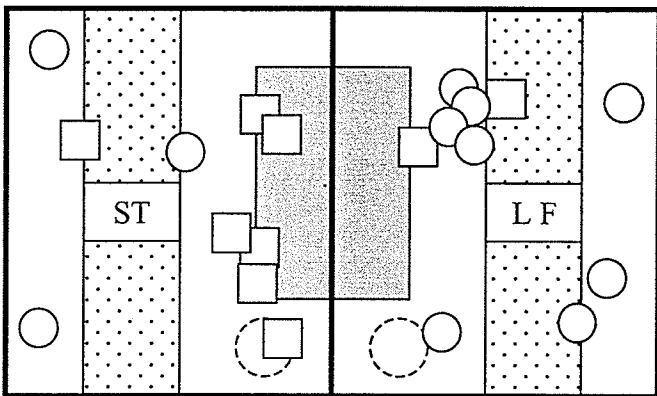
Crate: 25 Crate: 26
 Time: 1:30 Time: 1:30



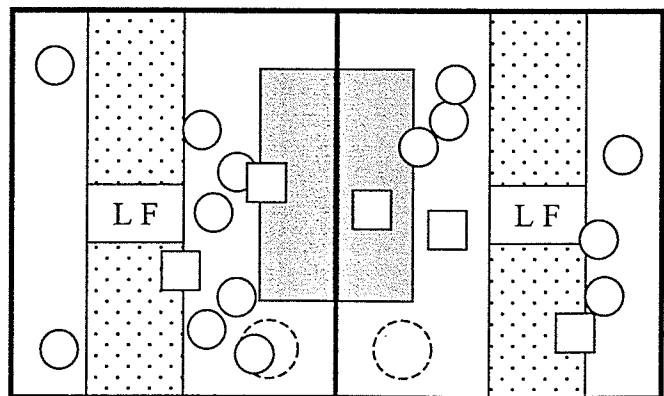
Crate: 25 Crate: 26
 Time: 2:00 Time: 2:00



Crate: 25 Crate: 26
 Time: 2:30 Time: 2:30

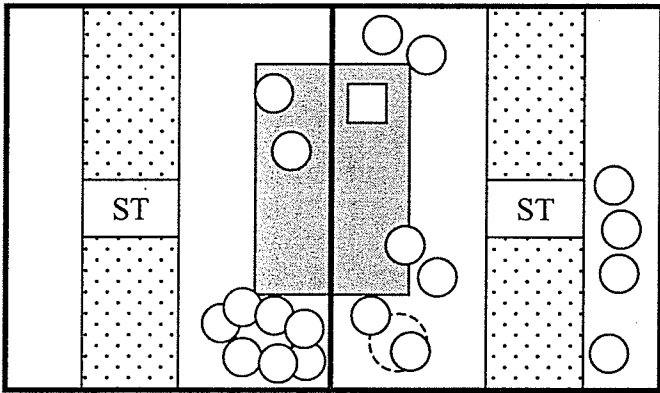


Crate: 25 Crate: 26
 Time: 3:00 Time: 3:00

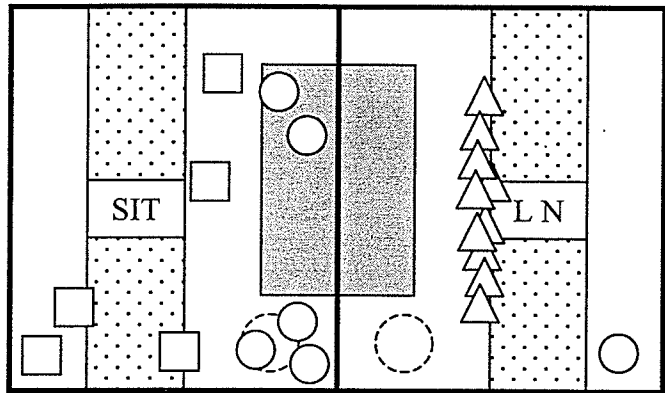


Crate: 25 Crate: 26
 Time: 3:30 Time: 3:30

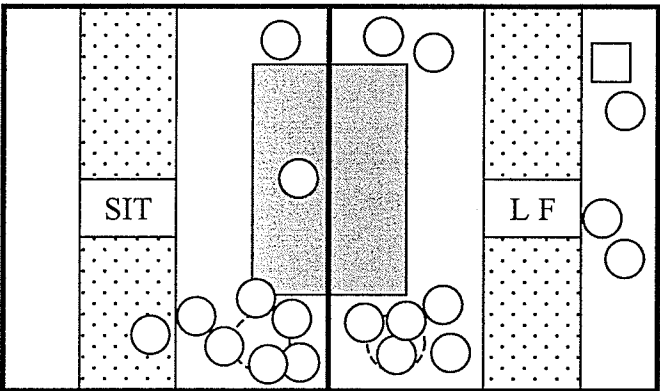
Behaviour Tests - Fall Farrowing 2000
 Day 7 - Section D (Heat Lamps Off)
 October 24, 2000



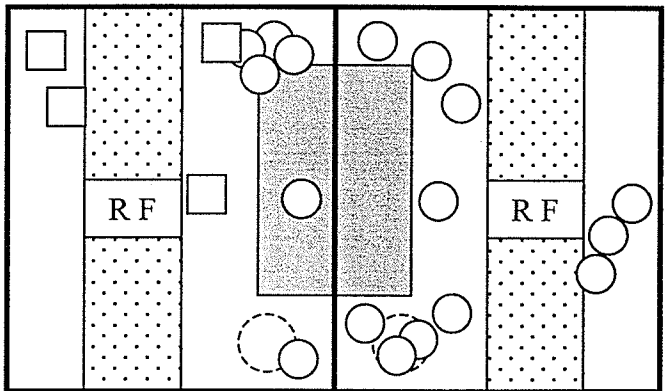
Crate: 33 Crate: 34
 Time: 9:30 Time: 9:30



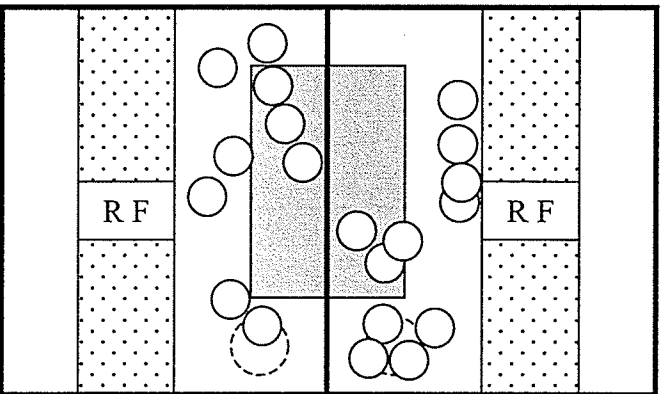
Crate: 33 Crate: 34
 Time: 10:00 Time: 10:00



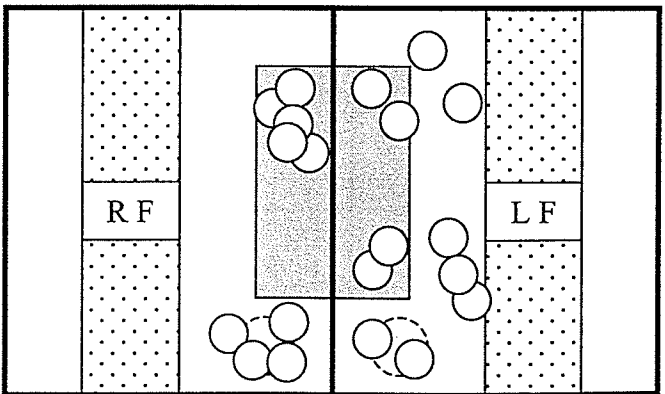
Crate: 33 Crate: 34
 Time: 10:30 Time: 10:30



Crate: 33 Crate: 34
 Time: 11:00 Time: 11:00



Crate: 33 Crate: 34
 Time: 11:30 Time: 11:30

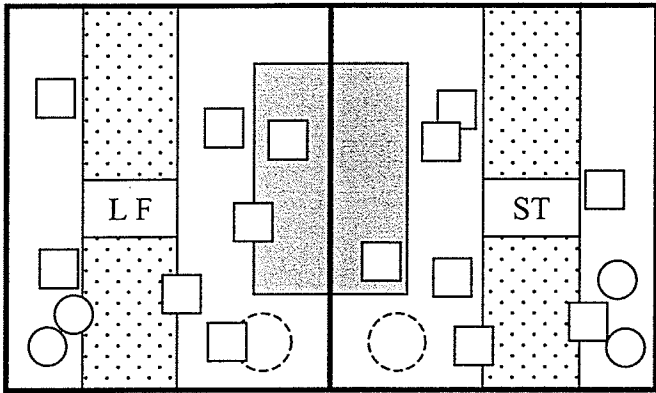


Crate: 33 Crate: 34
 Time: 12:00 Time: 12:00

Behaviour Tests - Fall Farrowing 2000

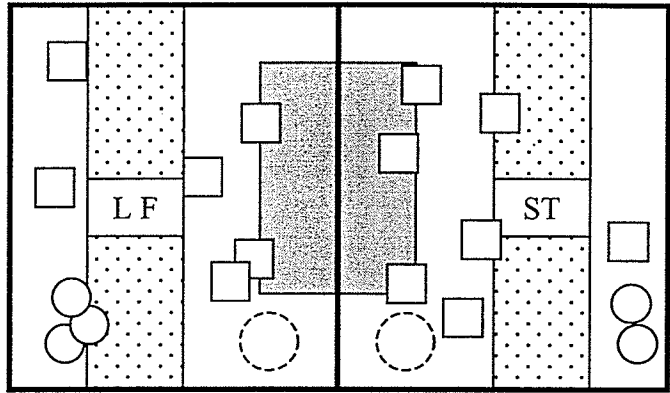
Day 16 - Section A (Heat Lamps Off)

October 29, 2000



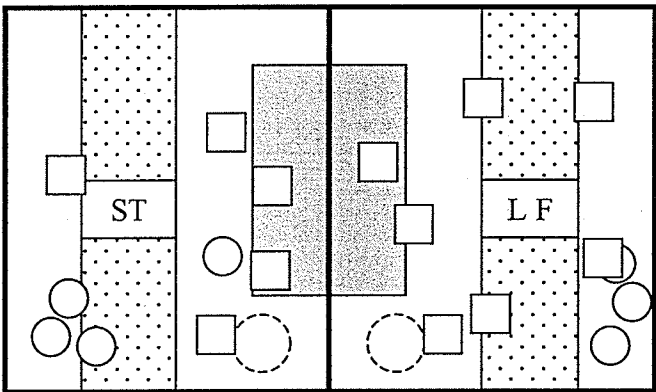
Crate: 3 Crate: 4

Time: 9:00 Time: 9:00



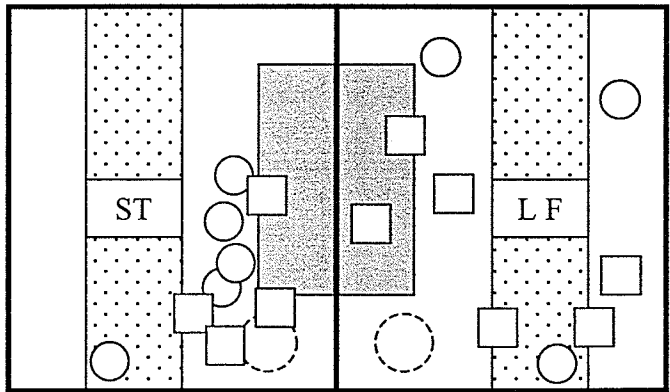
Crate: 3 Crate: 4

Time: 9:30 Time: 9:30



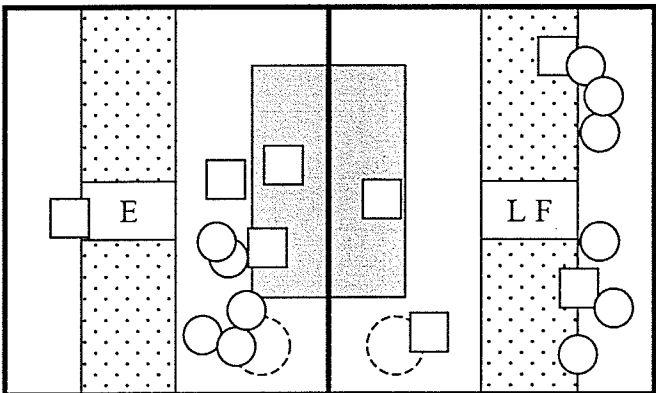
Crate: 3 Crate: 4

Time: 10:00 Time: 10:00



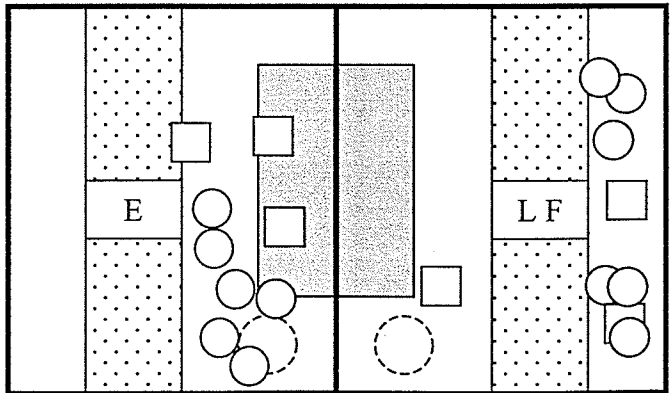
Crate: 3 Crate: 4

Time: 10:30 Time: 10:30



Crate: 3 Crate: 4

Time: 11:00 Time: 11:00



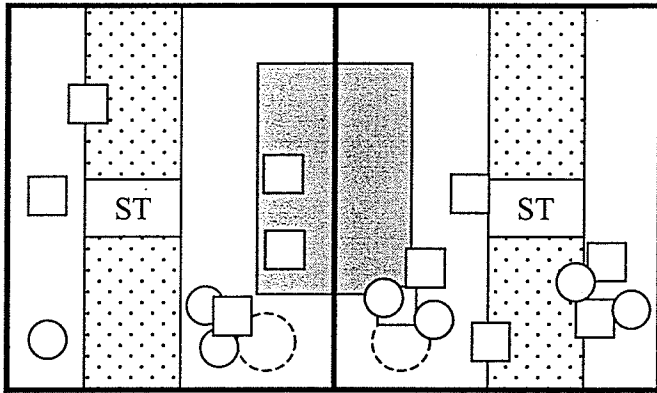
Crate: 3 Crate: 4

Time: 11:30 Time: 11:30

Behaviour Tests - Fall Farrowing 2000

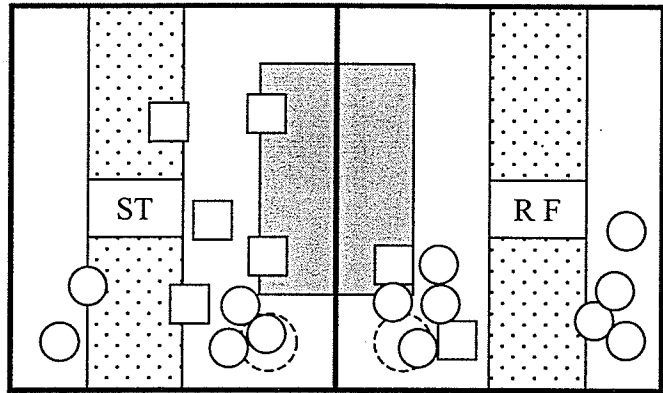
Day 16 - Section B (Heat Lamps Off)

November 2, 2000



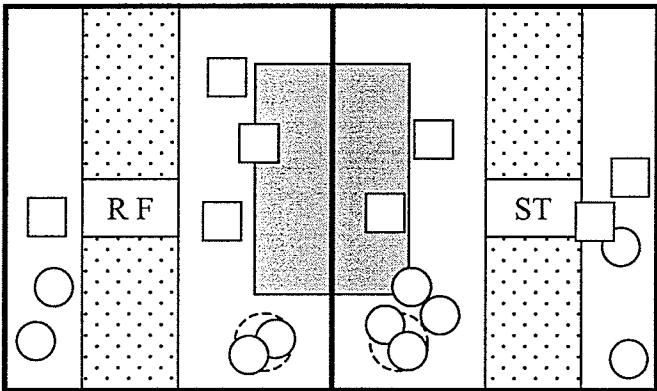
Crate: 11 Crate: 12

Time: 1:30 Time: 1:30



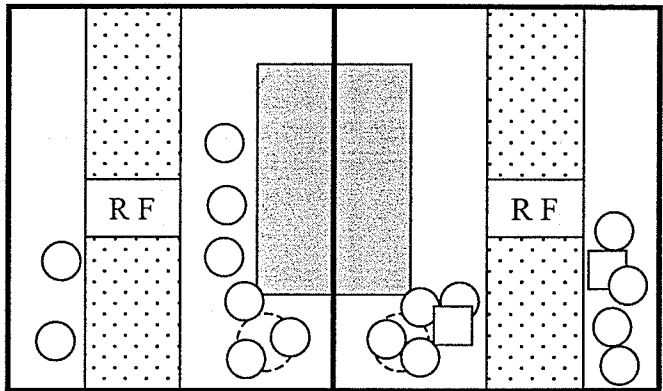
Crate: 11 Crate: 12

Time: 2:00 Time: 2:00



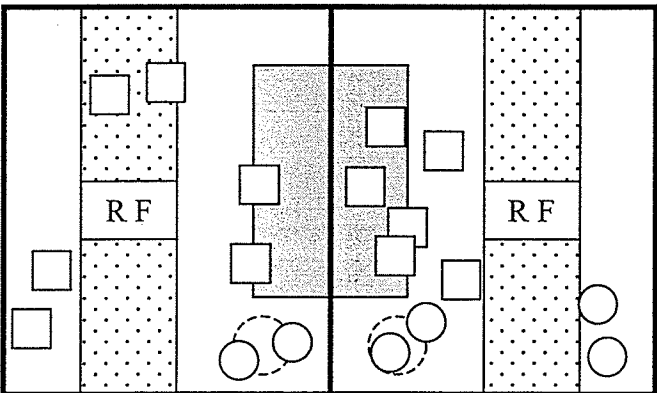
Crate: 11 Crate: 12

Time: 2:30 Time: 2:30



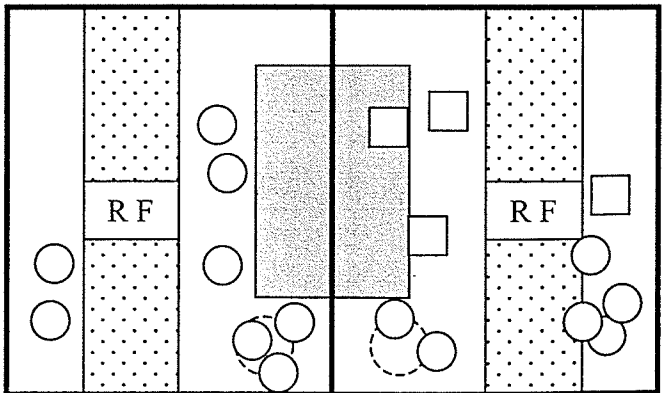
Crate: 11 Crate: 12

Time: 3:00 Time: 3:00



Crate: 11 Crate: 12

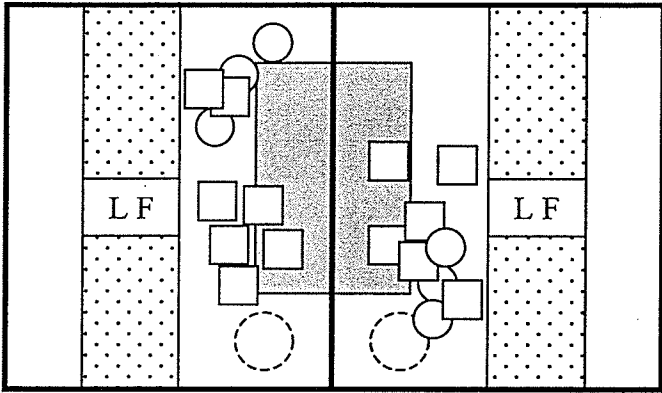
Time: 3:30 Time: 3:30



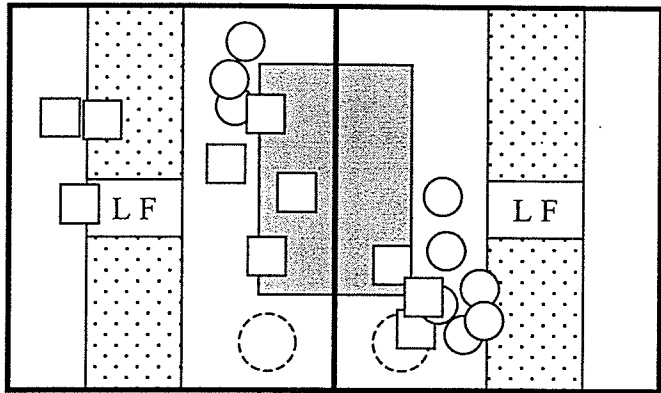
Crate: 11 Crate: 12

Time: 4:00 Time: 4:00

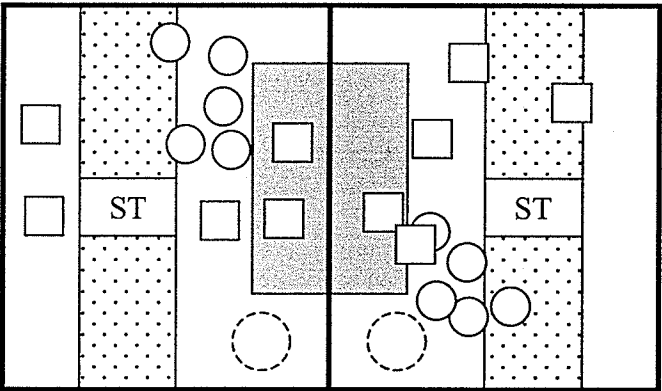
Behaviour Tests - Fall Farrowing 2000
 Day 16 - Section C (Heat Lamps Off)
 November 10, 2000



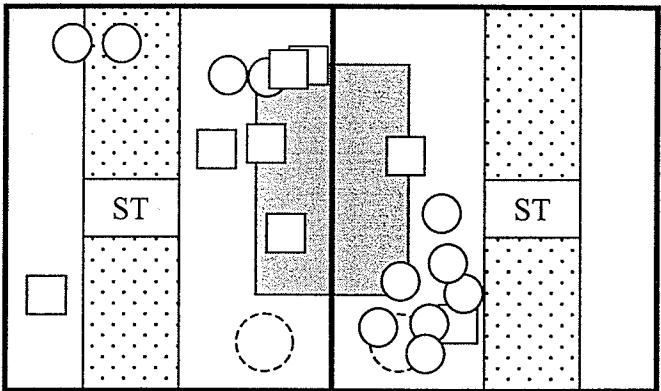
Crate: 25 Crate: 26
 Time: 1:00 Time: 1:00



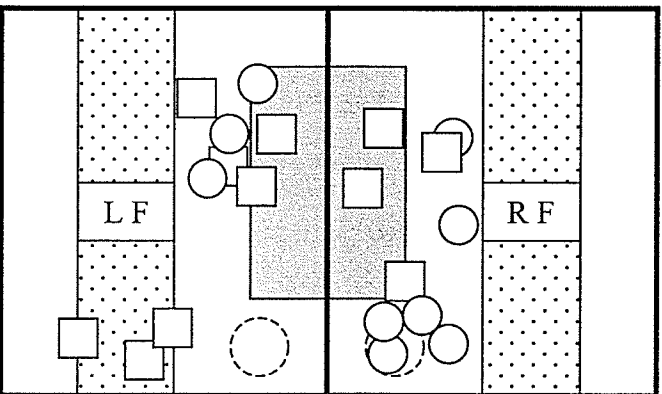
Crate: 25 Crate: 26
 Time: 1:30 Time: 1:30



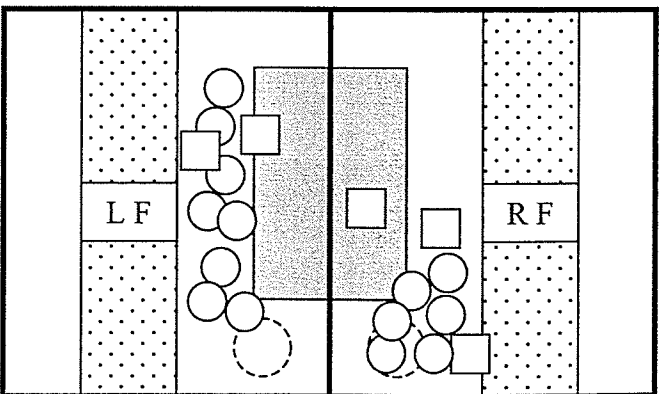
Crate: 25 Crate: 26
 Time: 2:00 Time: 2:00



Crate: 25 Crate: 26
 Time: 2:30 Time: 2:30

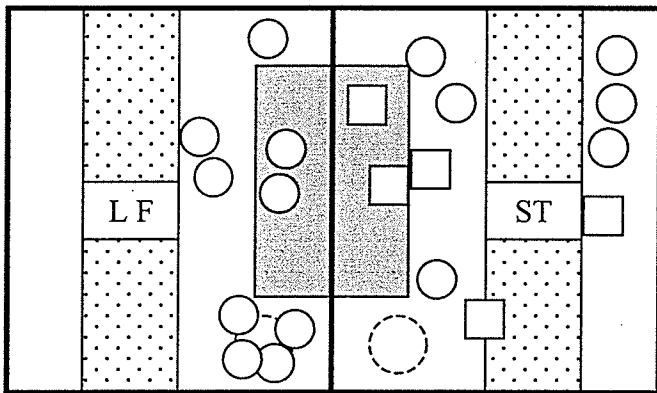


Crate: 25 Crate: 26
 Time: 3:00 Time: 3:00

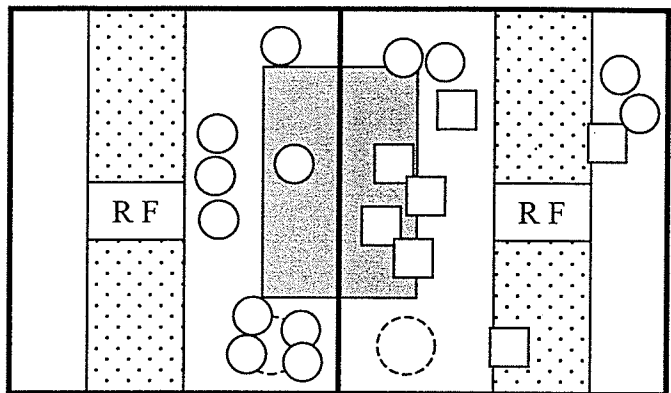


Crate: 25 Crate: 26
 Time: 3:30 Time: 3:30

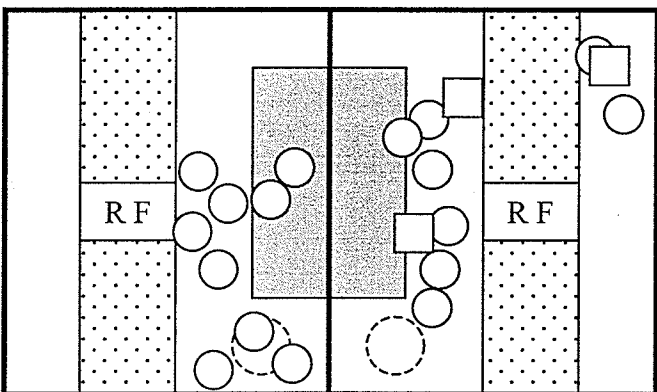
Behaviour Tests - Fall Farrowing 2000
 Day 16 - Section D (Heat Lamps Off)
 November 2, 2000



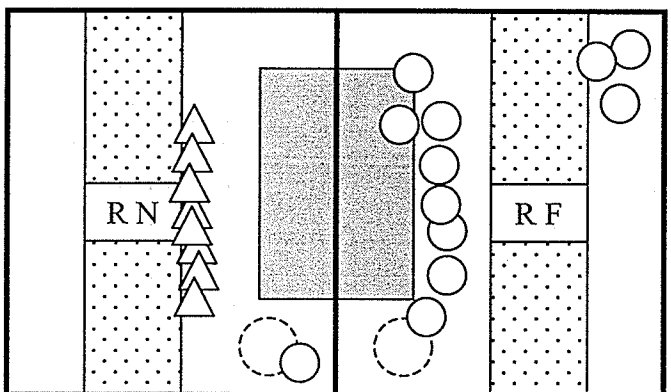
Crate: 33 Crate: 34
 Time: 1:30 Time: 1:30



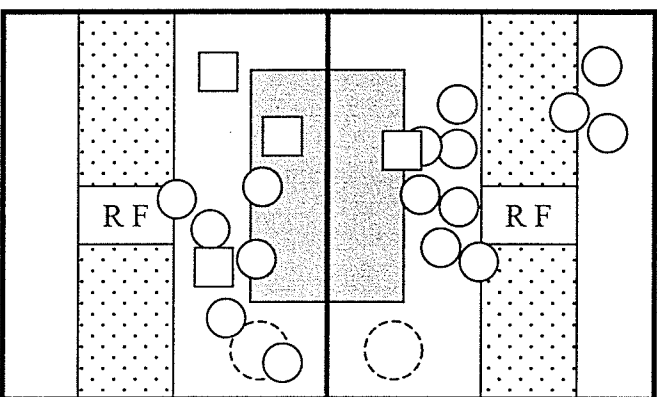
Crate: 33 Crate: 34
 Time: 2:00 Time: 2:00



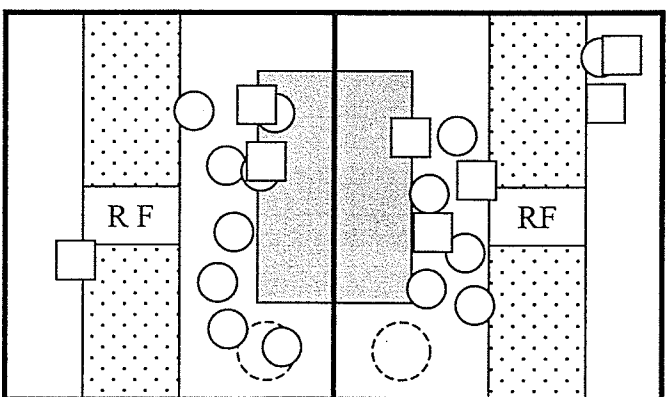
Crate: 33 Crate: 34
 Time: 2:30 Time: 2:30



Crate: 33 Crate: 34
 Time: 3:00 Time: 3:00



Crate: 33 Crate: 34
 Time: 3:30 Time: 3:30

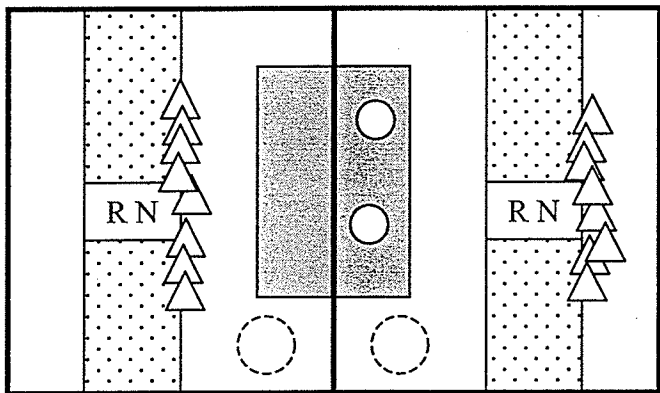


Crate: 33 Crate: 34
 Time: 4:00 Time: 4:00

Behaviour Tests - Winter Farrowing 2000

Day 1 - Section A (Heat Lamps Off)

December 18, 2000

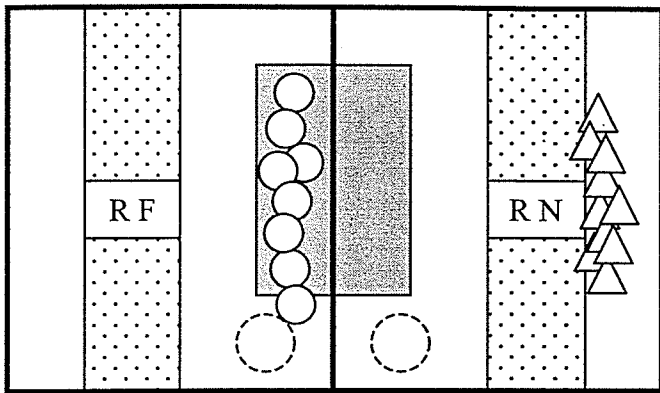


Crate: 5

Crate: 6

Time: 9:00

Time: 9:00

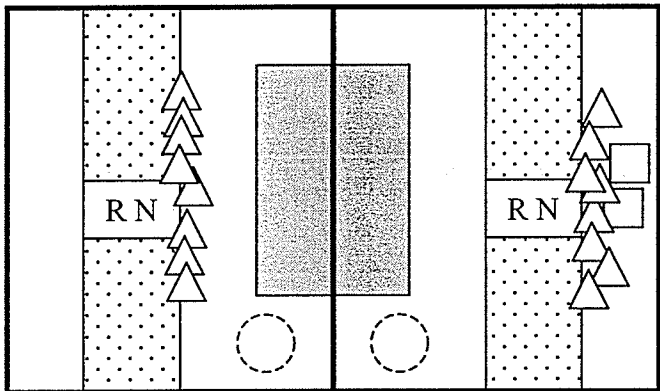


Crate: 5

Crate: 6

Time: 9:30

Time: 9:30

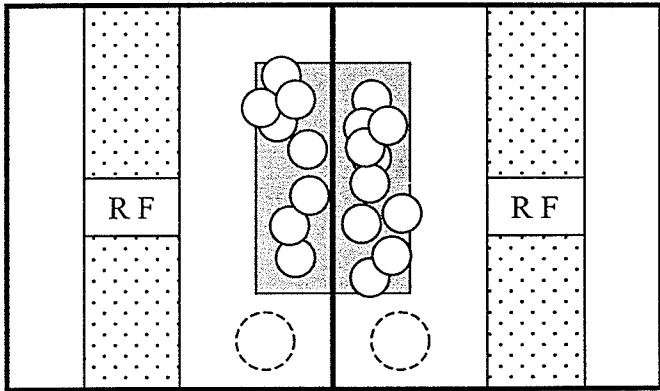


Crate: 5

Crate: 6

Time: 10:00

Time: 10:00

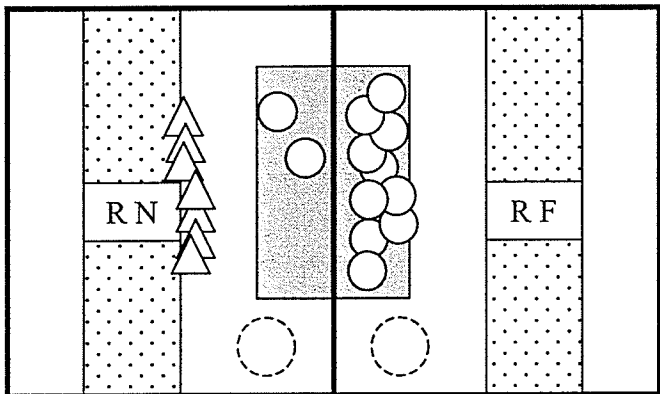


Crate: 5

Crate: 6

Time: 10:30

Time: 10:30

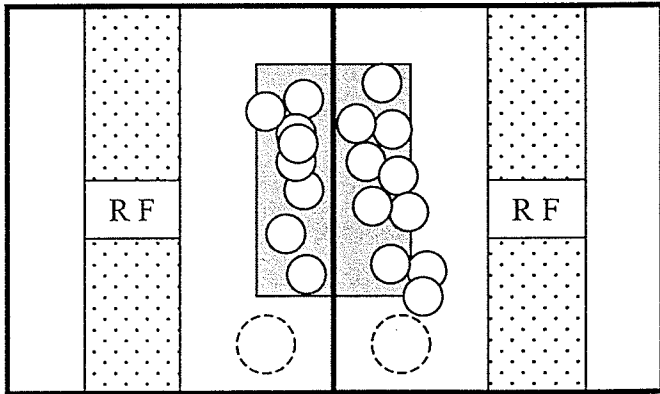


Crate: 5

Crate: 6

Time: 11:00

Time: 11:00



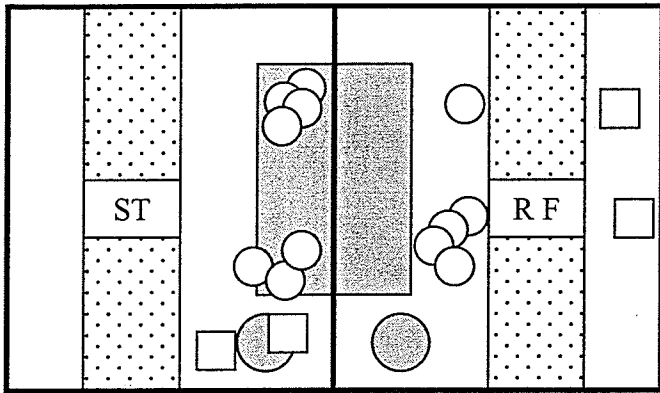
Crate: 5

Crate: 6

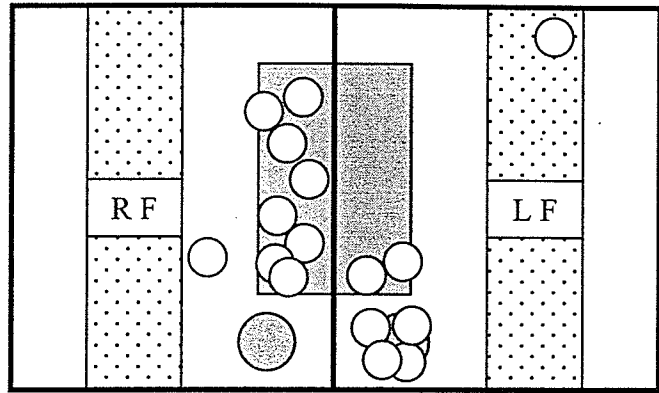
Time: 11:30

Time: 11:30

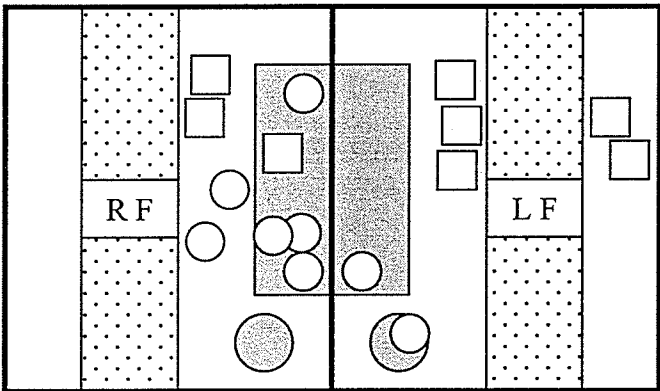
Behaviour Tests - Winter Farrowing 2000
 Day 1 - Section B (Heat Lamps On)
 December 22, 2000



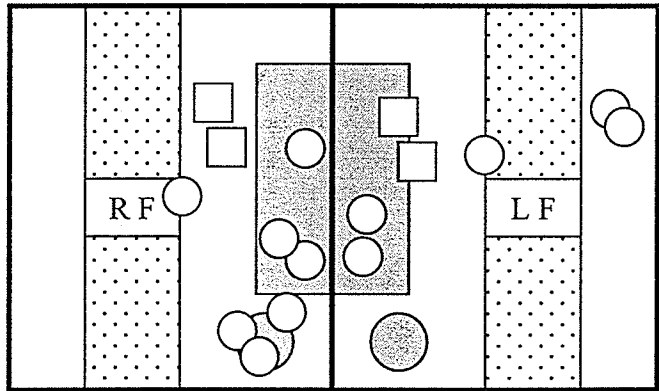
Crate: 11 Crate: 12
 Time: 10:30 Time: 10:30



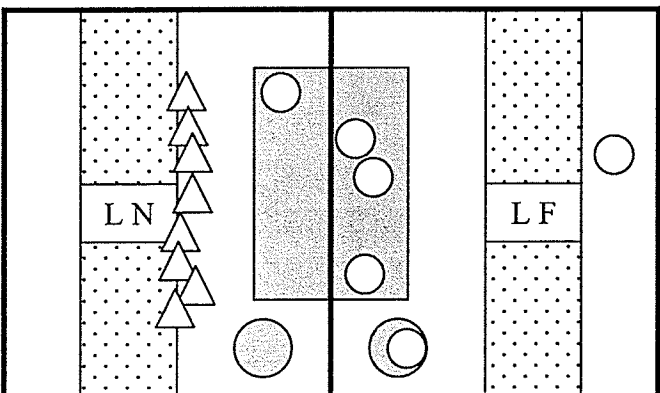
Crate: 11 Crate: 12
 Time: 11:00 Time: 11:00



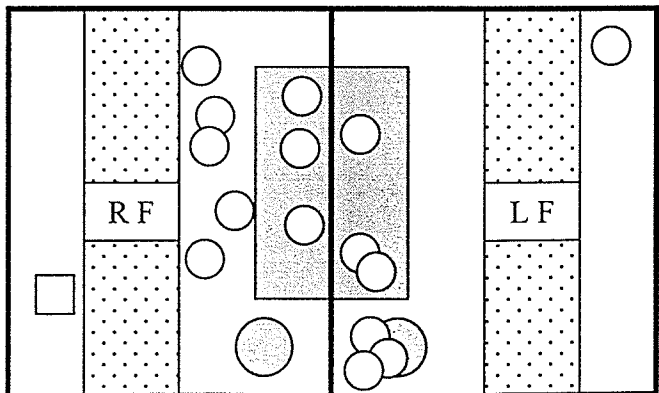
Crate: 11 Crate: 12
 Time: 11:30 Time: 11:30



Crate: 11 Crate: 12
 Time: 12:00 Time: 12:00

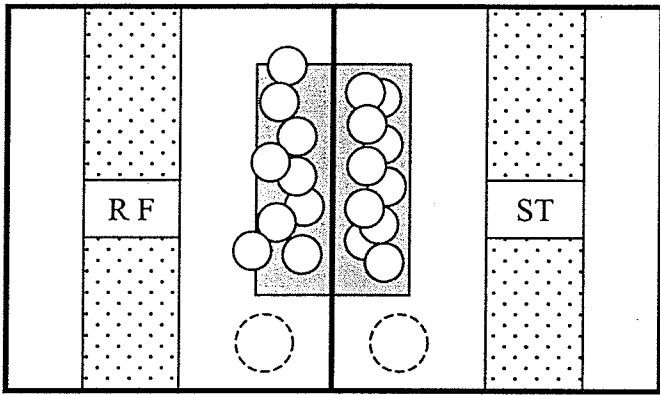


Crate: 11 Crate: 12
 Time: 12:30 Time: 12:30

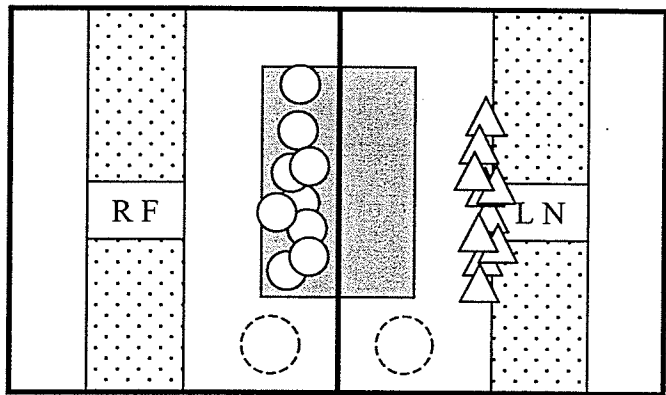


Crate: 11 Crate: 12
 Time: 1:00 Time: 1:00

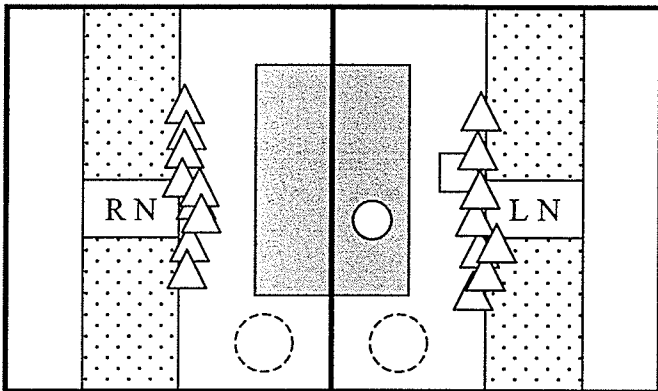
Behaviour Tests - Winter Farrowing 2000
 Day 1 - Section C (Heat Lamps Off)
 December 28, 2000



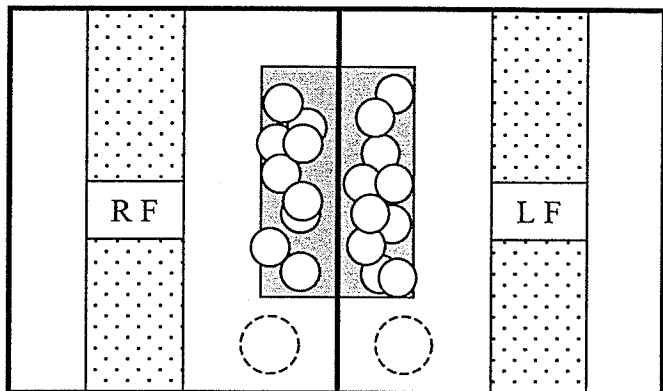
Crate: 23 Crate: 24
 Time: 1:00 Time: 1:00



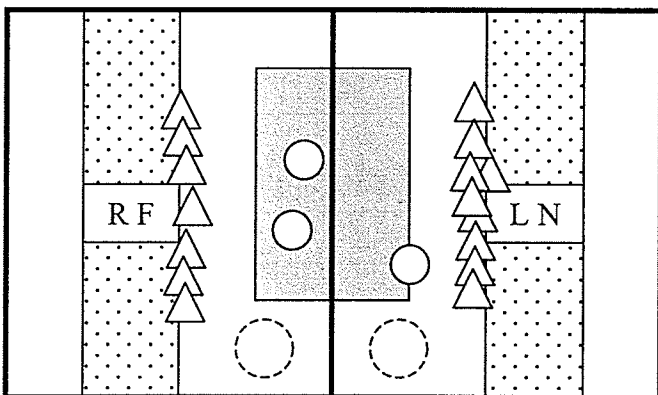
Crate: 23 Crate: 24
 Time: 1:30 Time: 1:30



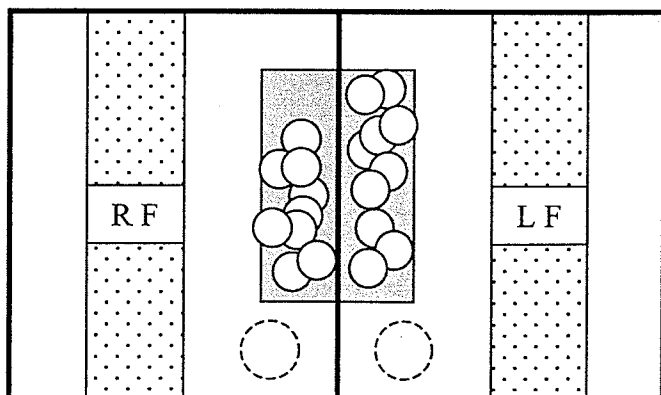
Crate: 23 Crate: 24
 Time: 2:00 Time: 2:00



Crate: 23 Crate: 24
 Time: 2:30 Time: 2:30



Crate: 23 Crate: 24
 Time: 3:00 Time: 3:00

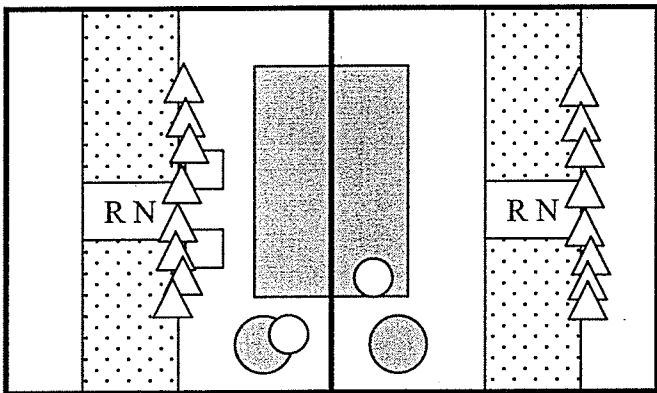


Crate: 23 Crate: 24
 Time: 3:30 Time: 3:30

Behaviour Tests - Winter Farrowing 2000

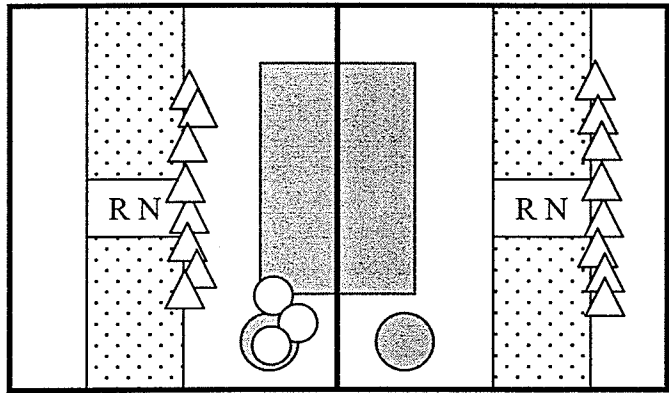
Day 1 - Section D (Heat Lamps On)

December 18-19, 2000



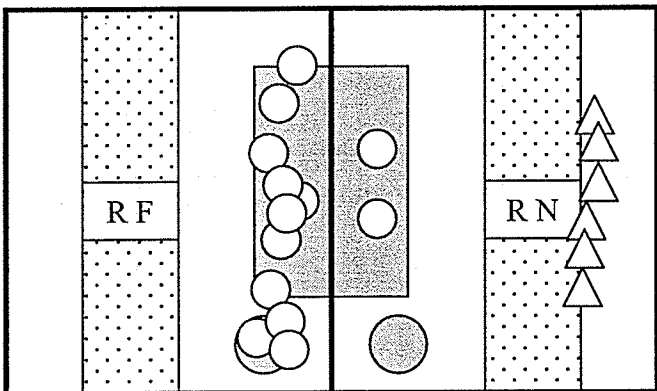
Crate: 33 Crate: 32

Time: 10:30 Time: 10:30



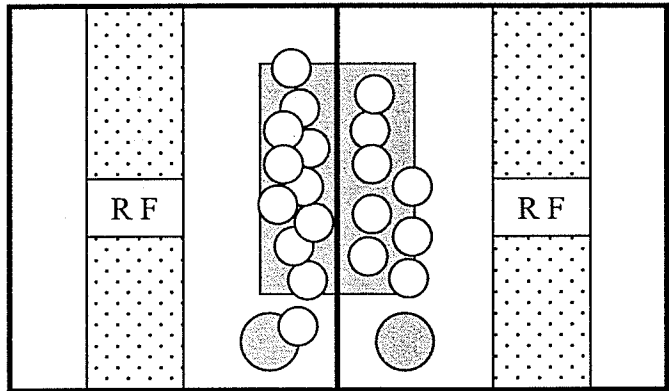
Crate: 33 Crate: 32

Time: 11:00 Time: 11:00



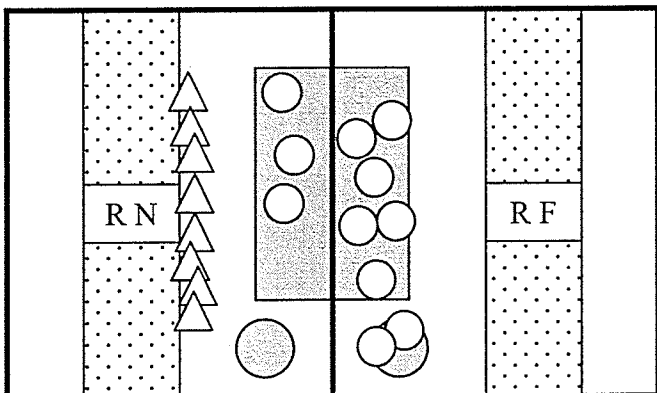
Crate: 33 Crate: 32

Time: 11:30 Time: 11:30



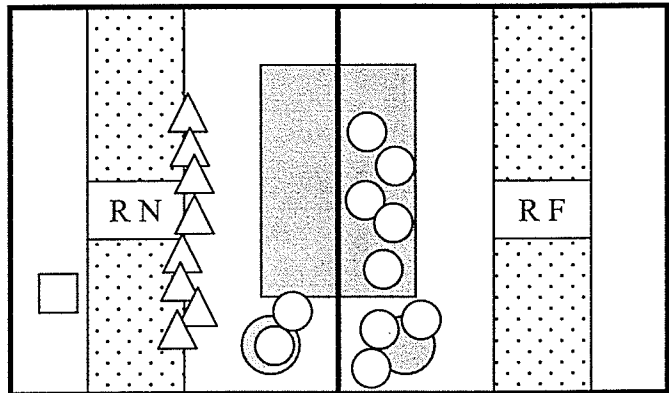
Crate: 33 Crate: 32

Time: 12:00 Time: 12:00



Crate: 33 Crate: 32

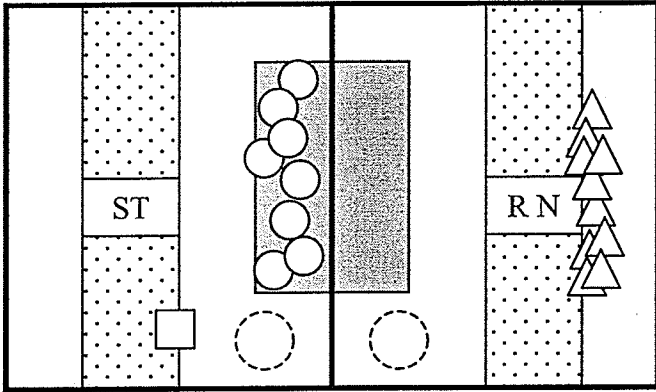
Time: 12:30 Time: 12:30



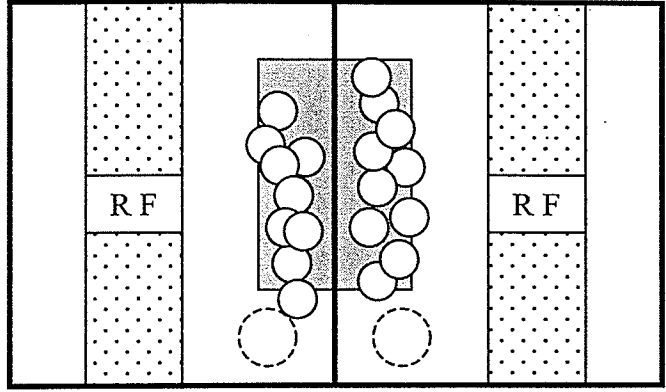
Crate: 33 Crate: 32

Time: 1:00 Time: 1:00

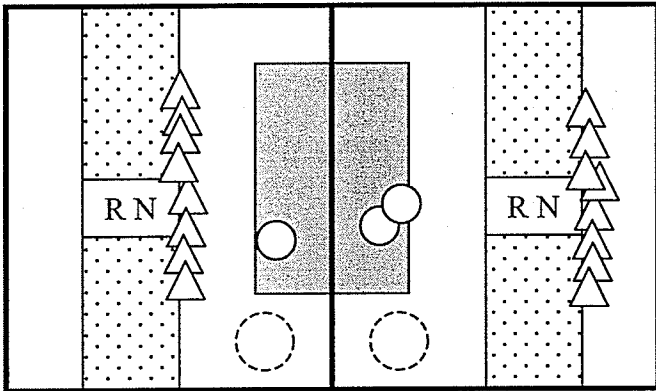
Behaviour Tests - Winter Farrowing 2000
 Day 3 - Section A (Heat Lamps Off)
 December 21, 2000



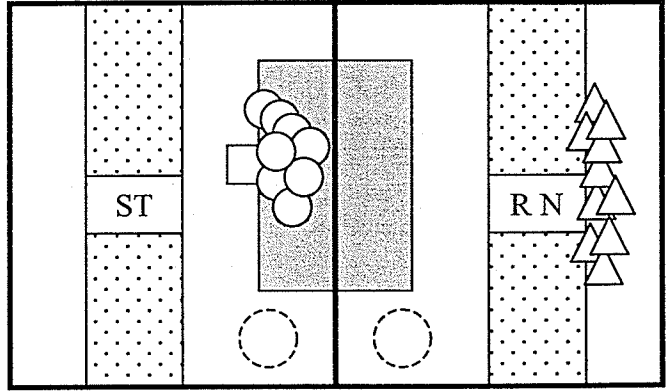
Crate: 5 Crate: 6
 Time: 9:00 Time: 9:00



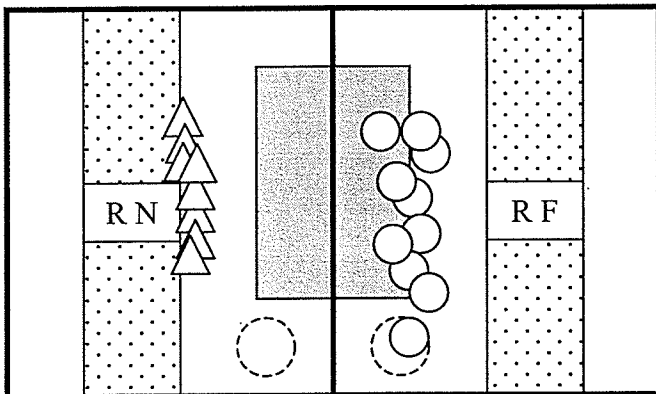
Crate: 5 Crate: 6
 Time: 9:30 Time: 9:30



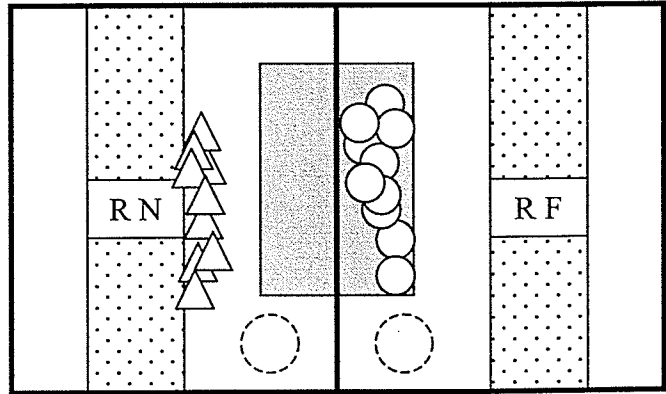
Crate: 5 Crate: 6
 Time: 10:00 Time: 10:00



Crate: 5 Crate: 6
 Time: 10:30 Time: 10:30

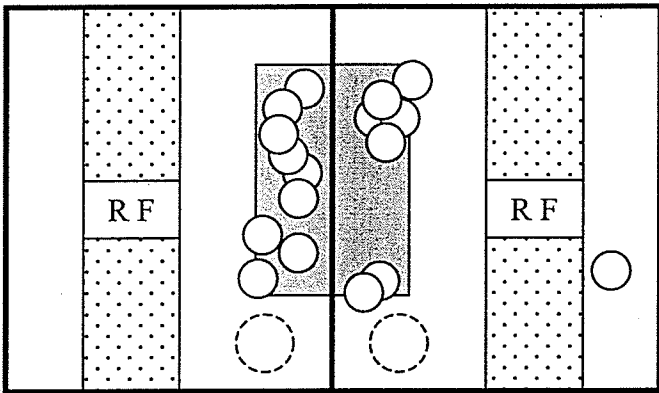


Crate: 5 Crate: 6
 Time: 11:00 Time: 11:00

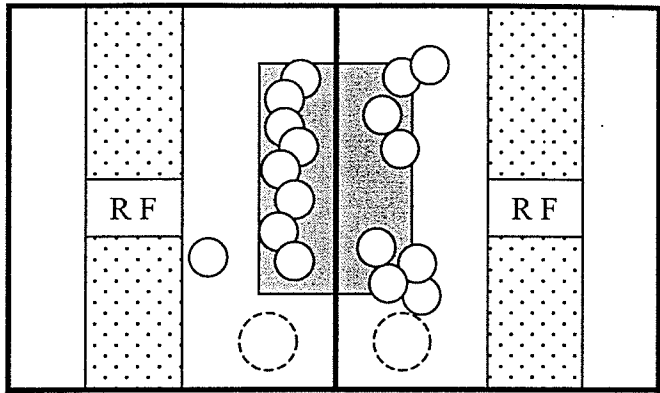


Crate: 5 Crate: 6
 Time: 11:30 Time: 11:30

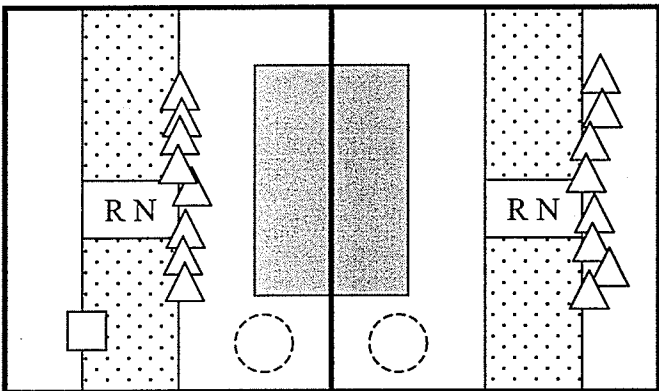
Behaviour Tests - Winter Farrowing 2000
 Day 3 - Section B (Heat Lamps Off)
 December 26, 2000



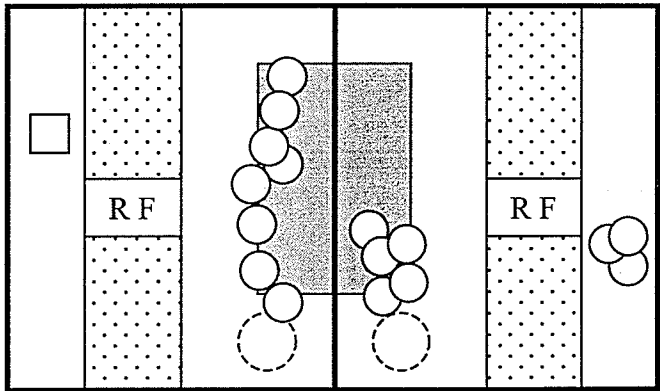
Crate: 11 Crate: 12
 Time: 1:00 Time: 1:00



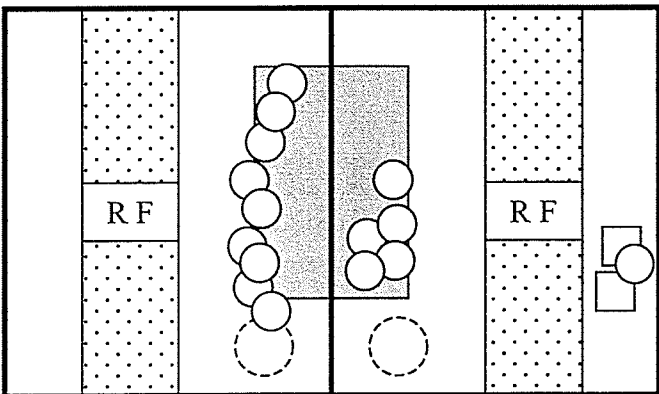
Crate: 11 Crate: 12
 Time: 1:30 Time: 1:30



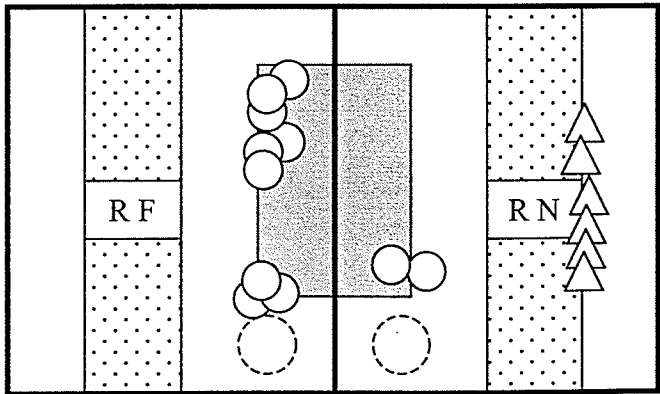
Crate: 11 Crate: 12
 Time: 2:00 Time: 2:00



Crate: 11 Crate: 12
 Time: 2:30 Time: 2:30



Crate: 11 Crate: 12
 Time: 3:00 Time: 3:00

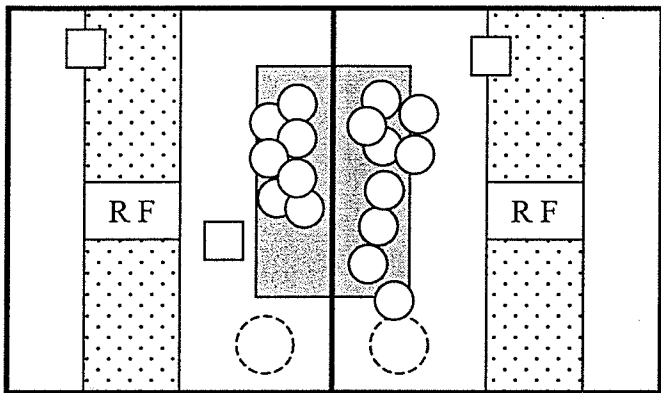


Crate: 11 Crate: 12
 Time: 3:30 Time: 3:30

Behaviour Tests - Winter Farrowing 2000

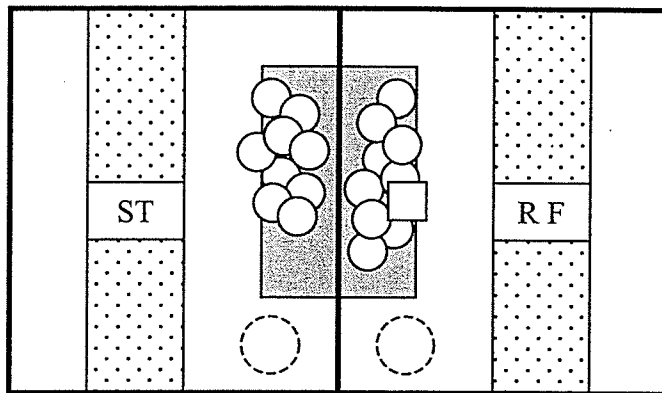
Day 3 - Section C (Heat Lamps Off)

December 30, 2000



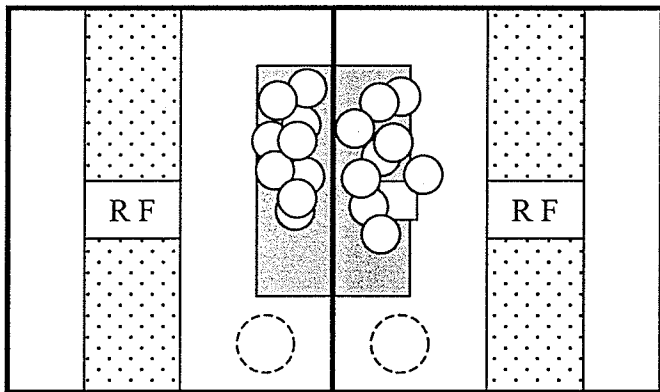
Crate: 23 Crate: 24

Time: 1:00 Time: 1:00



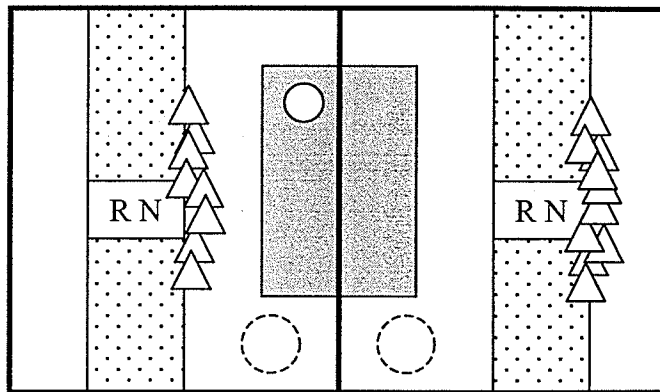
Crate: 23 Crate: 24

Time: 1:30 Time: 1:30



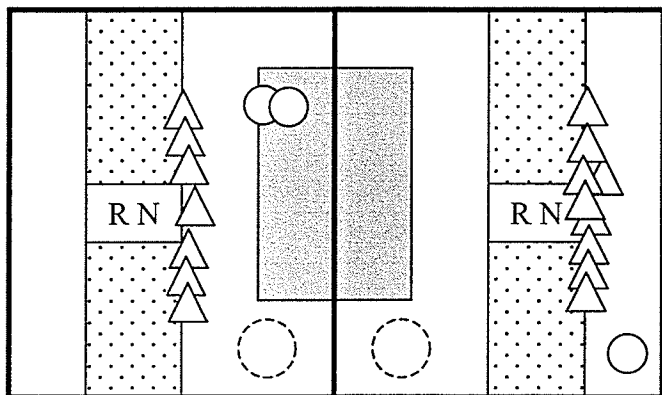
Crate: 23 Crate: 24

Time: 2:00 Time: 2:00



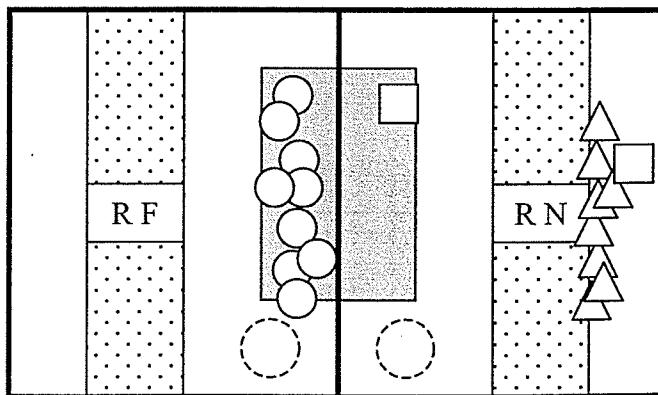
Crate: 23 Crate: 24

Time: 2:30 Time: 2:30



Crate: 23 Crate: 24

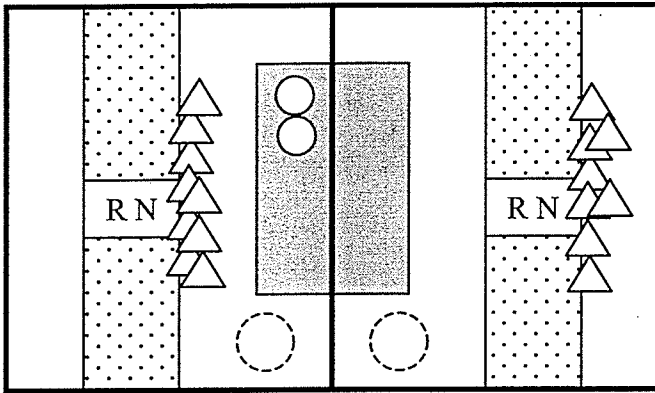
Time: 3:00 Time: 3:00



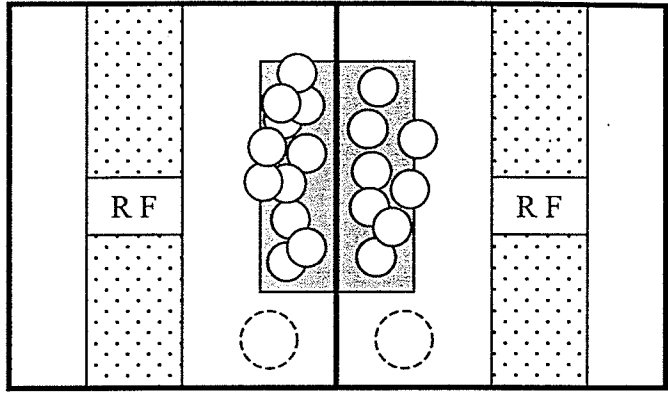
Crate: 23 Crate: 24

Time: 3:30 Time: 3:30

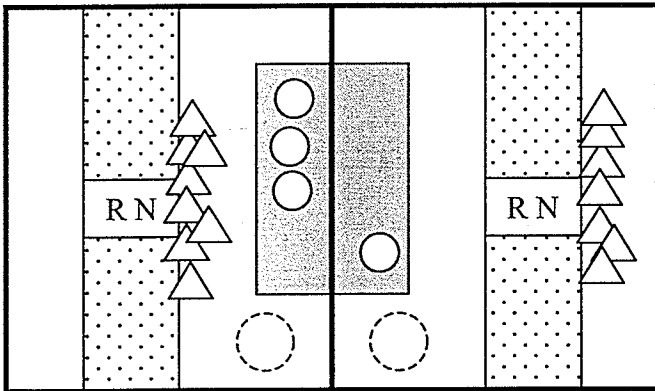
Behaviour Tests - Winter Farrowing 2000
 Day 3 - Section D (Heat Lamps Off)
 December 21-22, 2000



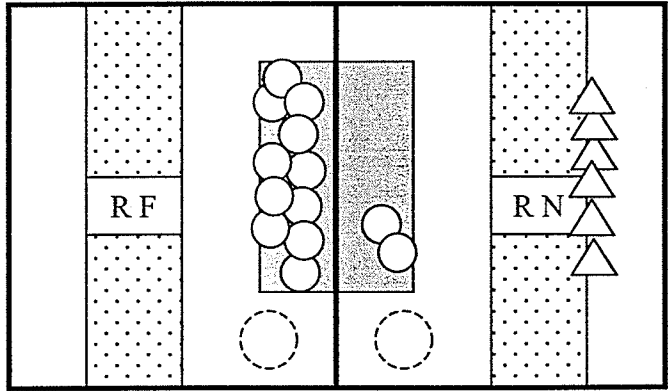
Crate: 33 Crate: 32
 Time: 9:30 Time: 9:30



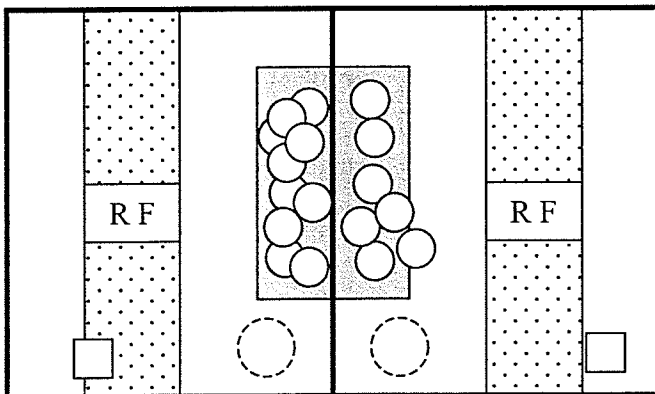
Crate: 33 Crate: 32
 Time: 10:00 Time: 10:00



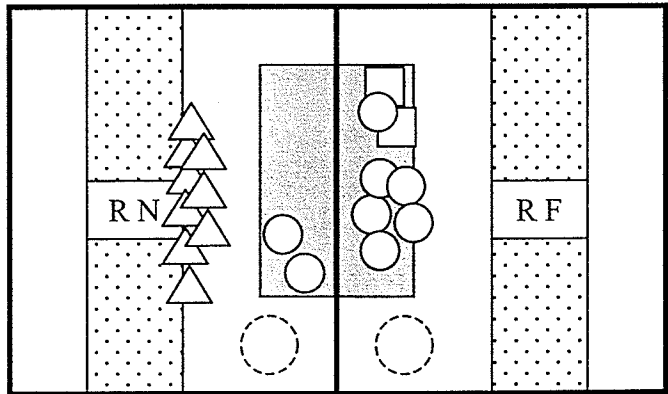
Crate: 33 Crate: 32
 Time: 10:30 Time: 10:30



Crate: 33 Crate: 32
 Time: 11:00 Time: 11:00

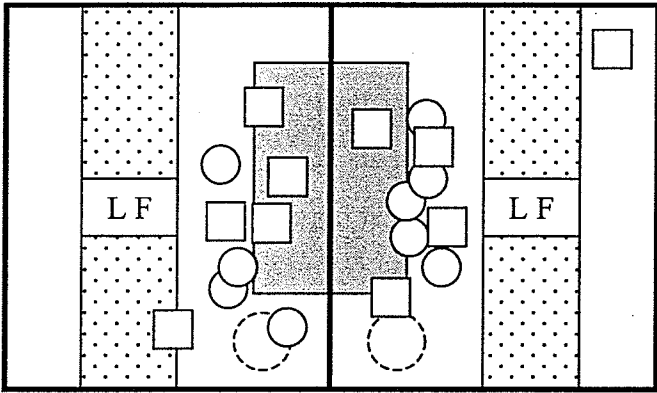


Crate: 33 Crate: 32
 Time: 11:30 Time: 11:30

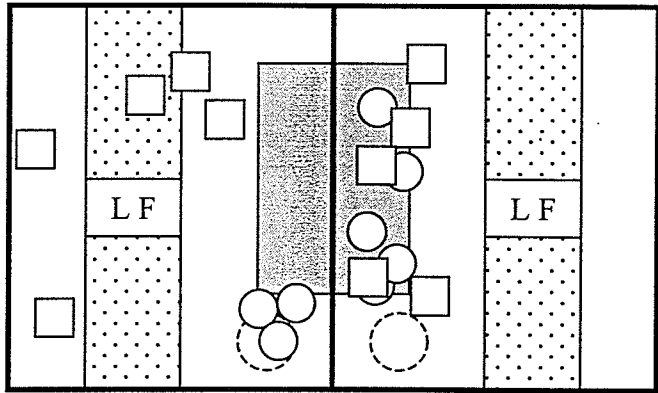


Crate: 33 Crate: 32
 Time: 12:00 Time: 12:00

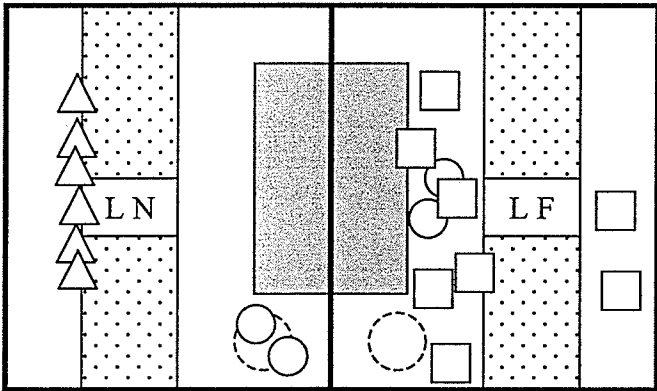
Behaviour Tests - Winter Farrowing 2000
 Day 7 - Section A (Heat Lamps Off)
 December 26, 2000



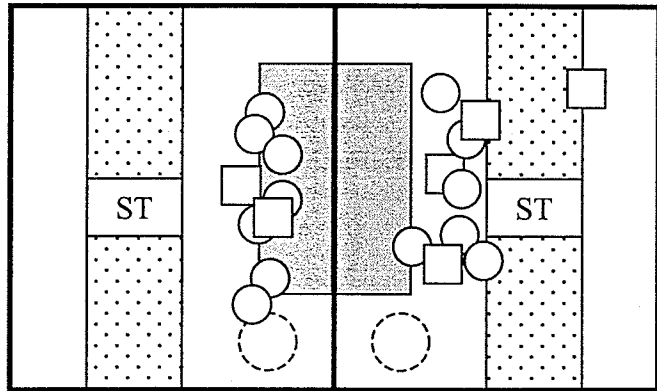
Crate: 5 Crate: 6
 Time: 9:30 Time: 9:30



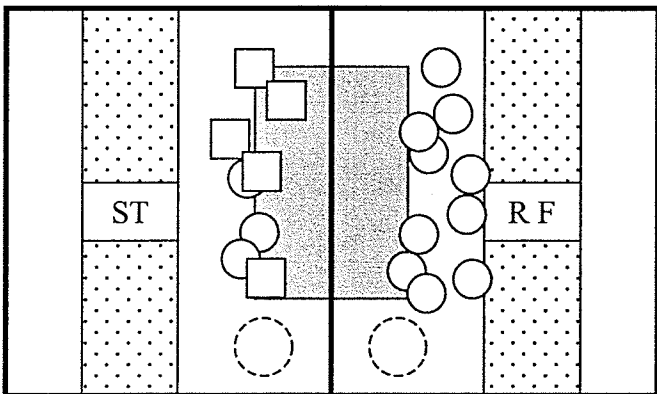
Crate: 5 Crate: 6
 Time: 10:00 Time: 10:00



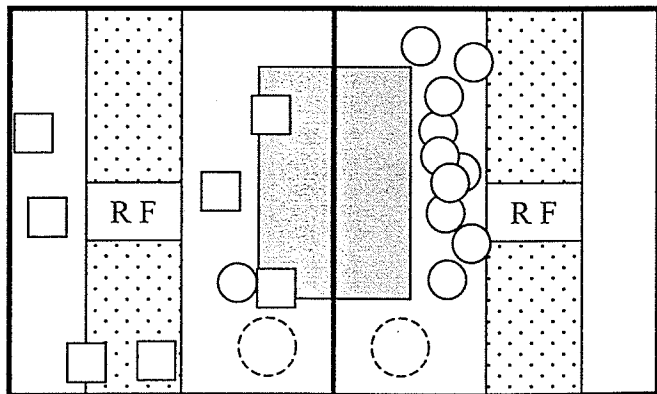
Crate: 5 Crate: 6
 Time: 10:30 Time: 10:30



Crate: 5 Crate: 6
 Time: 11:00 Time: 11:00



Crate: 5 Crate: 6
 Time: 11:30 Time: 11:30

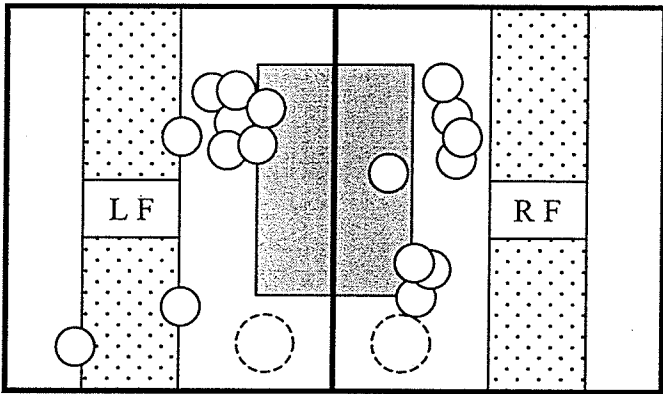


Crate: 5 Crate: 6
 Time: 12:00 Time: 12:00

Behaviour Tests - Winter Farrowing 2000

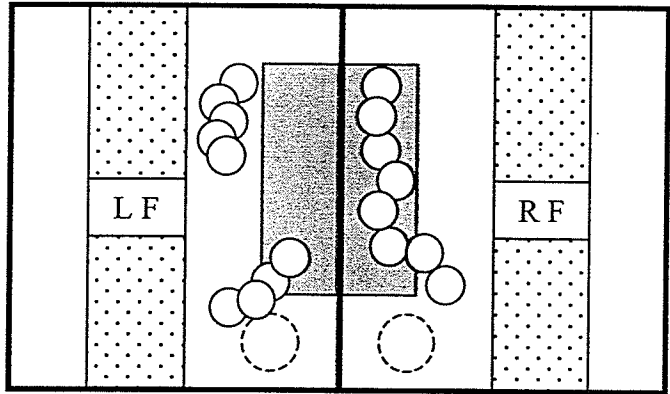
Day 7 - Section B (Heat Lamps Off)

December 29, 2000



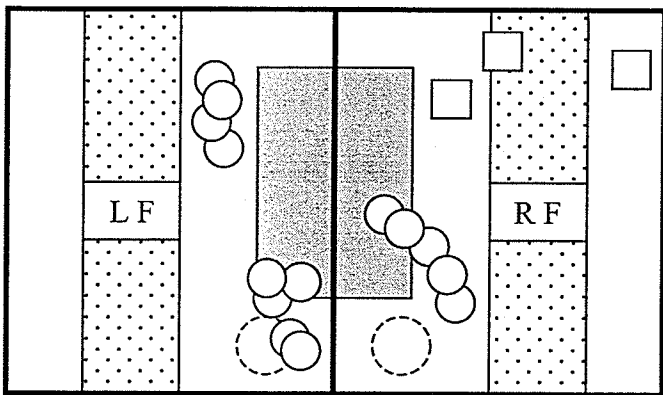
Crate: 11 Crate: 12

Time: 1:00 Time: 1:00



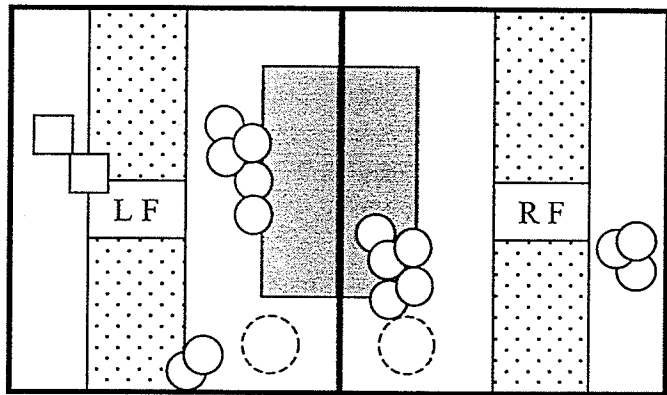
Crate: 11 Crate: 12

Time: 1:30 Time: 1:30



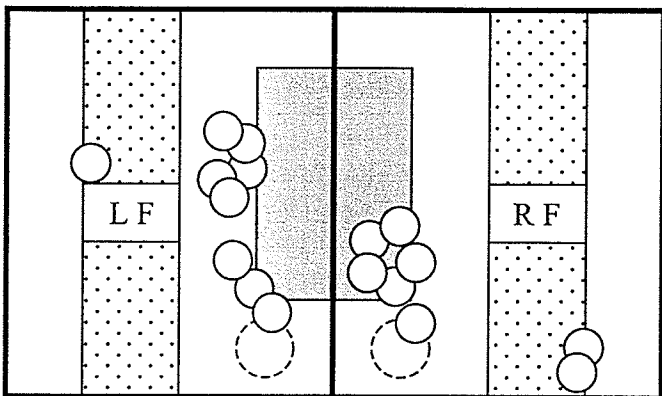
Crate: 11 Crate: 12

Time: 2:00 Time: 2:00



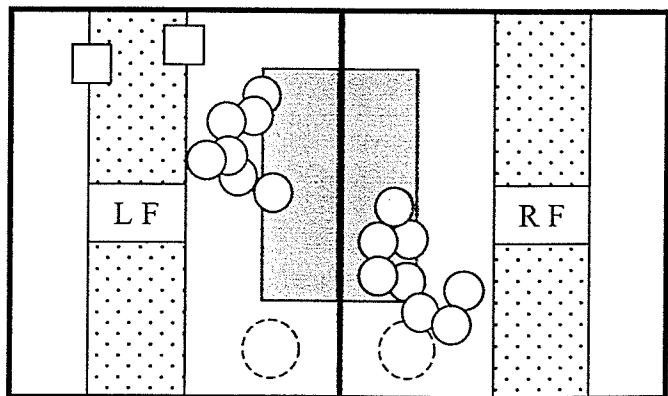
Crate: 11 Crate: 12

Time: 2:30 Time: 2:30



Crate: 11 Crate: 12

Time: 3:00 Time: 3:00



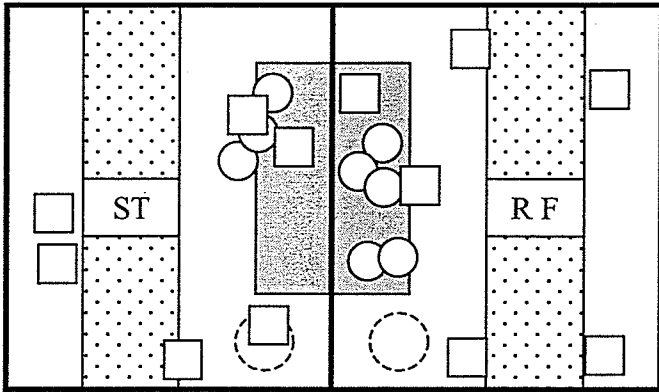
Crate: 11 Crate: 12

Time: 3:30 Time: 3:30

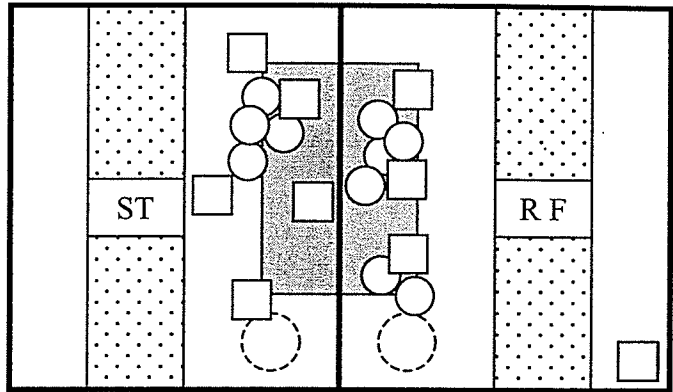
Behaviour Tests - Winter Farrowing 2000

Day 7 - Section C (Heat Lamps Off)

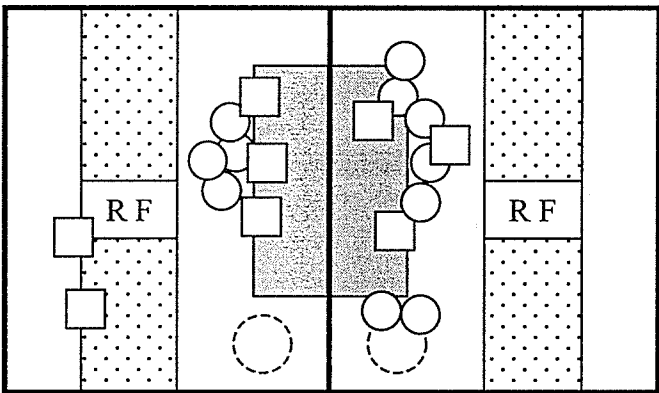
January 3, 2001



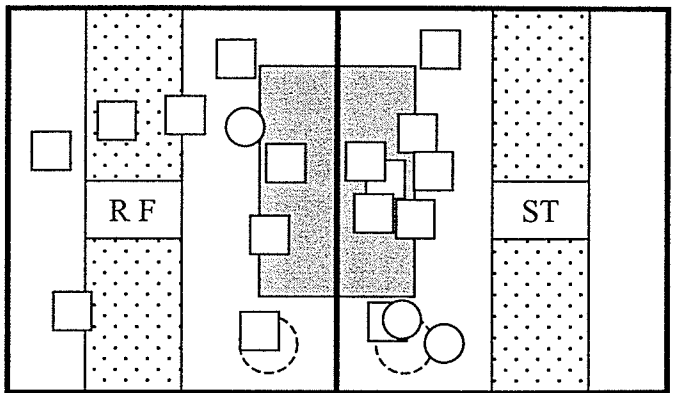
Crate: 23 Crate: 24
 Time: 1:00 Time: 1:00



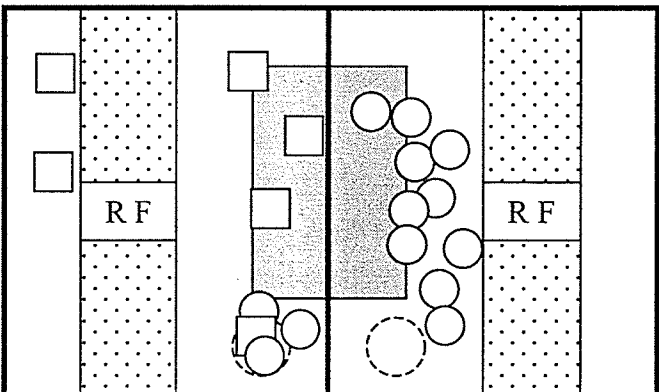
Crate: 23 Crate: 24
 Time: 1:30 Time: 1:30



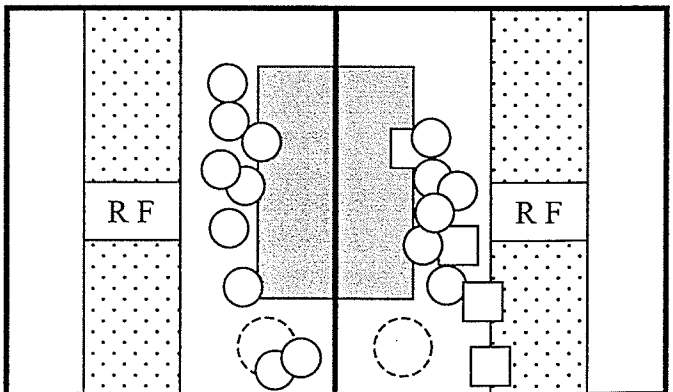
Crate: 23 Crate: 24
 Time: 2:00 Time: 2:00



Crate: 23 Crate: 24
 Time: 2:30 Time: 2:30

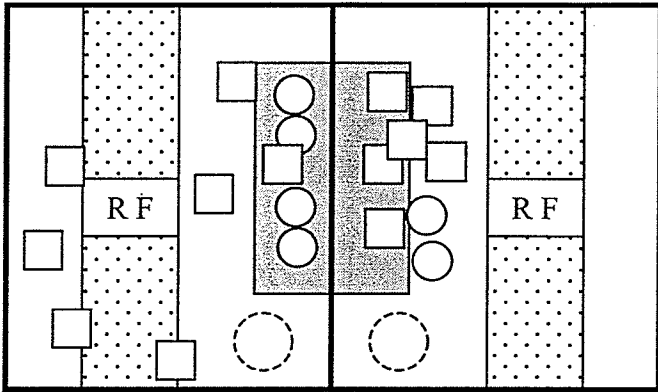


Crate: 23 Crate: 24
 Time: 3:00 Time: 3:00

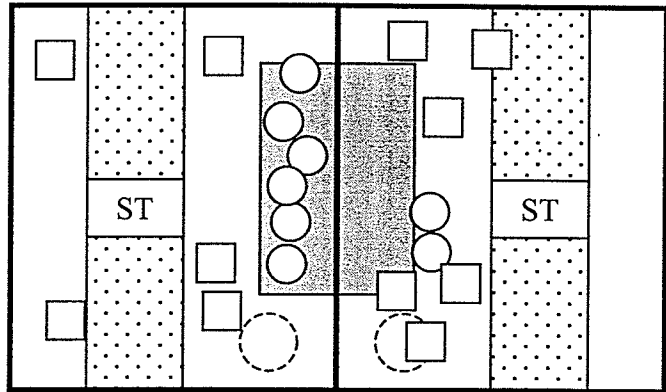


Crate: 23 Crate: 24
 Time: 3:30 Time: 3:30

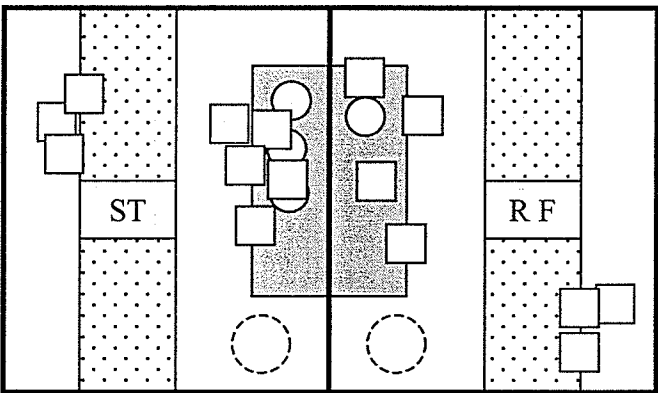
Behaviour Tests - Winter Farrowing 2000
 Day 7 - Section D (Heat Lamps Off)
 December 27, 2000



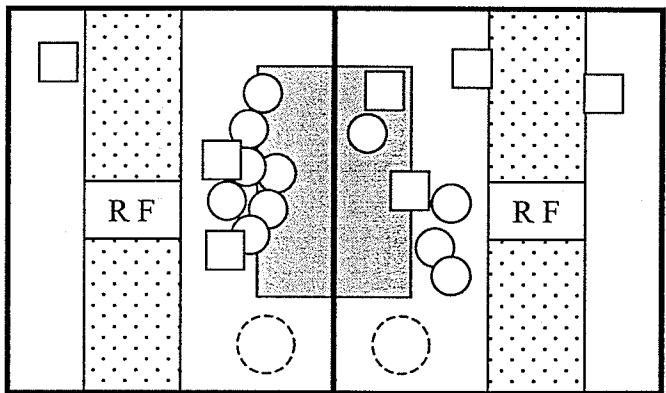
Crate: 33 Crate: 32
 Time: 1:00 Time: 1:00



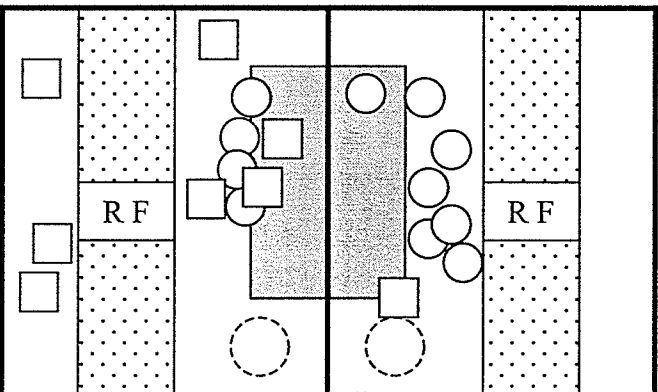
Crate: 33 Crate: 32
 Time: 1:30 Time: 1:30



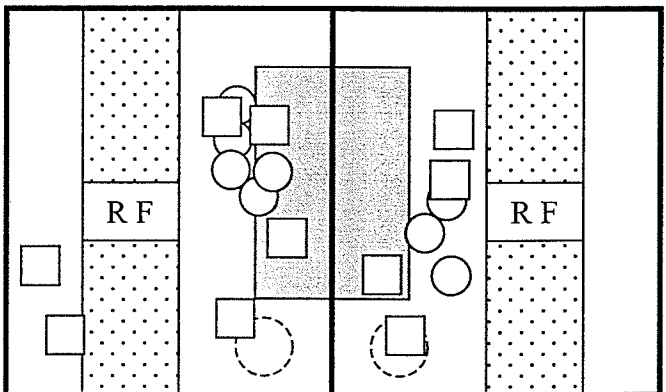
Crate: 33 Crate: 32
 Time: 2:00 Time: 2:00



Crate: 33 Crate: 32
 Time: 2:30 Time: 2:30



Crate: 33 Crate: 32
 Time: 3:00 Time: 3:00

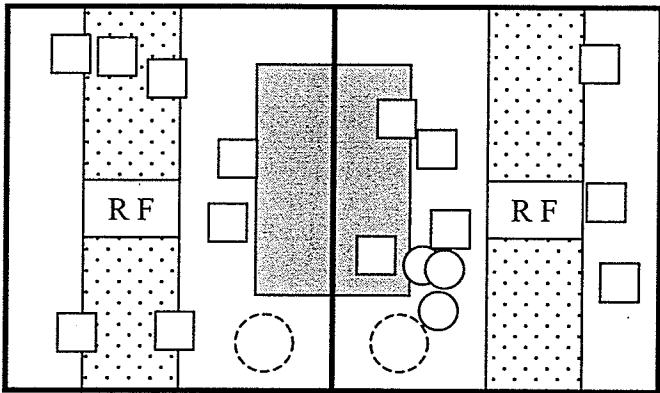


Crate: 33 Crate: 32
 Time: 3:30 Time: 3:30

Behaviour Tests - Winter Farrowing 2000

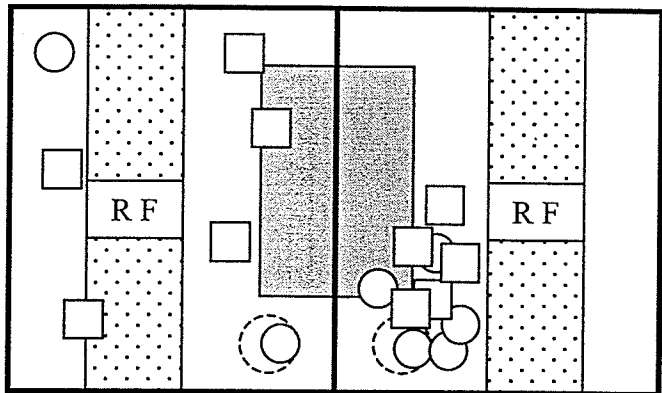
Day 16 - Section A (Heat Lamps Off)

January 3, 2001



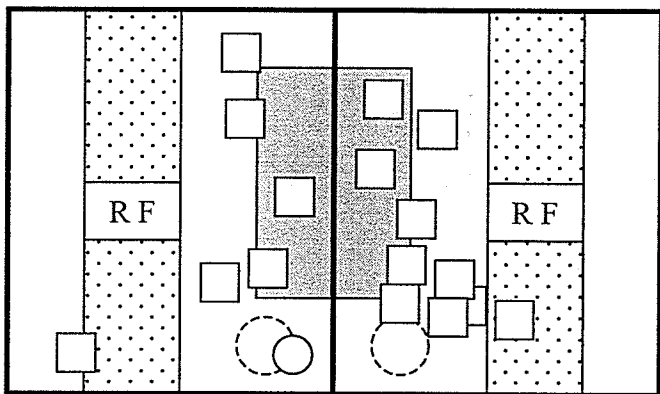
Crate: 5 Crate: 6

Time: 1:30 Time: 1:30



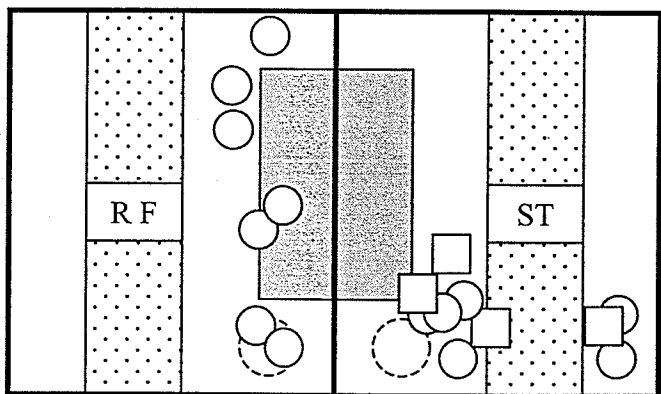
Crate: 5 Crate: 6

Time: 2:00 Time: 2:00



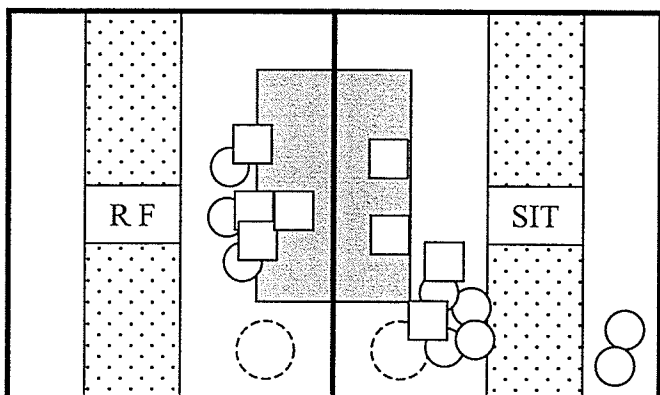
Crate: 5 Crate: 6

Time: 2:30 Time: 2:30



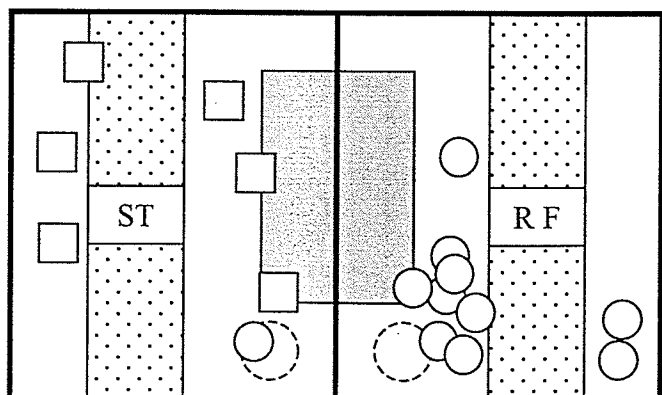
Crate: 5 Crate: 6

Time: 3:00 Time: 3:00



Crate: 5 Crate: 6

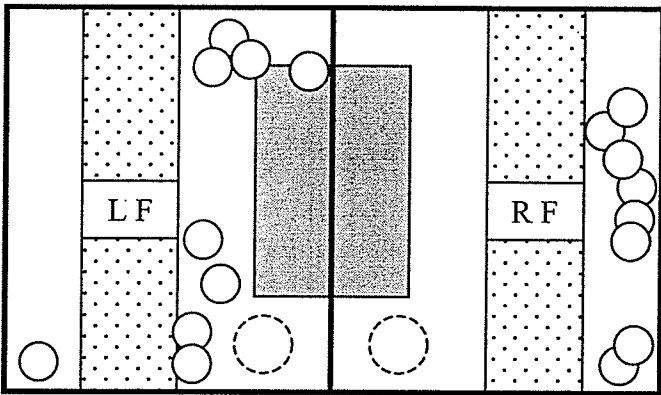
Time: 3:30 Time: 3:30



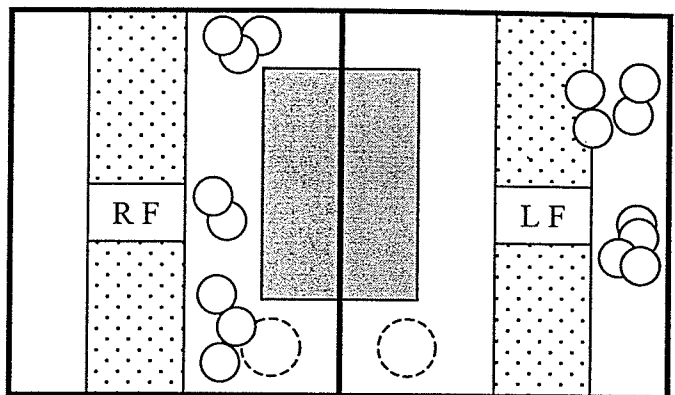
Crate: 5 Crate: 6

Time: 4:00 Time: 4:00

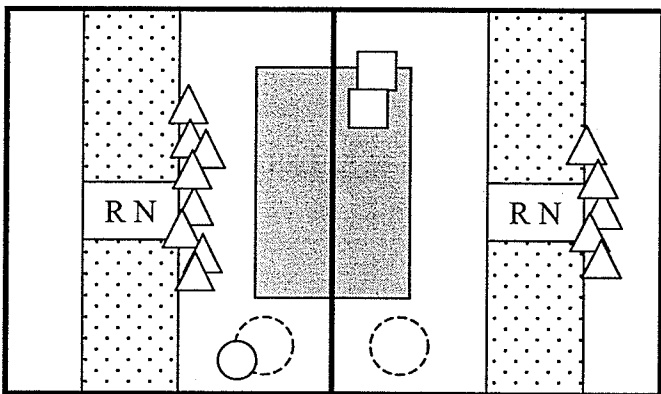
Behaviour Tests - Winter Farrowing 2000
 Day 16 - Section B (Heat Lamps Off)
 January 7, 2001



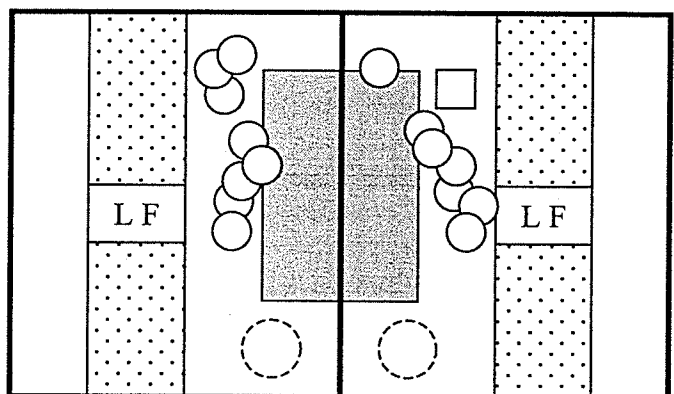
Crate: 11 Crate: 12
 Time: 9:30 Time: 9:30



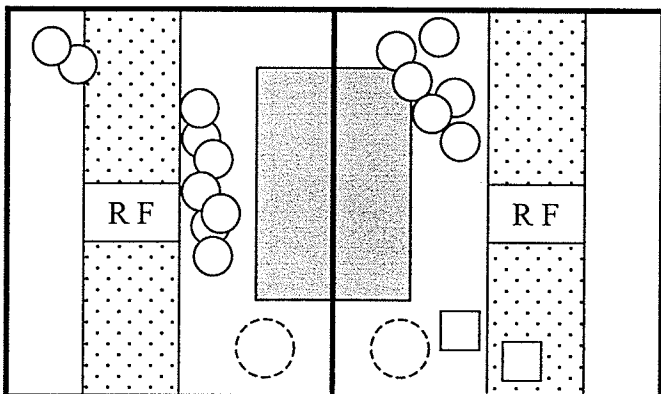
Crate: 11 Crate: 12
 Time: 10:00 Time: 10:00



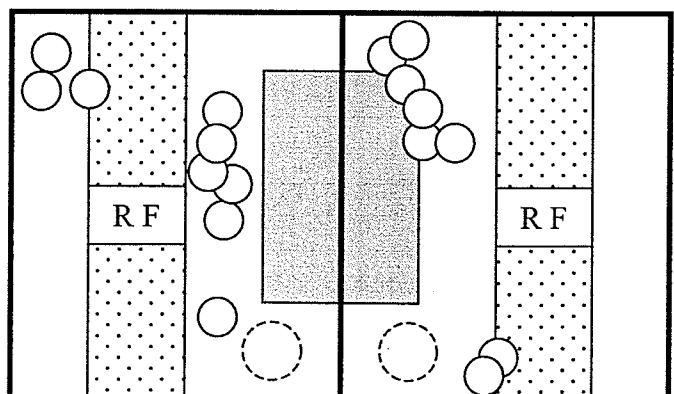
Crate: 11 Crate: 12
 Time: 10:30 Time: 10:30



Crate: 11 Crate: 12
 Time: 11:00 Time: 11:00

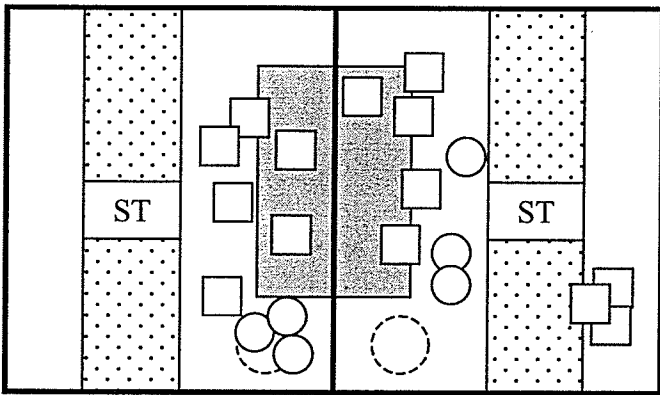


Crate: 11 Crate: 12
 Time: 11:30 Time: 11:30

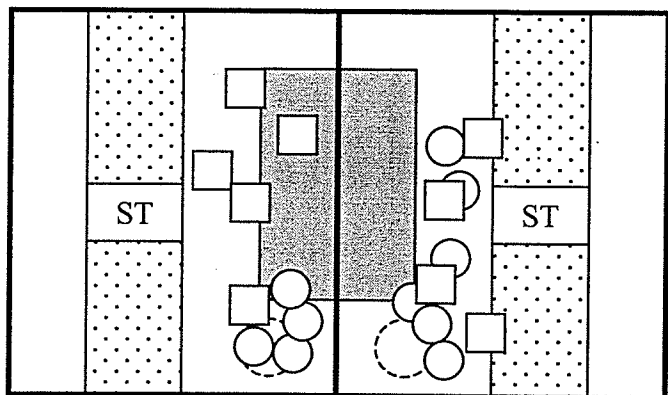


Crate: 11 Crate: 12
 Time: 12:00 Time: 12:00

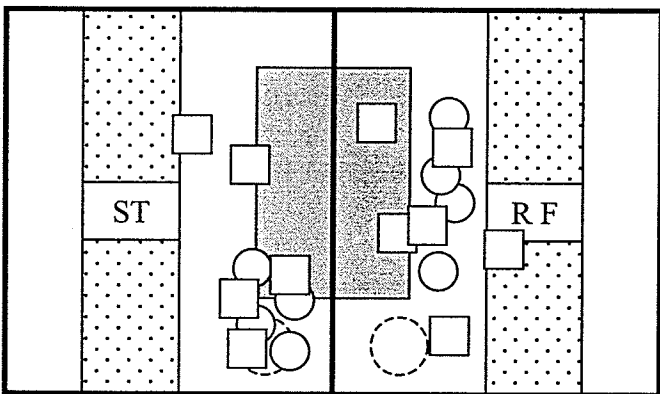
Behaviour Tests - Winter Farrowing 2000
 Day 16 - Section C (Heat Lamps Off)
 January 13, 2001



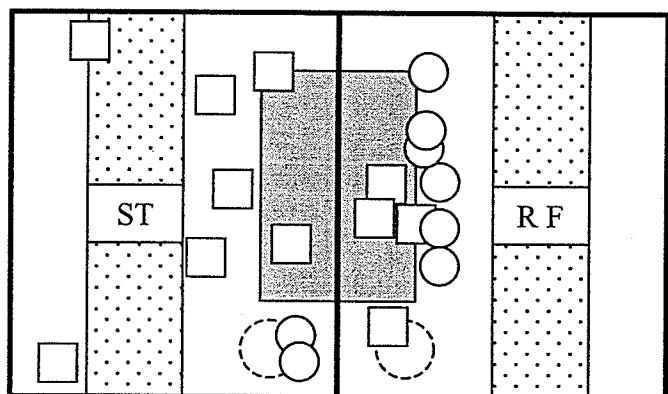
Crate: 23 Crate: 24
 Time: 9:00 Time: 9:00



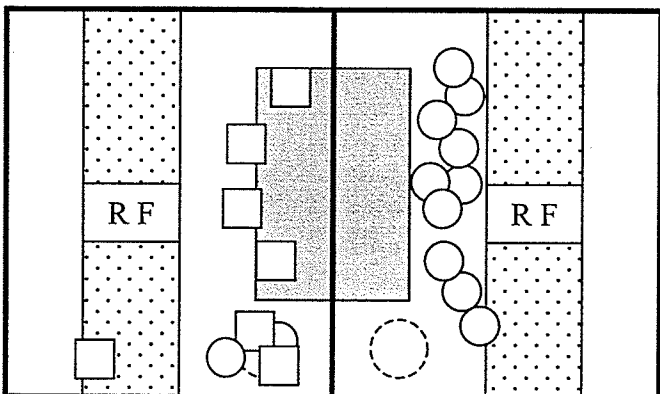
Crate: 23 Crate: 24
 Time: 9:30 Time: 9:30



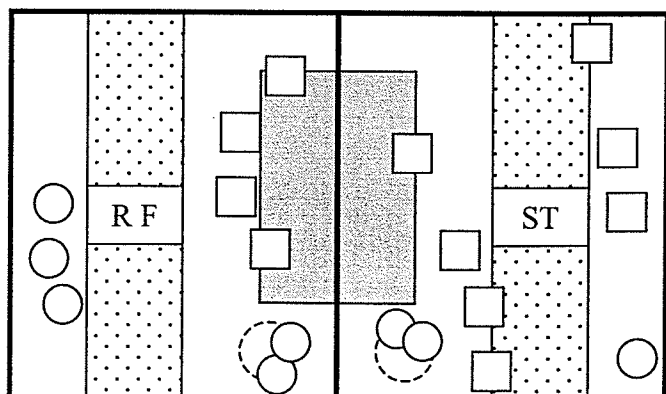
Crate: 23 Crate: 24
 Time: 10:00 Time: 10:00



Crate: 23 Crate: 24
 Time: 10:30 Time: 10:30



Crate: 23 Crate: 24
 Time: 11:00 Time: 11:00

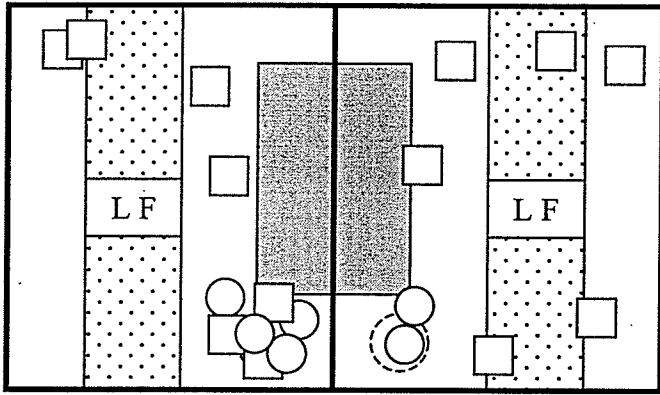


Crate: 23 Crate: 24
 Time: 11:30 Time: 11:30

Behaviour Tests - Winter Farrowing 2000

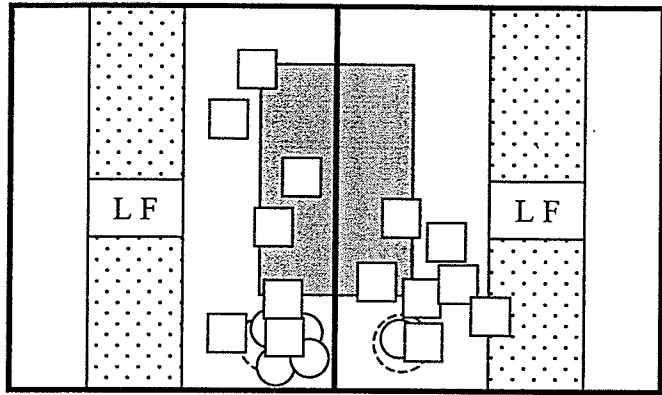
Day 16 - Section D (Heat Lamps Off)

January 5, 2001



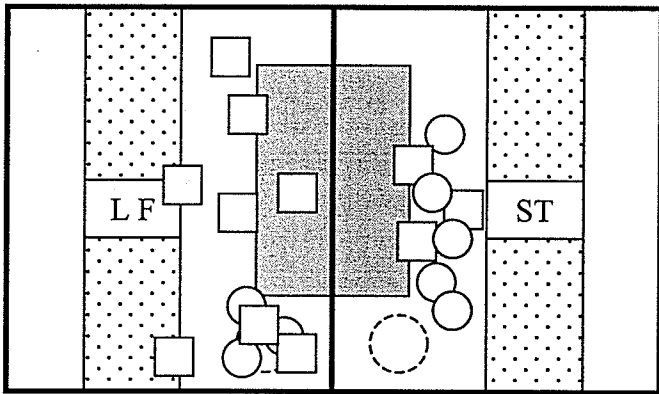
Crate: 33 Crate: 32

Time: 1:00 Time: 1:00



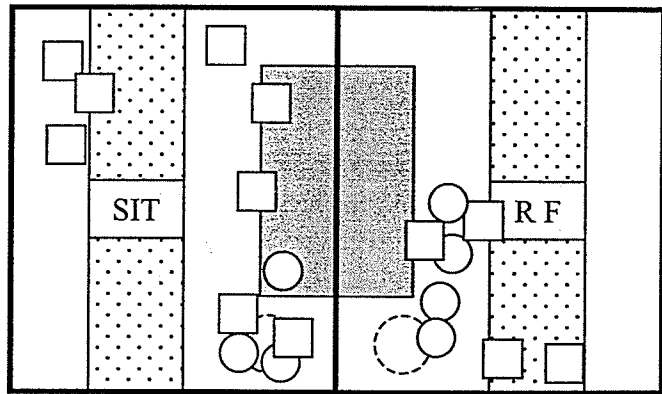
Crate: 33 Crate: 32

Time: 1:30 Time: 1:30



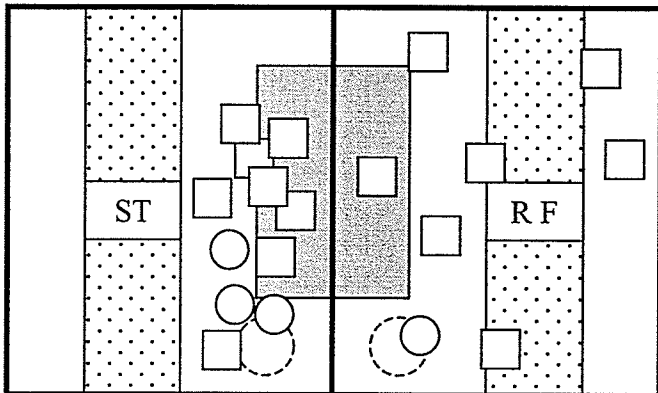
Crate: 33 Crate: 32

Time: 2:00 Time: 2:00



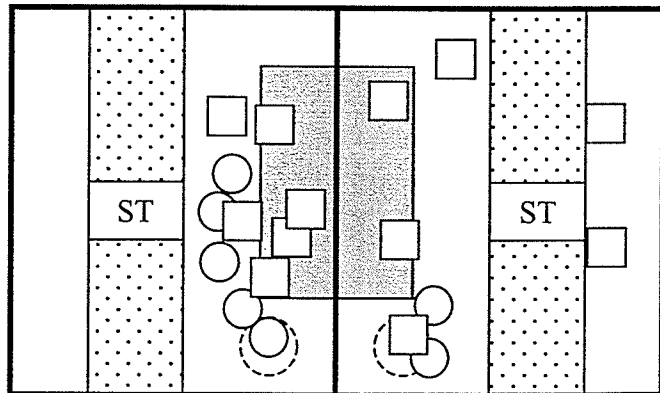
Crate: 33 Crate: 32

Time: 2:30 Time: 2:30



Crate: 33 Crate: 32

Time: 3:00 Time: 3:00



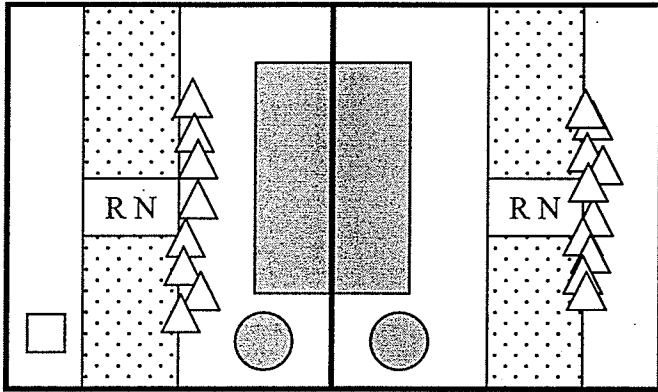
Crate: 33 Crate: 32

Time: 3:30 Time: 3:30

Behaviour Tests - Spring Farrowing 2001

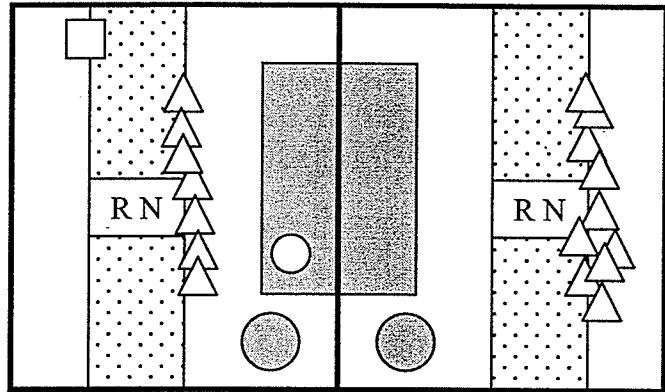
Day 1 - Section A (Heat Lamps On)

March 7-9, 2000



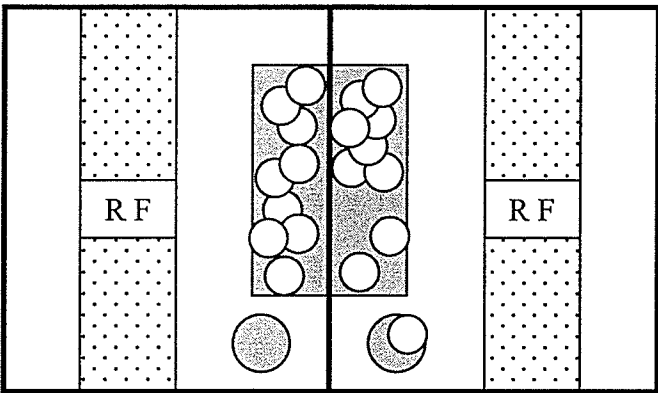
Crate: 1 Crate: 2

Time: 9:30 Time: 9:30



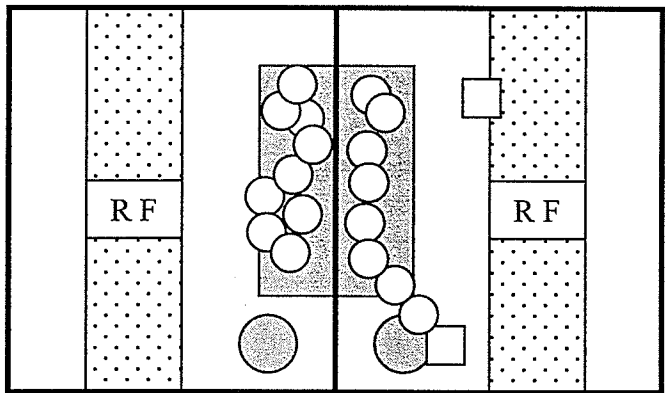
Crate: 1 Crate: 2

Time: 10:00 Time: 10:00



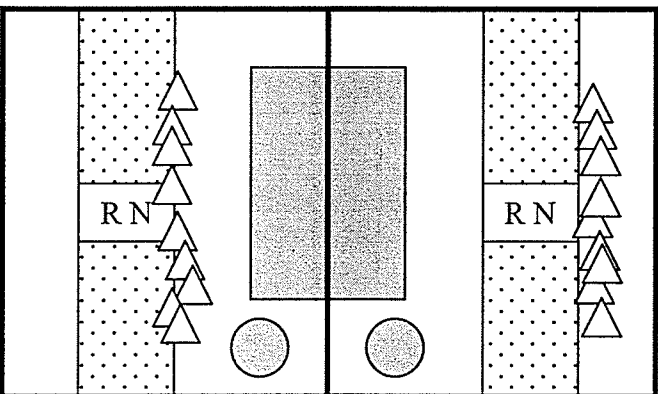
Crate: 1 Crate: 2

Time: 10:30 Time: 10:30



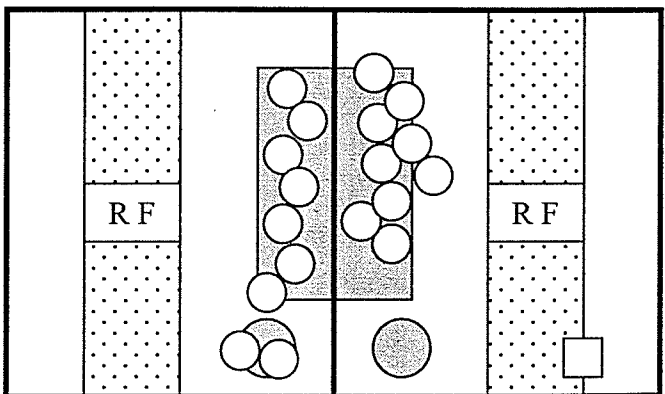
Crate: 1 Crate: 2

Time: 11:00 Time: 11:00



Crate: 1 Crate: 2

Time: 12:00 Time: 12:00



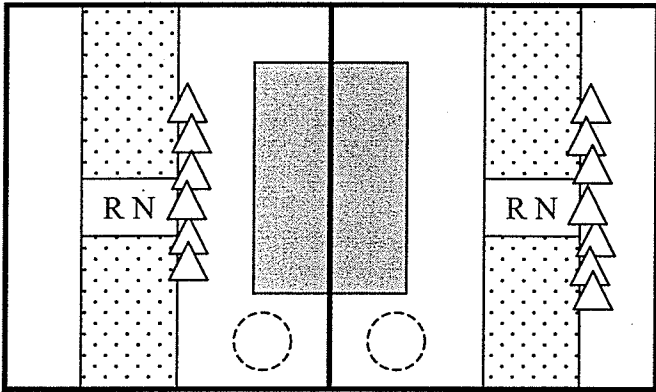
Crate: 1 Crate: 2

Time: 12:30 Time: 12:30

Behaviour Tests - Spring Farrowing 2001

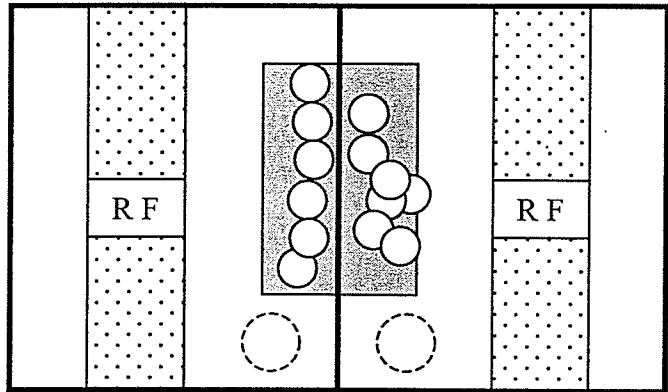
Day 1 - Section B (Heat Lamps Off)

March 17, 2001



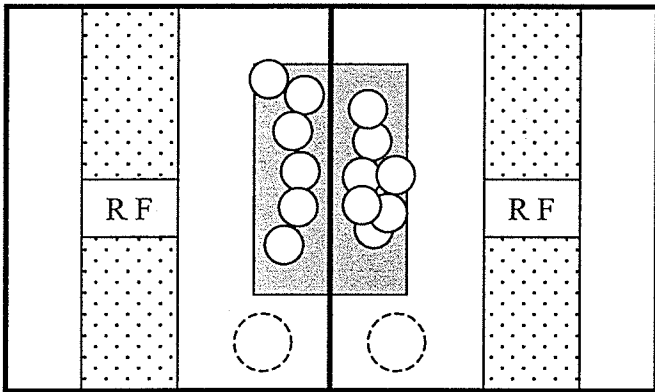
Crate: 11 Crate: 14

Time: 9:00 Time: 9:00



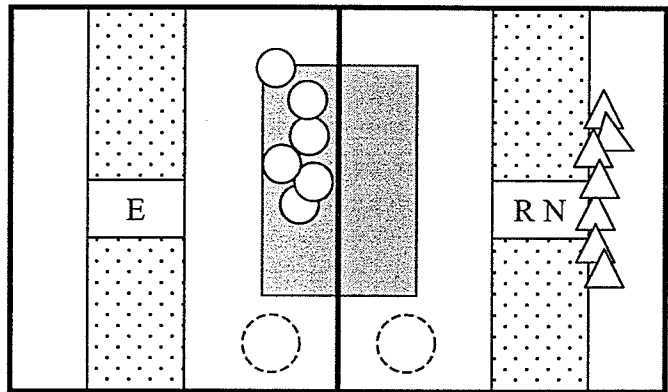
Crate: 11 Crate: 14

Time: 9:30 Time: 9:30



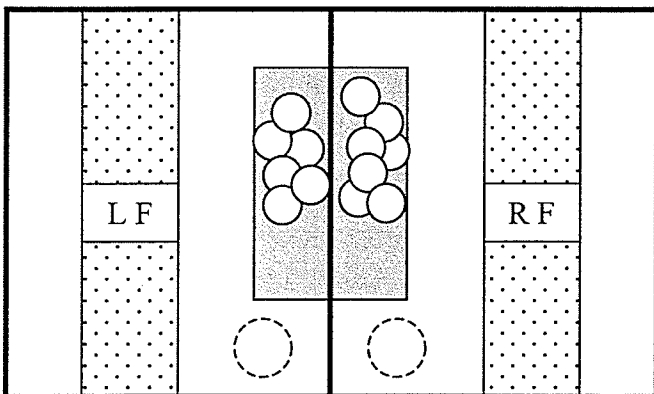
Crate: 11 Crate: 14

Time: 10:00 Time: 10:00



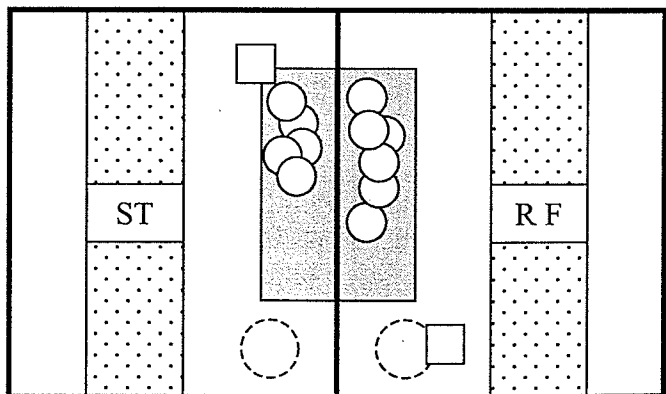
Crate: 11 Crate: 14

Time: 10:30 Time: 10:30



Crate: 11 Crate: 14

Time: 11:00 Time: 11:00



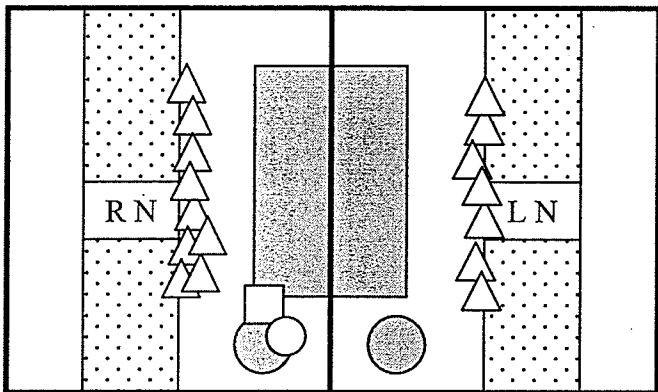
Crate: 11 Crate: 14

Time: 11:30 Time: 11:30

Behaviour Tests - Spring Farrowing 2001

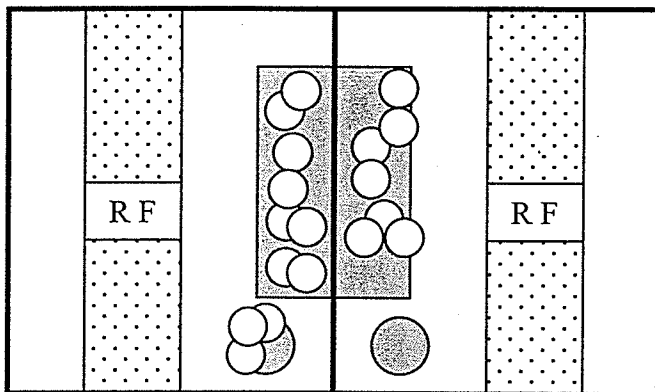
Day 1 - Section C (Heat Lamps On)

March 22, 2000



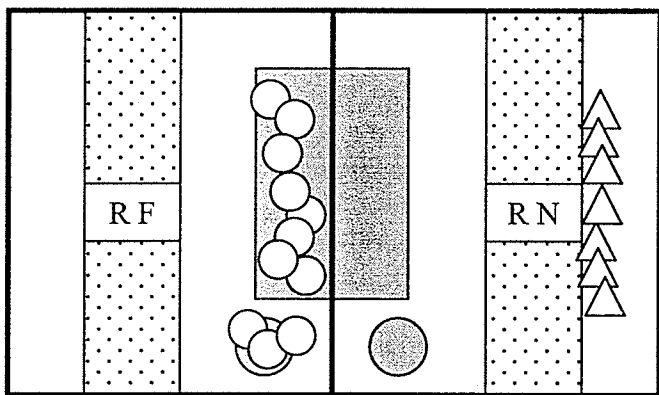
Crate: 19 Crate: 20

Time: 9:00 Time: 9:00



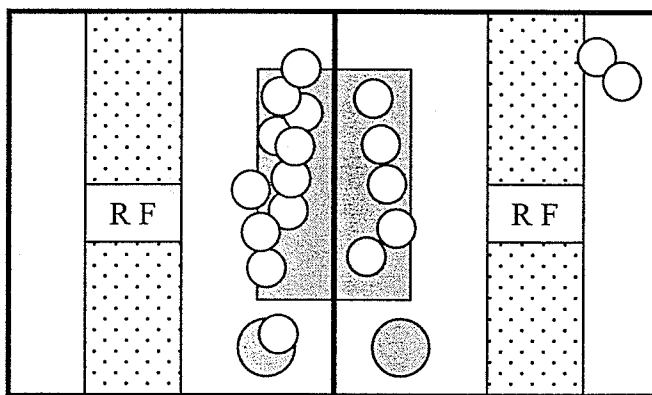
Crate: 19 Crate: 20

Time: 9:30 Time: 9:30



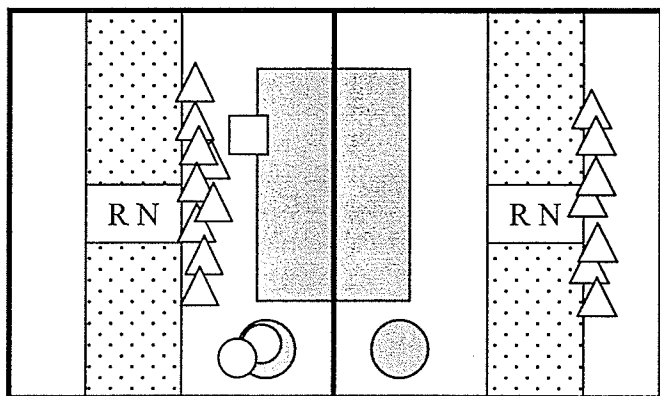
Crate: 19 Crate: 20

Time: 10:00 Time: 10:00



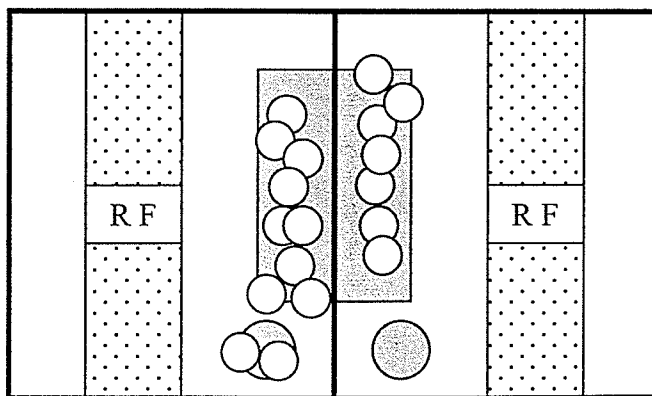
Crate: 19 Crate: 20

Time: 10:30 Time: 10:30



Crate: 19 Crate: 20

Time: 11:00 Time: 11:00



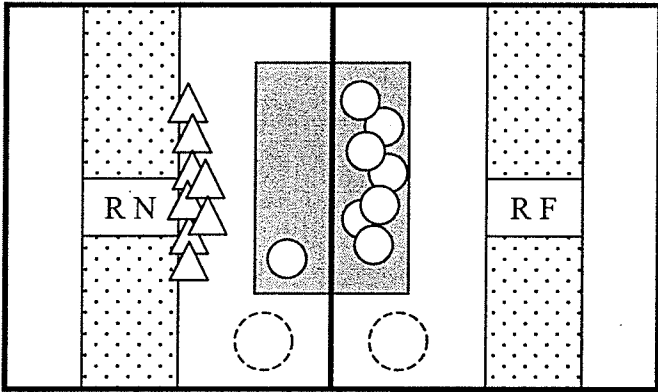
Crate: 19 Crate: 20

Time: 11:30 Time: 11:30

Behaviour Tests - Spring Farrowing 2001

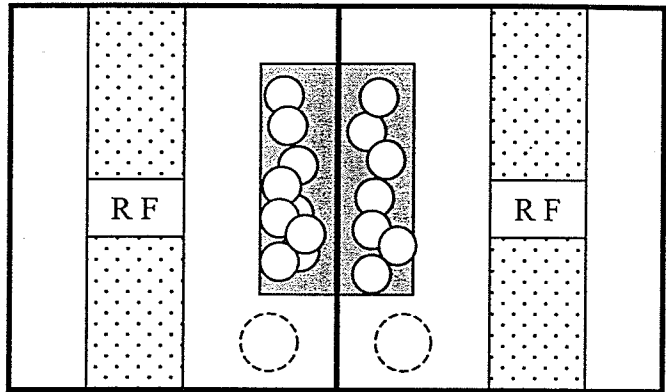
Day 1 - Section D (Heat Lamps Off)

March 9, 2001



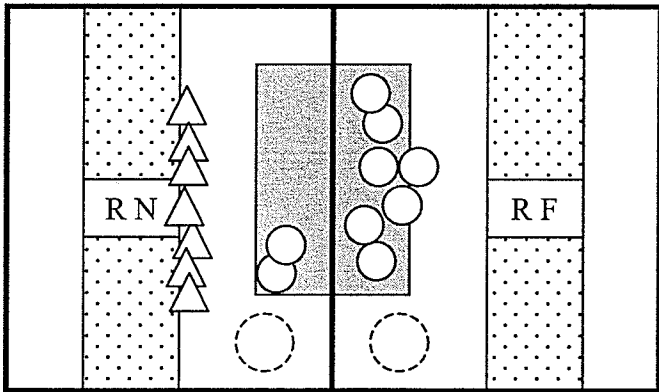
Crate: 35 Crate: 36

Time: 9:30 Time: 9:30



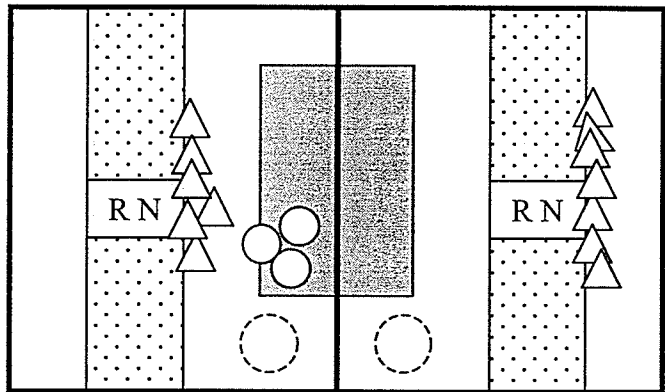
Crate: 35 Crate: 36

Time: 10:00 Time: 10:00



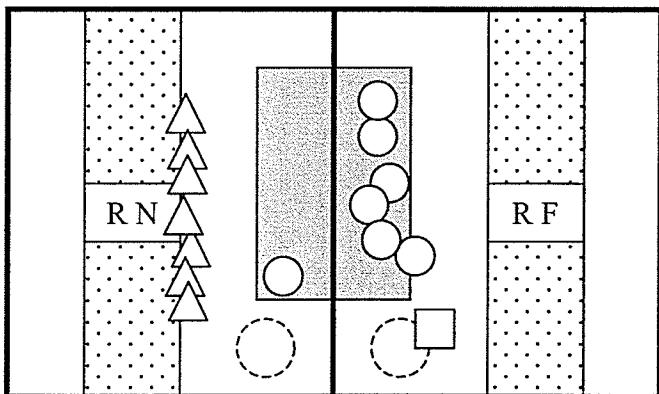
Crate: 35 Crate: 36

Time: 10:30 Time: 10:30



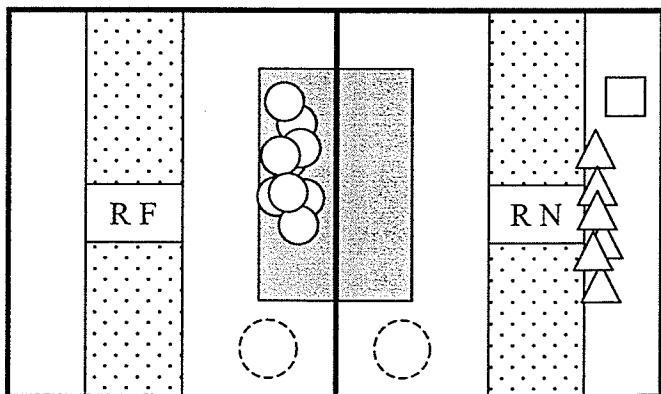
Crate: 35 Crate: 36

Time: 11:00 Time: 11:00



Crate: 35 Crate: 36

Time: 11:30 Time: 11:30



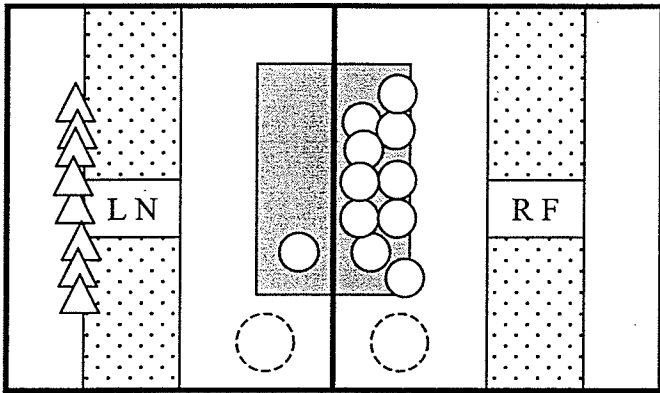
Crate: 35 Crate: 36

Time: 12:00 Time: 12:00

Behaviour Tests - Spring Farrowing 2001

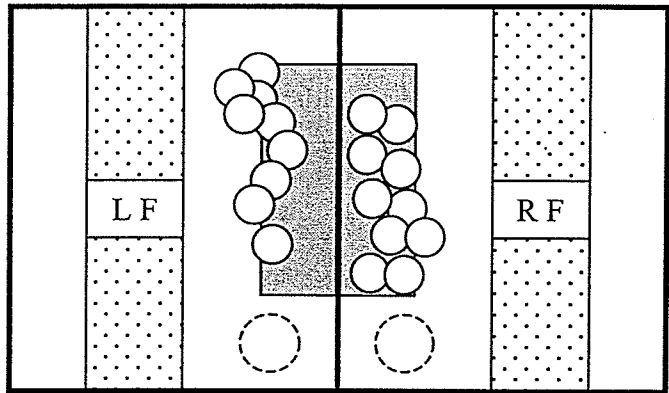
Day 3 - Section A (Heat Lamps Off)

March 10-12, 2001



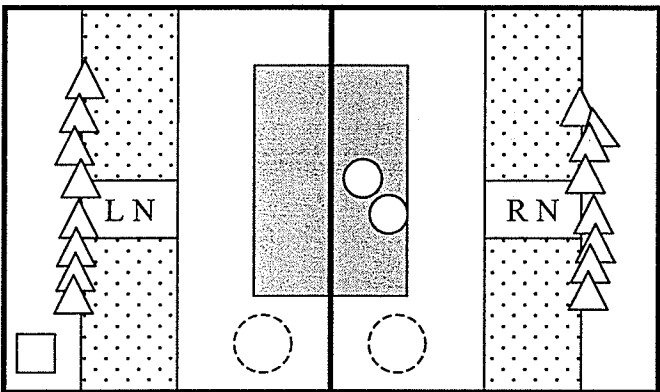
Crate: 1 Crate: 2

Time: 9:00 Time: 9:00



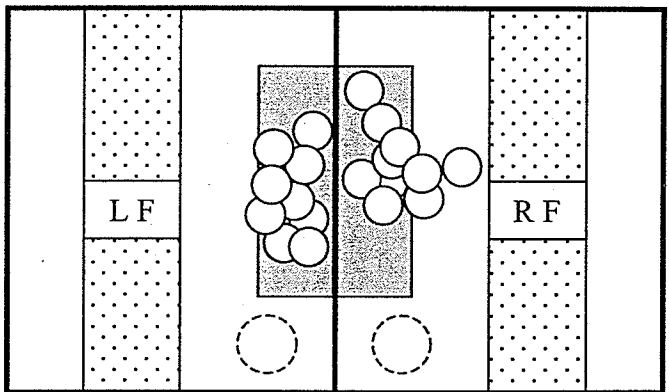
Crate: 1 Crate: 2

Time: 9:30 Time: 9:30



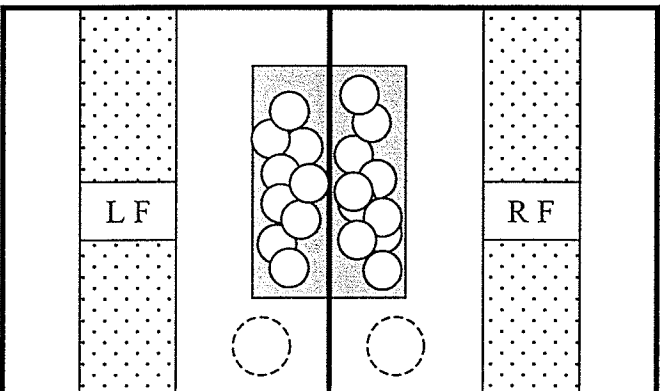
Crate: 1 Crate: 2

Time: 10:00 Time: 10:00



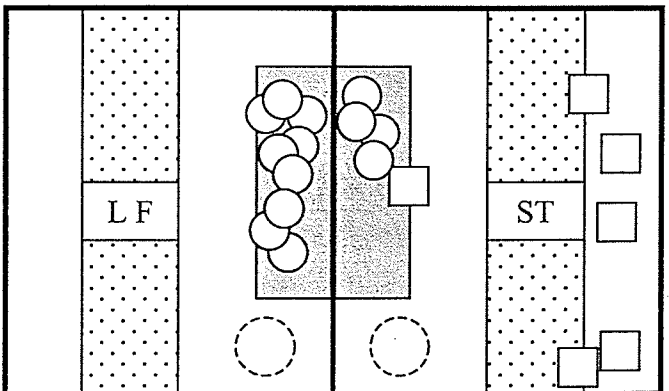
Crate: 1 Crate: 2

Time: 10:30 Time: 10:30



Crate: 1 Crate: 2

Time: 11:00 Time: 11:00



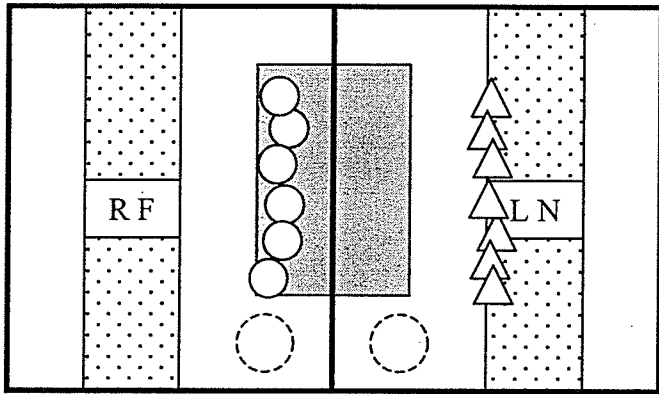
Crate: 1 Crate: 2

Time: 11:30 Time: 11:30

Behaviour Tests - Spring Farrowing 2001

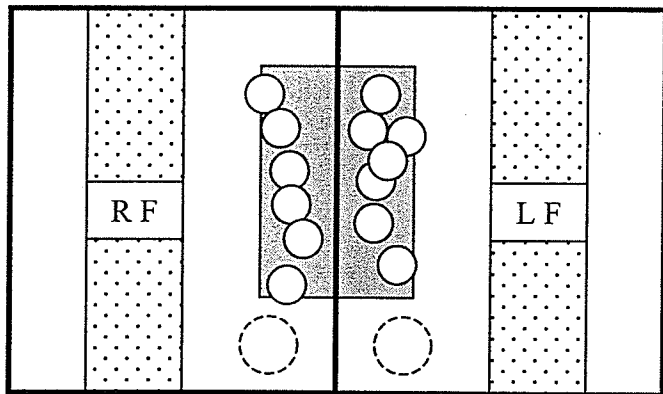
Day 3 - Section B (Heat Lamps Off)

March 20, 2001



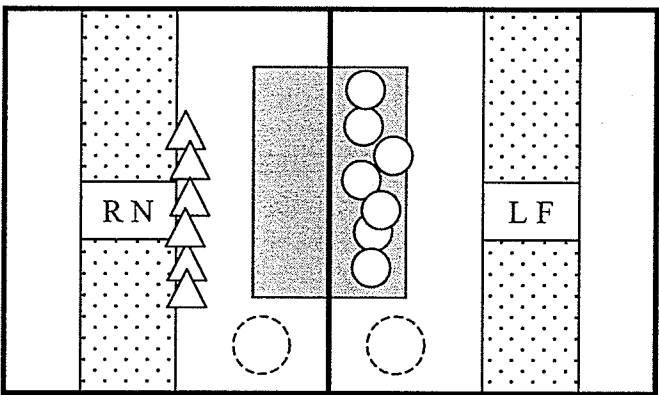
Crate: 11 Crate: 14

Time: 9:00 Time: 9:00



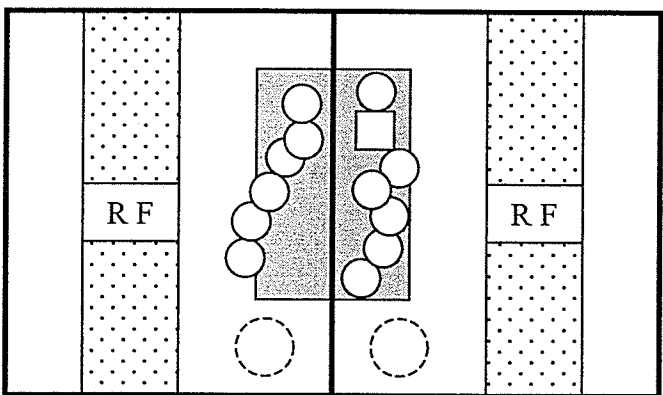
Crate: 11 Crate: 14

Time: 9:30 Time: 9:30



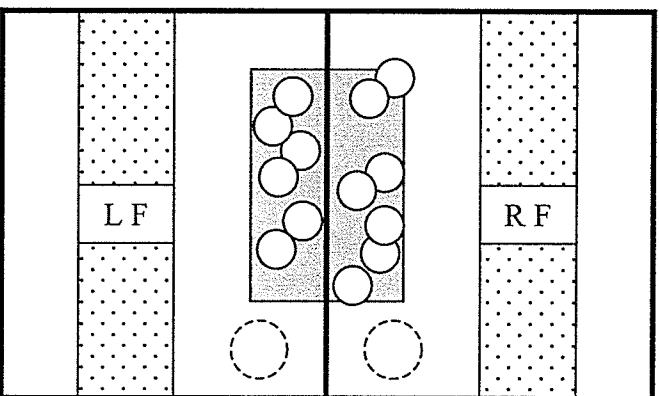
Crate: 11 Crate: 14

Time: 10:00 Time: 10:00



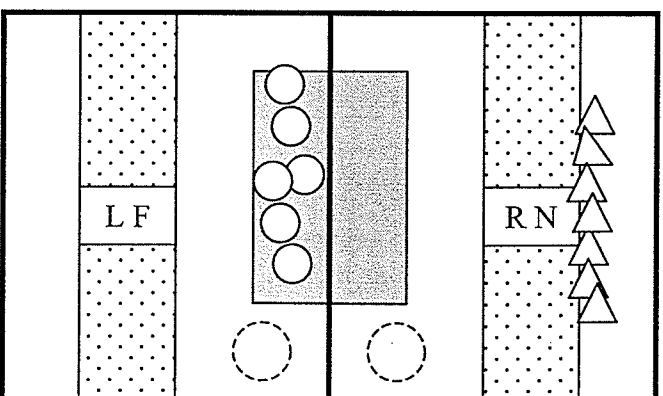
Crate: 11 Crate: 14

Time: 10:30 Time: 10:30



Crate: 11 Crate: 14

Time: 11:00 Time: 11:00



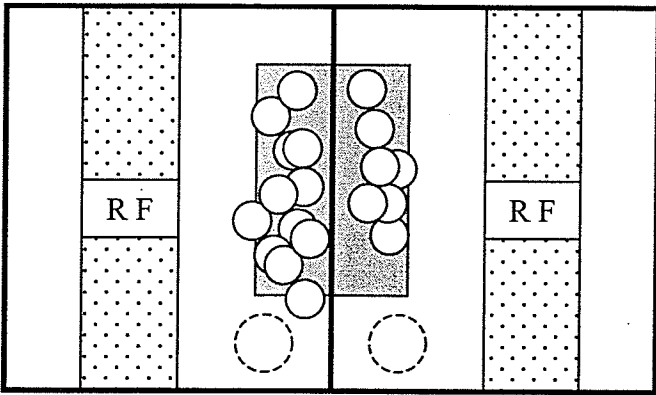
Crate: 11 Crate: 14

Time: 11:30 Time: 11:30

Behaviour Tests - Spring Farrowing 2001

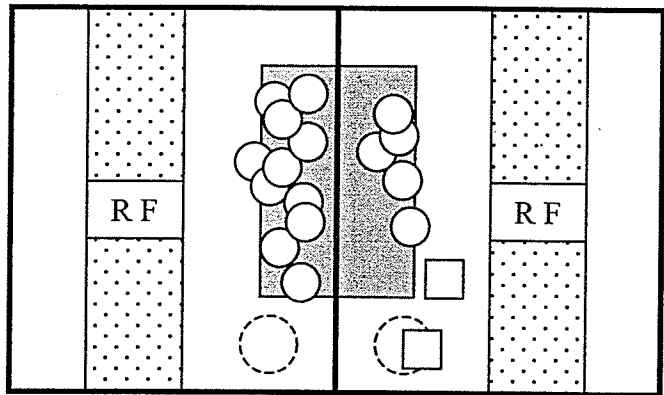
Day 3 - Section C (Heat Lamps Off)

March 25, 2001



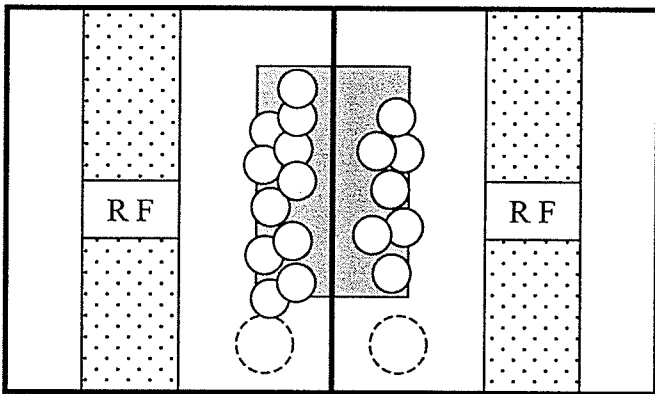
Crate: 19 Crate: 20

Time: 9:00 Time: 9:00



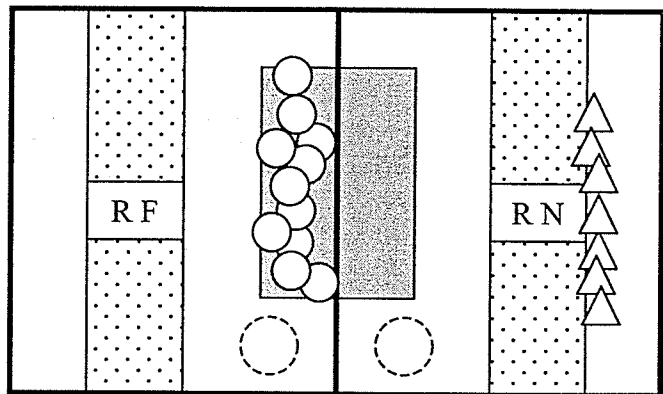
Crate: 19 Crate: 20

Time: 9:30 Time: 9:30



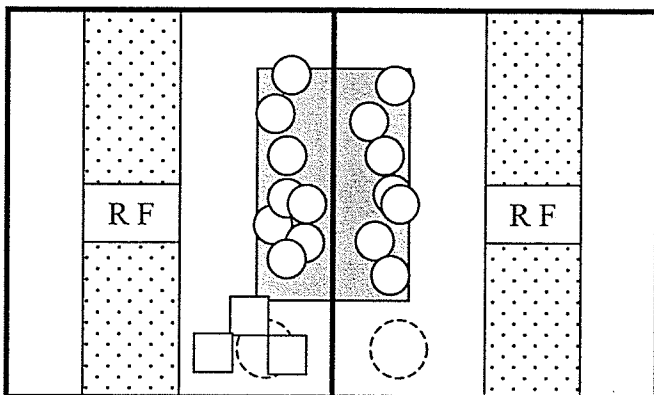
Crate: 19 Crate: 20

Time: 10:00 Time: 10:00



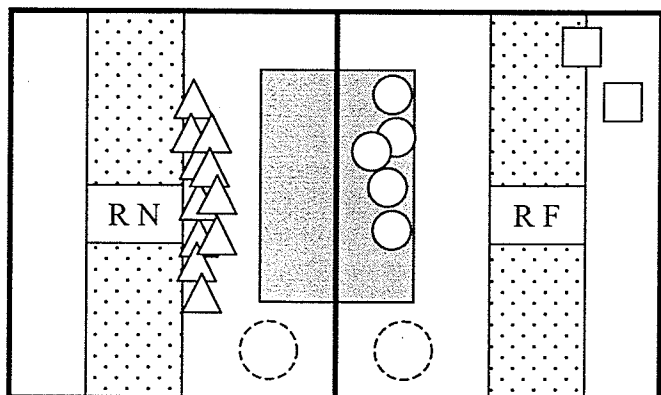
Crate: 19 Crate: 20

Time: 10:30 Time: 10:30



Crate: 19 Crate: 20

Time: 11:00 Time: 11:00



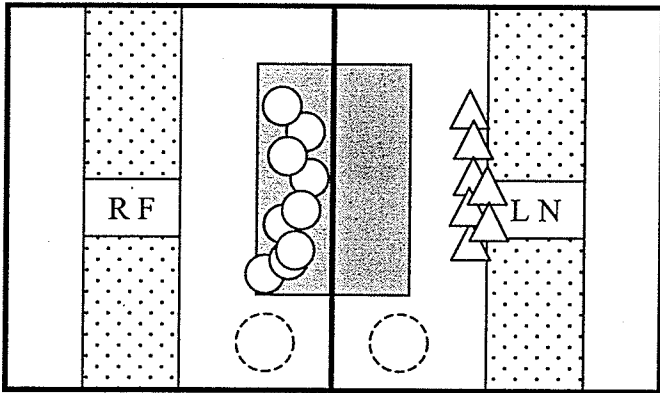
Crate: 19 Crate: 20

Time: 12:30 Time: 12:30

Behaviour Tests - Spring Farrowing 2001

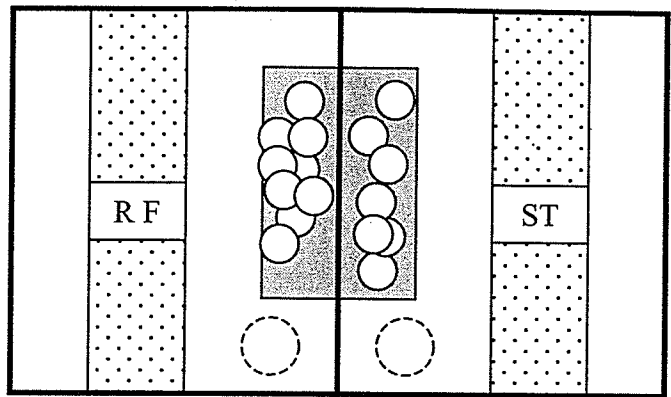
Day 3 - Section D (Heat Lamps Off)

March 12, 2001



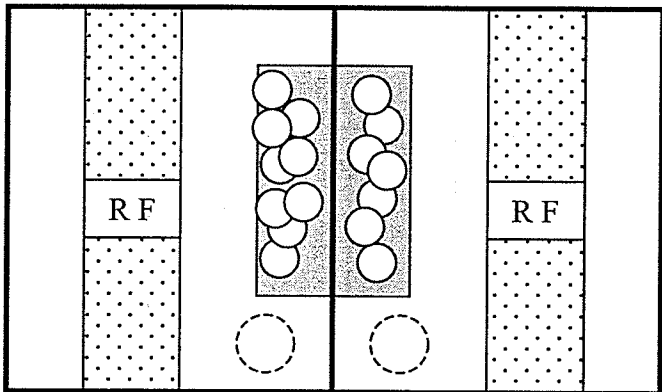
Crate: 35 Crate: 36

Time: 9:30 Time: 9:30



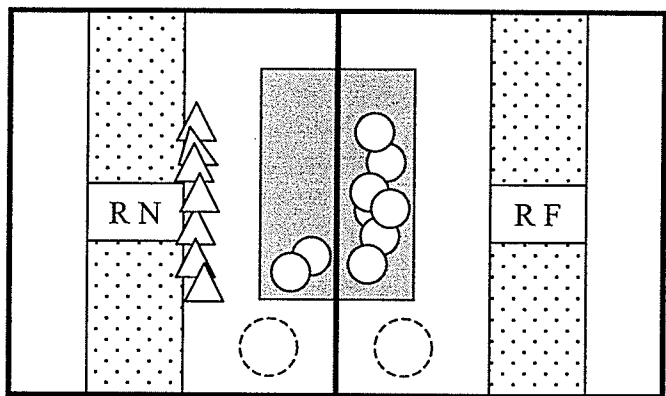
Crate: 35 Crate: 36

Time: 10:00 Time: 10:00



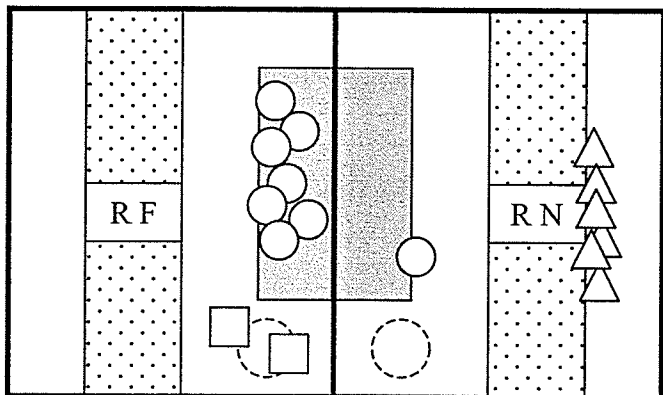
Crate: 35 Crate: 36

Time: 10:30 Time: 10:30



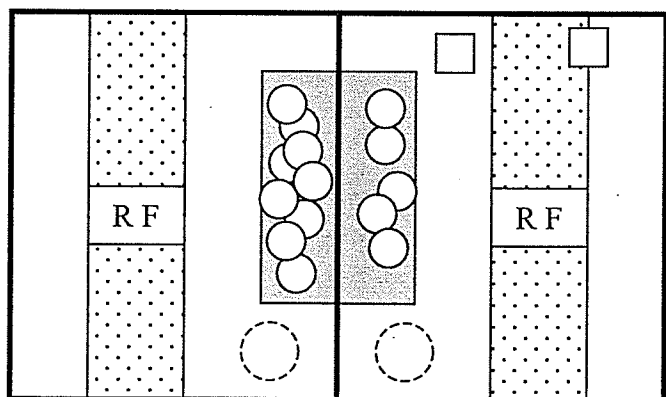
Crate: 35 Crate: 36

Time: 11:00 Time: 11:00



Crate: 35 Crate: 36

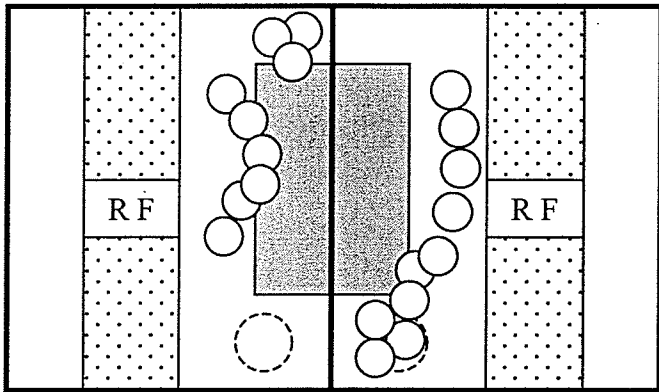
Time: 11:30 Time: 11:30



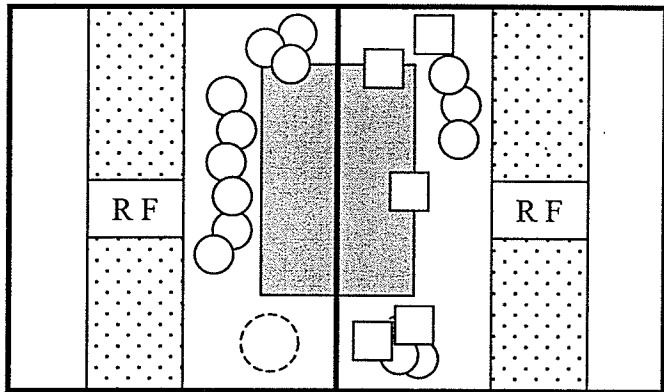
Crate: 35 Crate: 36

Time: 12:00 Time: 12:00

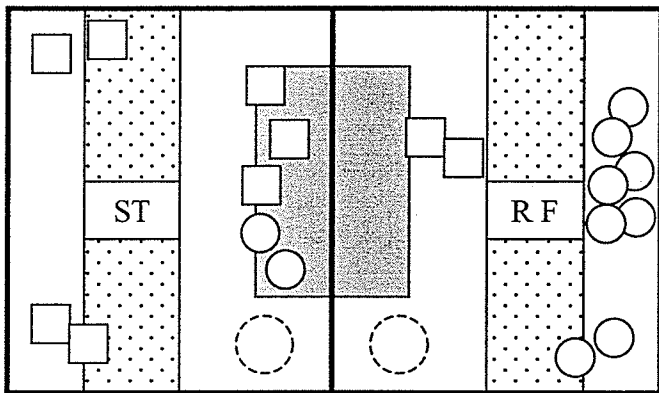
Behaviour Tests - Spring Farrowing 2001
 Day 7 - Section A (Heat Lamps Off)
 March 17-19, 2001



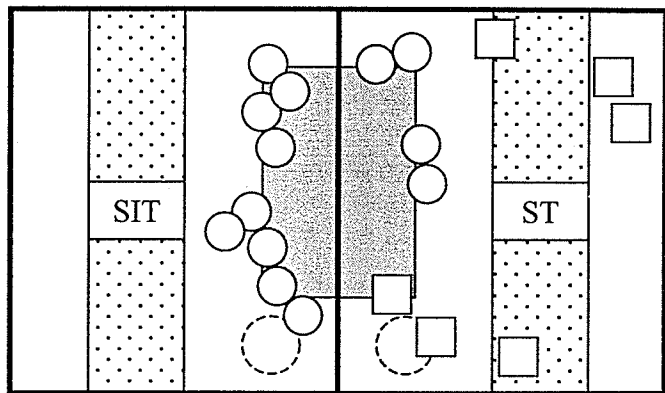
Crate: 1 Crate: 2
 Time: 9:30 Time: 9:30



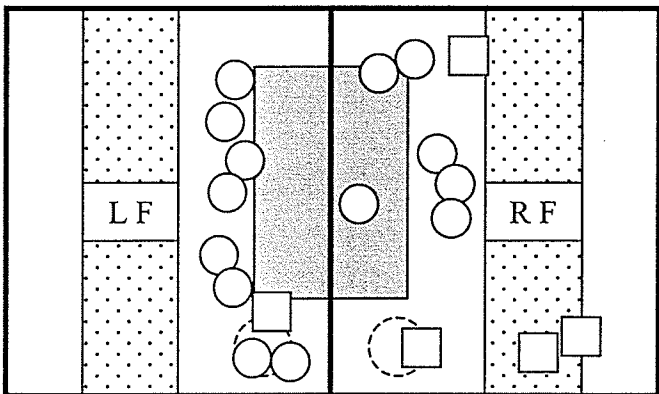
Crate: 1 Crate: 2
 Time: 10:00 Time: 10:00



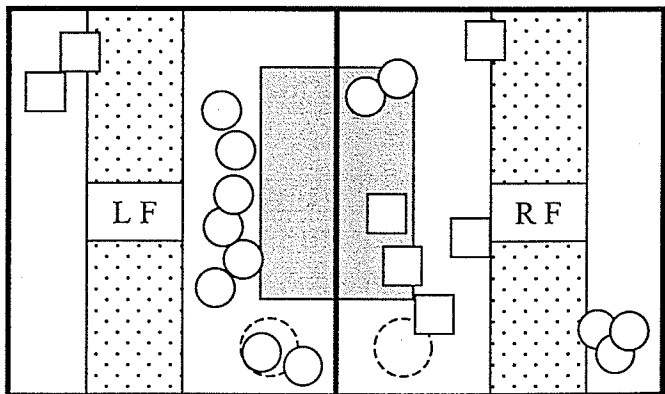
Crate: 1 Crate: 2
 Time: 10:30 Time: 10:30



Crate: 1 Crate: 2
 Time: 11:00 Time: 11:00



Crate: 1 Crate: 2
 Time: 11:30 Time: 11:30

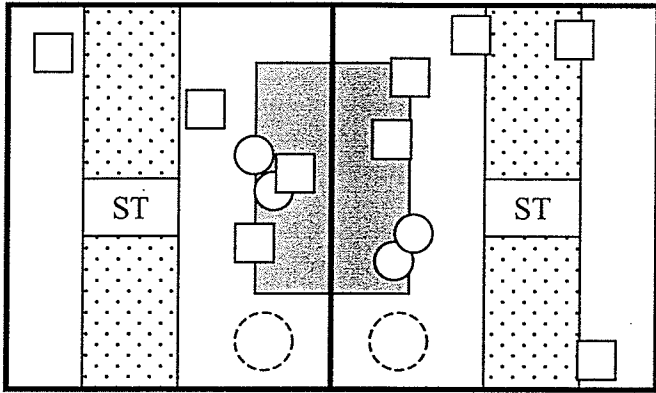


Crate: 1 Crate: 2
 Time: 12:00 Time: 12:00

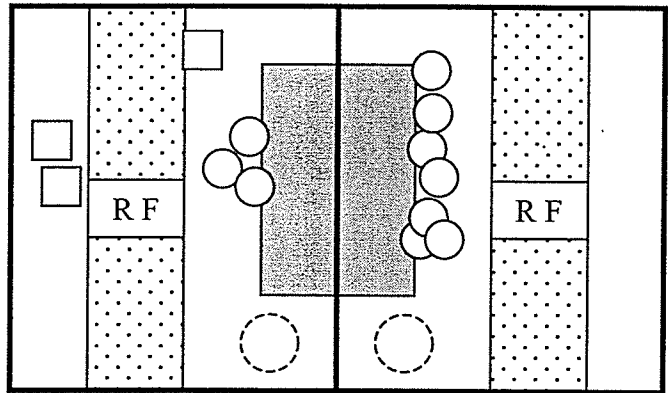
Behaviour Tests - Spring Farrowing 2001

Day 7 - Section B (Heat Lamps Off)

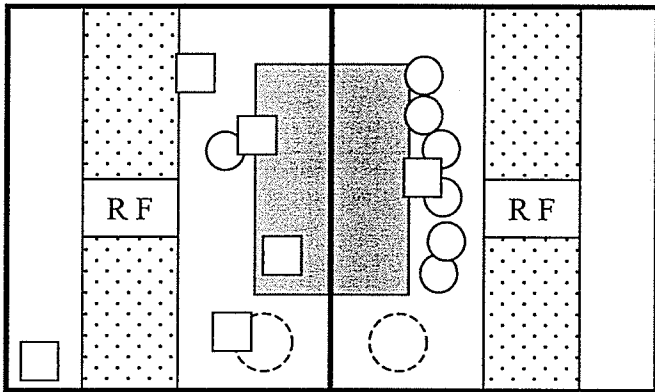
March 24, 2001



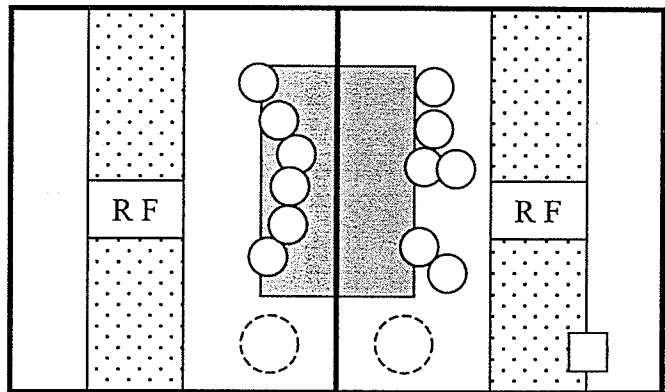
Crate: 11 Crate: 14
 Time: 1:00 Time: 1:00



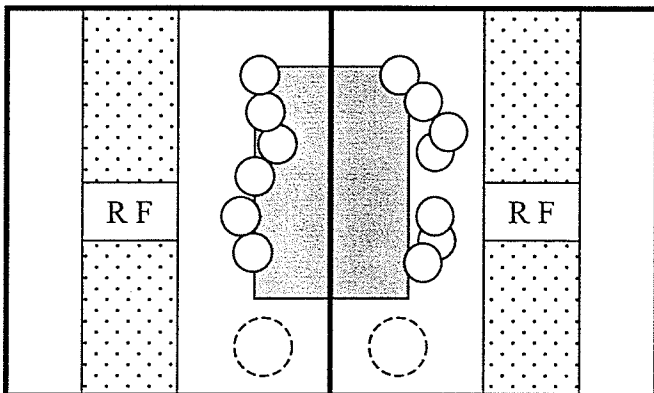
Crate: 11 Crate: 14
 Time: 1:30 Time: 1:30



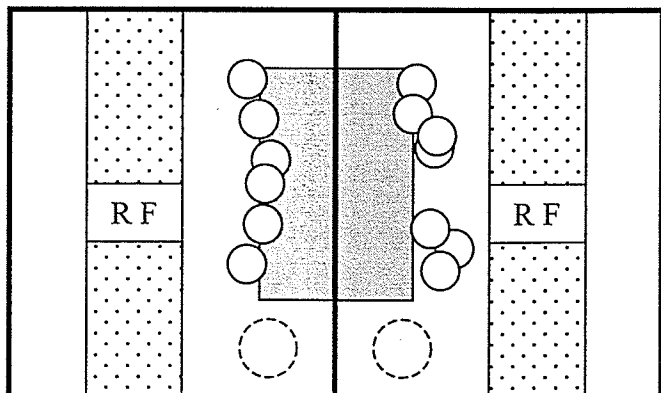
Crate: 11 Crate: 14
 Time: 2:00 Time: 2:00



Crate: 11 Crate: 14
 Time: 2:30 Time: 2:30



Crate: 11 Crate: 14
 Time: 3:00 Time: 3:00

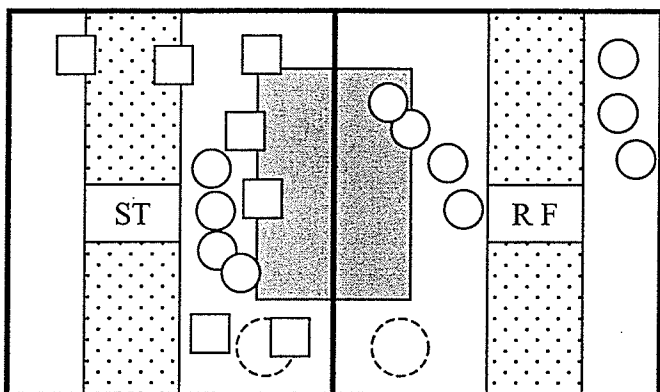


Crate: 11 Crate: 14
 Time: 3:30 Time: 3:30

Behaviour Tests - Spring Farrowing 2001

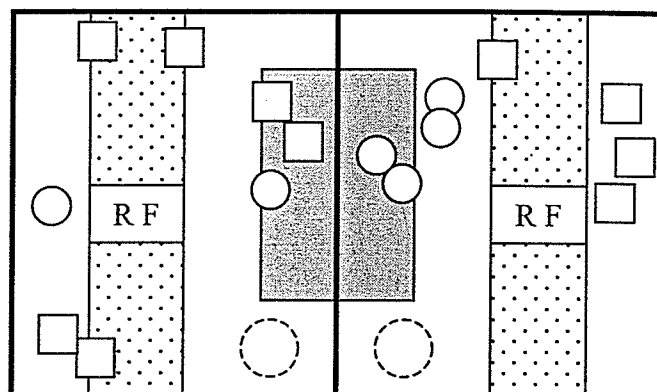
Day 7 - Section C (Heat Lamps Off)

March 29, 2001



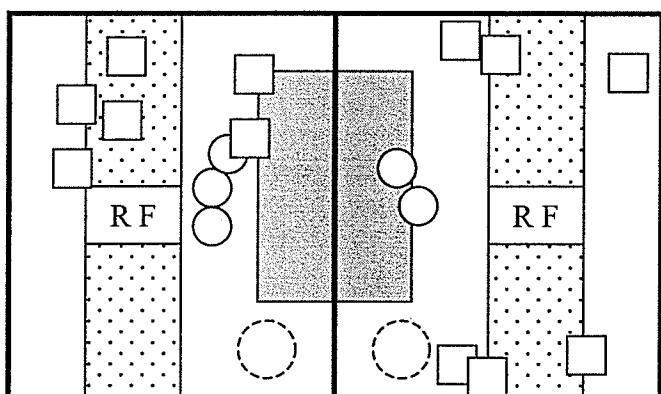
Crate: 19 Crate: 20

Time: 1:00 Time: 1:00



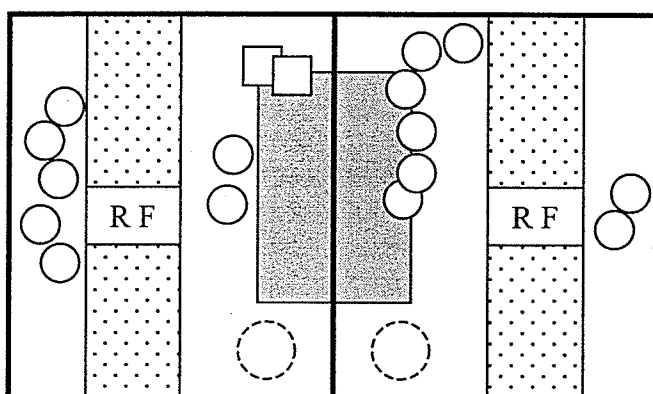
Crate: 19 Crate: 20

Time: 1:30 Time: 1:30



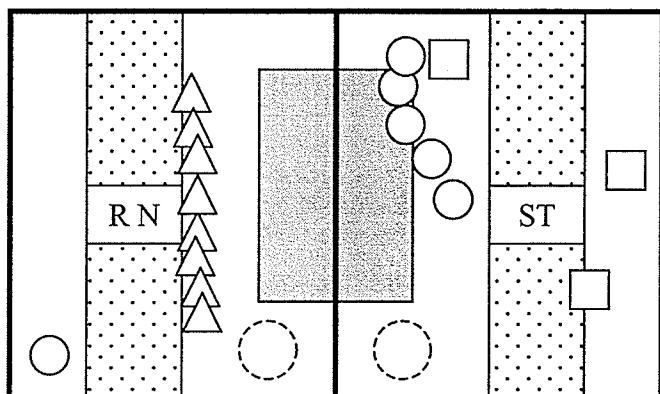
Crate: 19 Crate: 20

Time: 2:00 Time: 2:00



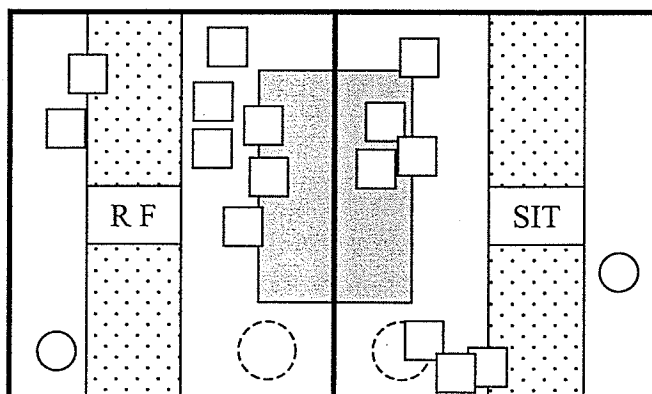
Crate: 19 Crate: 20

Time: 2:30 Time: 2:30



Crate: 19 Crate: 20

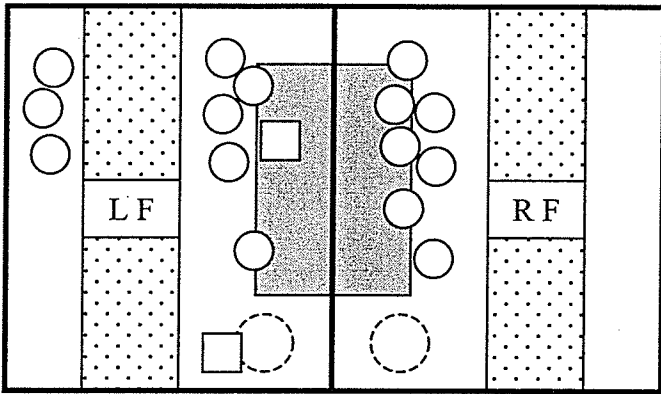
Time: 3:00 Time: 3:00



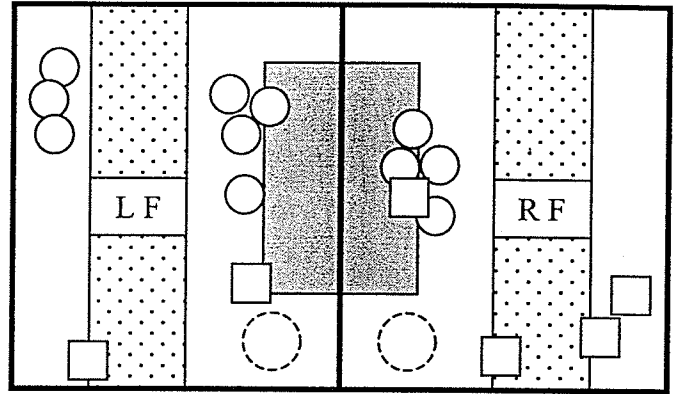
Crate: 19 Crate: 20

Time: 3:30 Time: 3:30

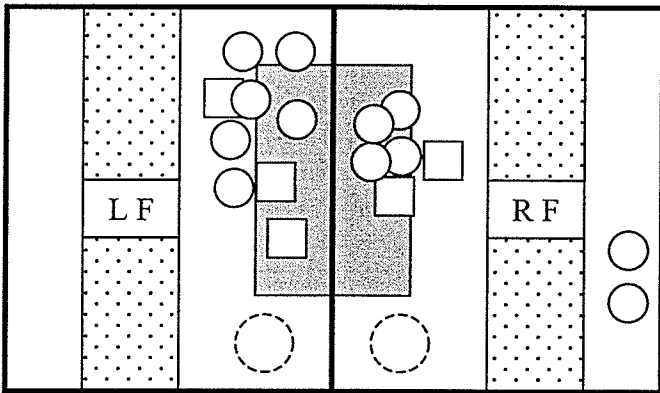
Behaviour Tests - Spring Farrowing 2001
 Day 7 - Section D (Heat Lamps Off)
 March 16, 2001



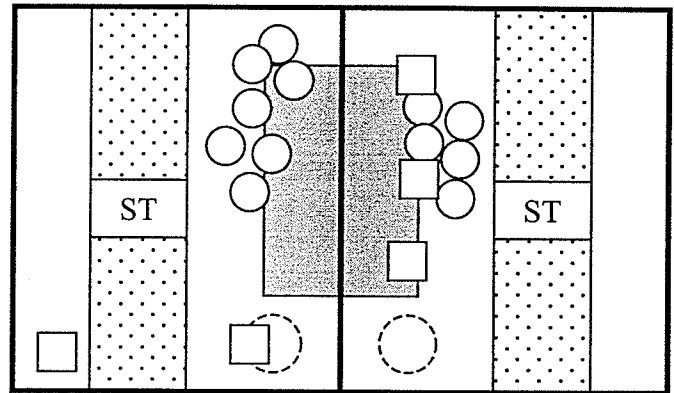
Crate: 35 Crate: 36
 Time: 9:30 Time: 9:30



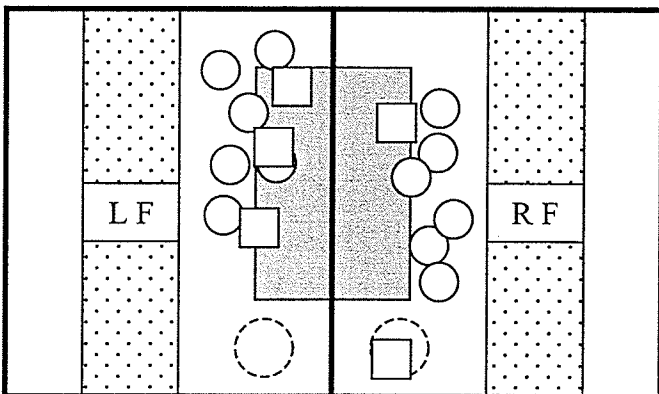
Crate: 35 Crate: 36
 Time: 10:00 Time: 10:00



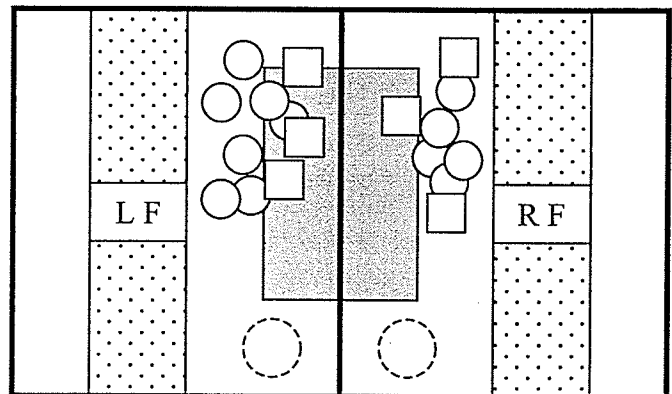
Crate: 35 Crate: 36
 Time: 10:30 Time: 10:30



Crate: 35 Crate: 36
 Time: 11:00 Time: 11:00



Crate: 35 Crate: 36
 Time: 11:30 Time: 11:30

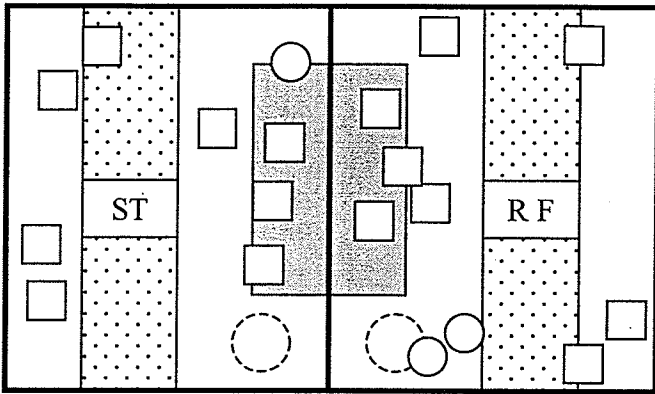


Crate: 35 Crate: 36
 Time: 12:00 Time: 12:00

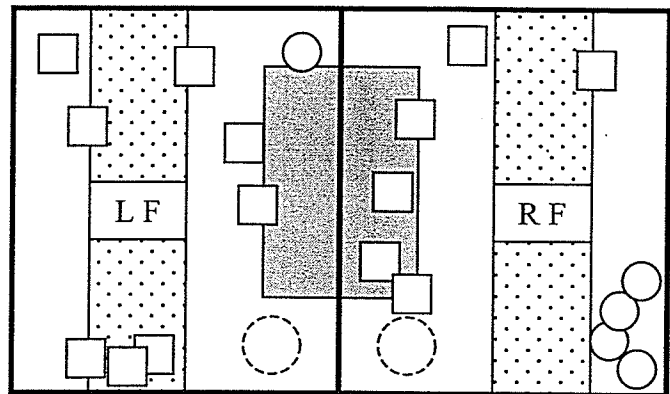
Behaviour Tests - Spring Farrowing 2001

Day 16 - Section A (Heat Lamps Off)

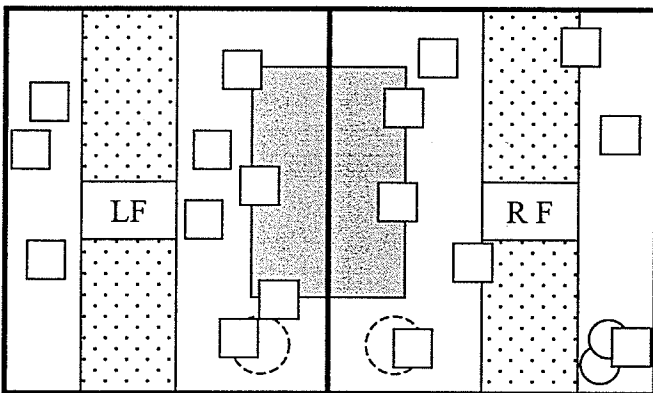
March 23-25, 2001



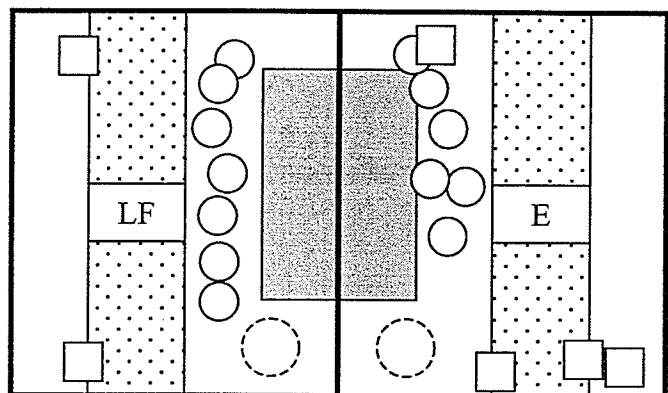
Crate: 1 Crate: 2
 Time: 1:30 Time: 1:30



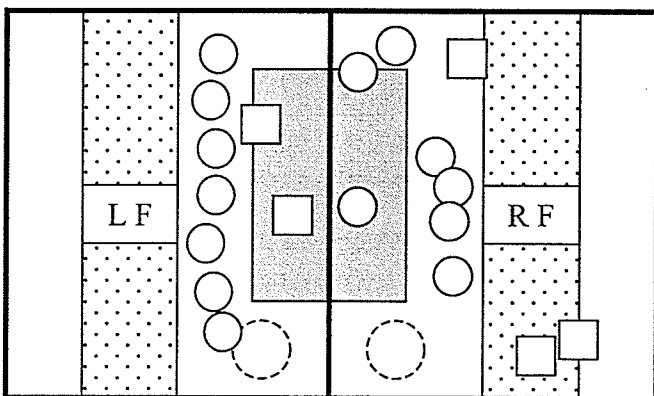
Crate: 1 Crate: 2
 Time: 2:00 Time: 2:00



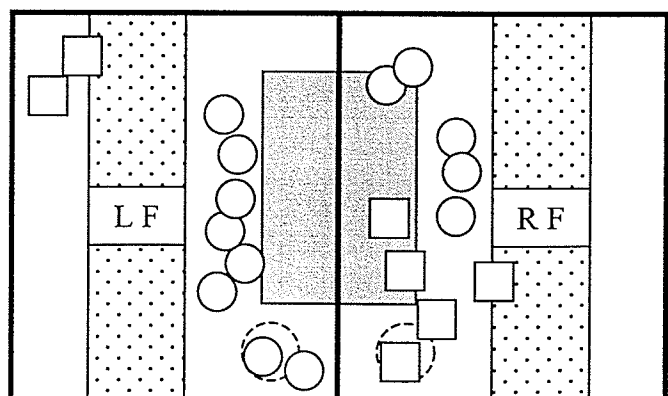
Crate: 1 Crate: 2
 Time: 2:30 Time: 2:30



Crate: 1 Crate: 2
 Time: 3:00 Time: 3:00



Crate: 1 Crate: 2
 Time: 3:30 Time: 3:30

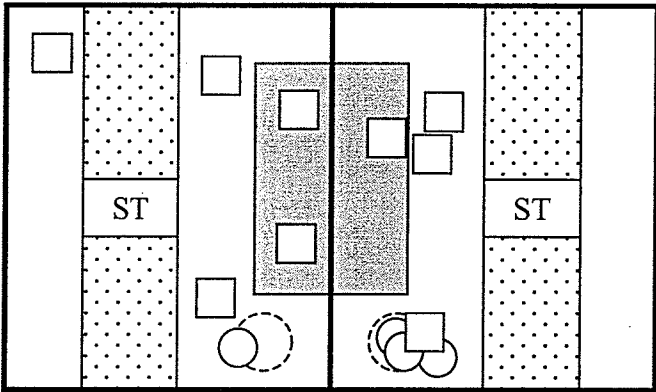


Crate: 1 Crate: 2
 Time: 4:00 Time: 4:00

Behaviour Tests - Spring Farrowing 2001

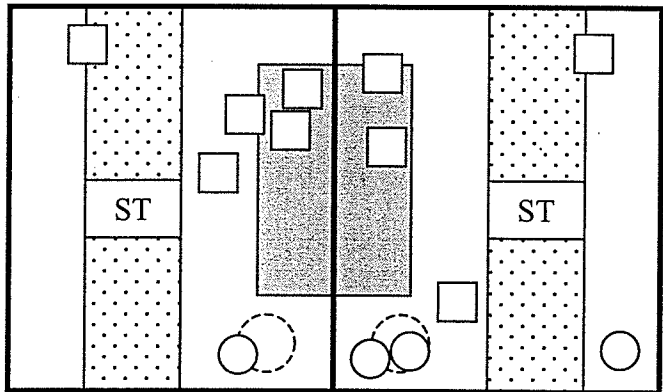
Day 16 - Section B (Heat Lamps Off)

April 2, 2001



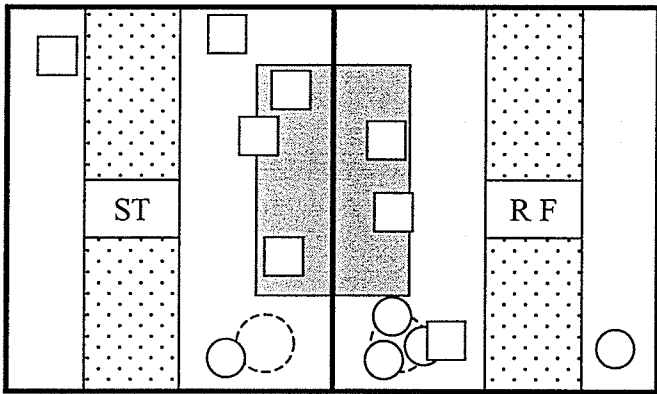
Crate: 11 Crate: 14

Time: 1:00 Time: 1:00



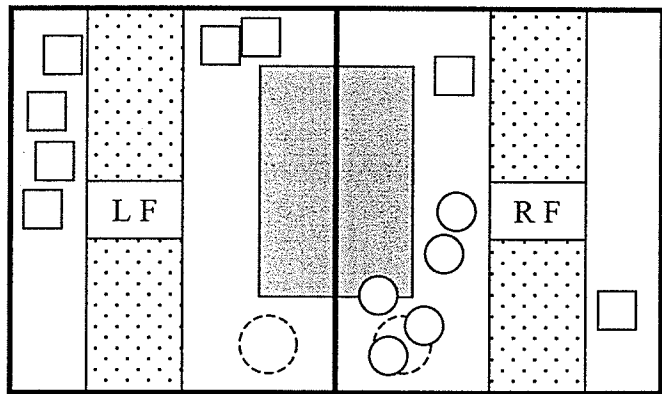
Crate: 11 Crate: 14

Time: 1:30 Time: 1:30



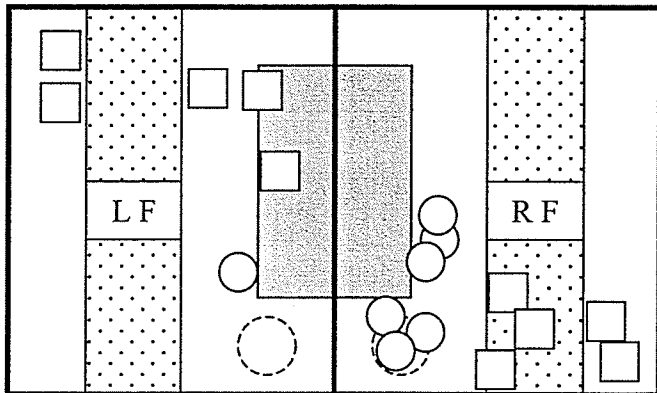
Crate: 11 Crate: 14

Time: 2:00 Time: 2:00



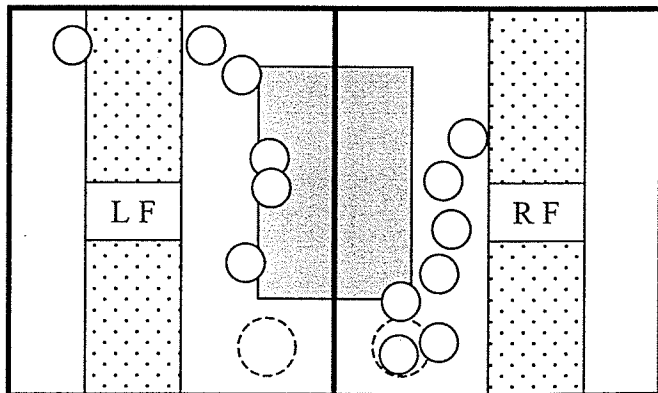
Crate: 11 Crate: 14

Time: 2:30 Time: 2:30



Crate: 11 Crate: 14

Time: 3:00 Time: 3:00



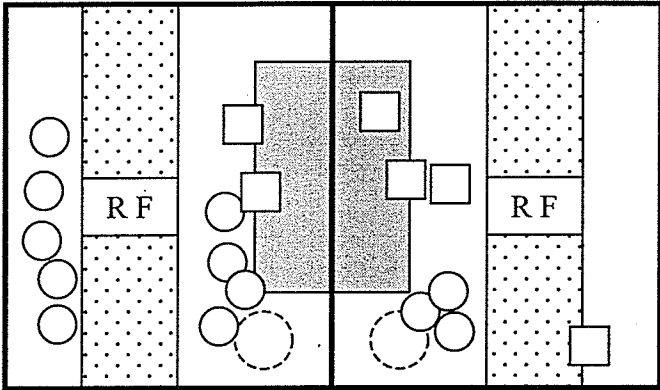
Crate: 11 Crate: 14

Time: 3:30 Time: 3:30

Behaviour Tests - Spring Farrowing 2001

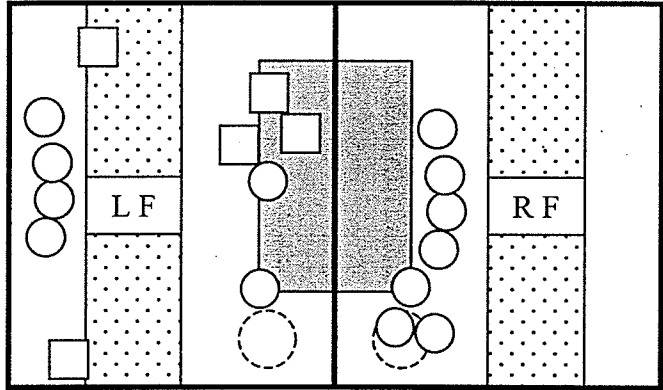
Day 16 - Section C (Heat Lamps Off)

April 7, 2001



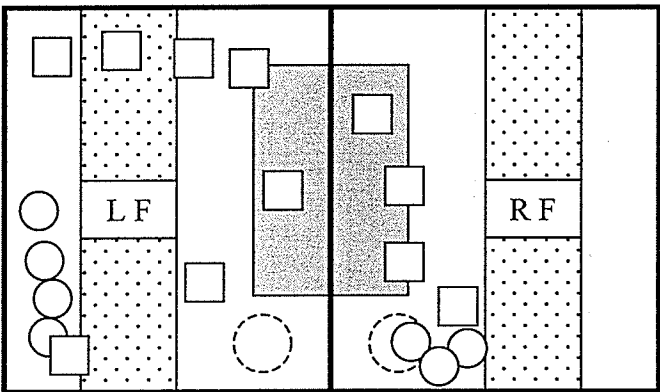
Crate: 19 Crate: 20

Time: 1:00 Time: 1:00



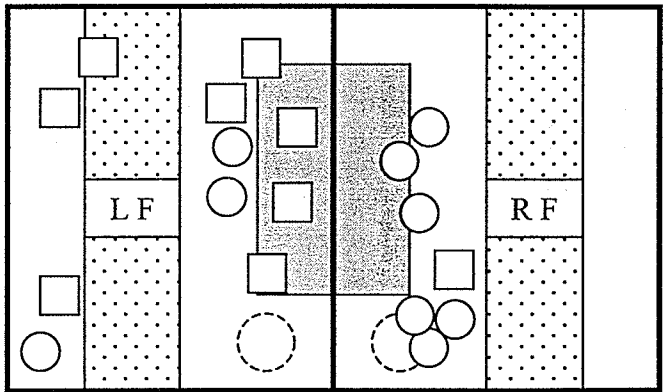
Crate: 19 Crate: 20

Time: 1:30 Time: 1:30



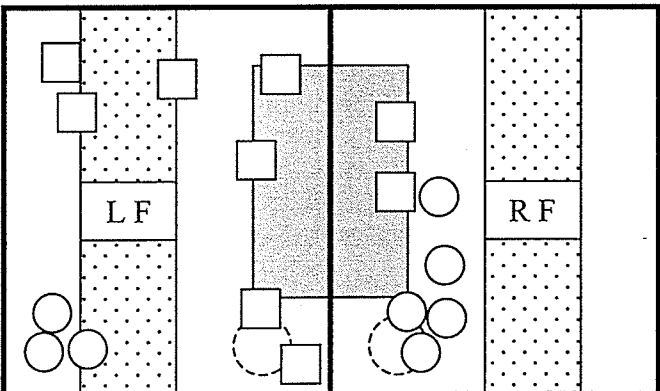
Crate: 19 Crate: 20

Time: 2:00 Time: 2:00



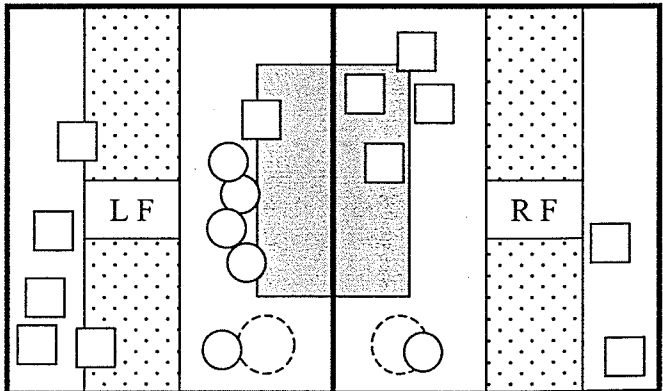
Crate: 19 Crate: 20

Time: 2:30 Time: 2:30



Crate: 19 Crate: 20

Time: 3:00 Time: 3:00



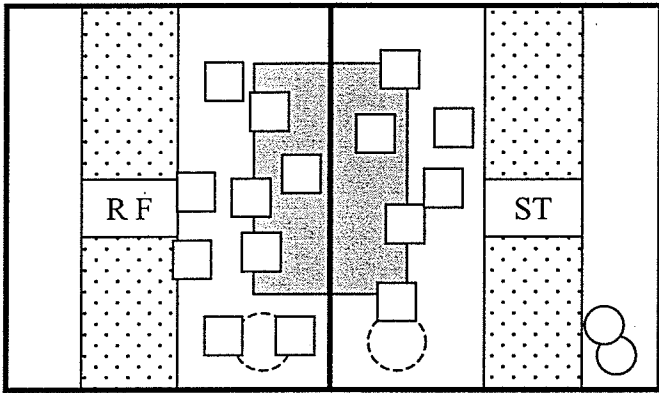
Crate: 19 Crate: 20

Time: 3:30 Time: 3:30

Behaviour Tests - Spring Farrowing 2001

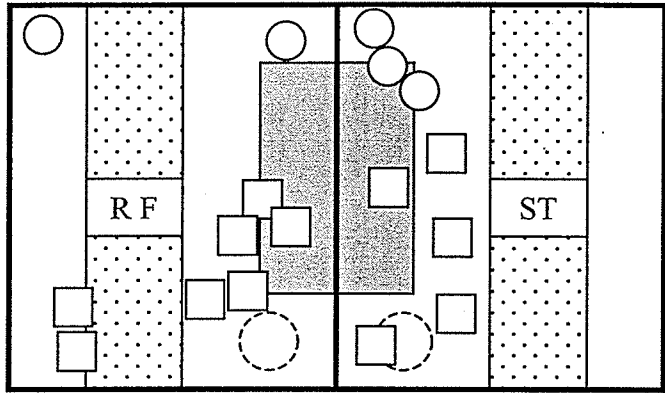
Day 16 - Section D (Heat Lamps Off)

March 25, 2001



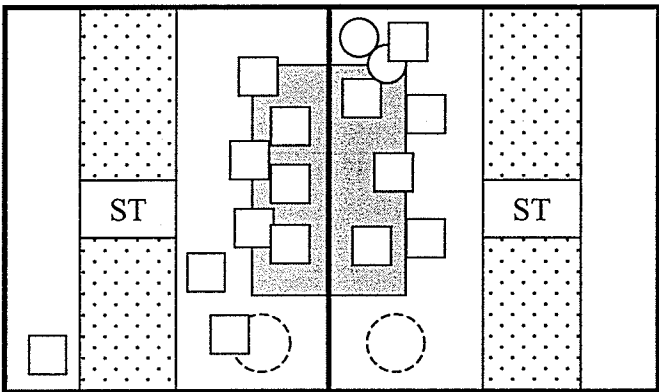
Crate: 35 Crate: 36

Time: 1:30 Time: 1:30



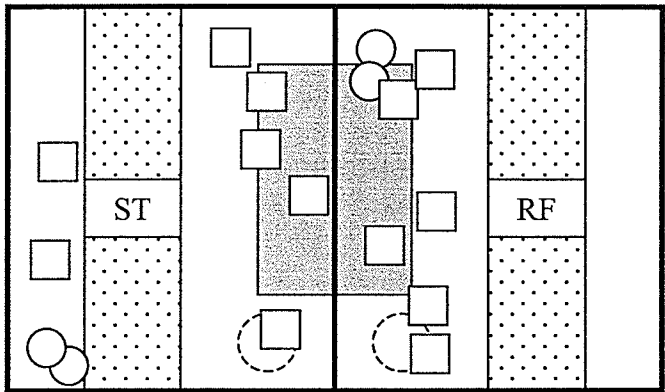
Crate: 35 Crate: 36

Time: 2:00 Time: 2:00



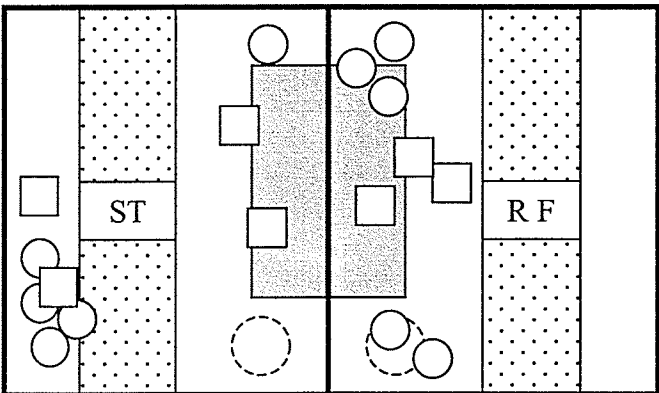
Crate: 35 Crate: 36

Time: 2:30 Time: 2:30



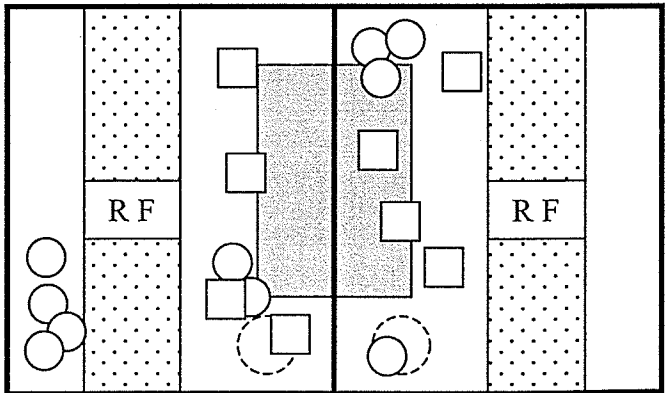
Crate: 35 Crate: 36

Time: 3:00 Time: 3:00



Crate: 35 Crate: 36

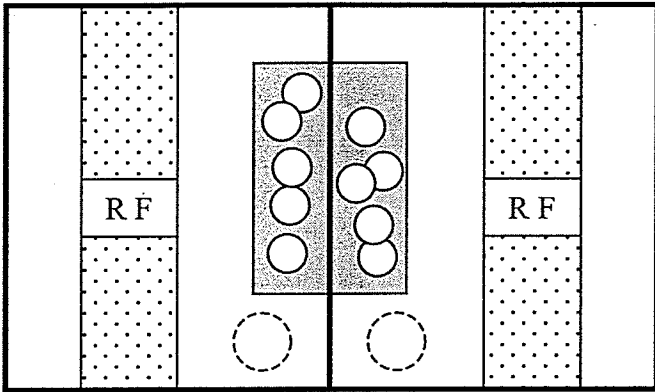
Time: 3:30 Time: 3:30



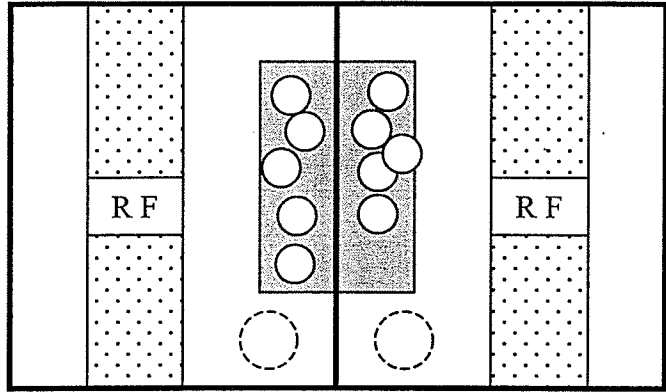
Crate: 35 Crate: 36

Time: 4:00 Time: 4:00

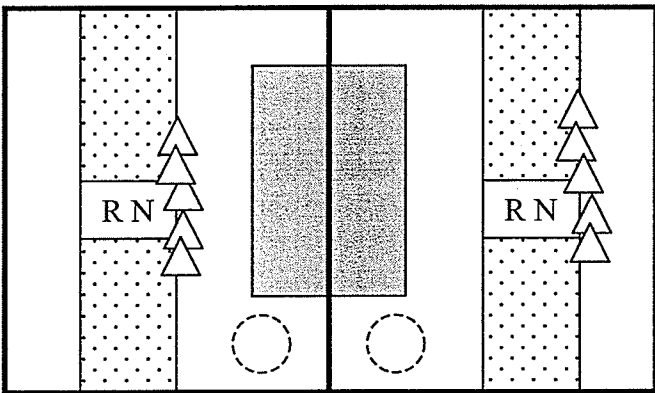
Behaviour Tests - Summer Farrowing 2001
 Day 1 - Section A (Heat Lamps Off)
 May 2-3, 2001



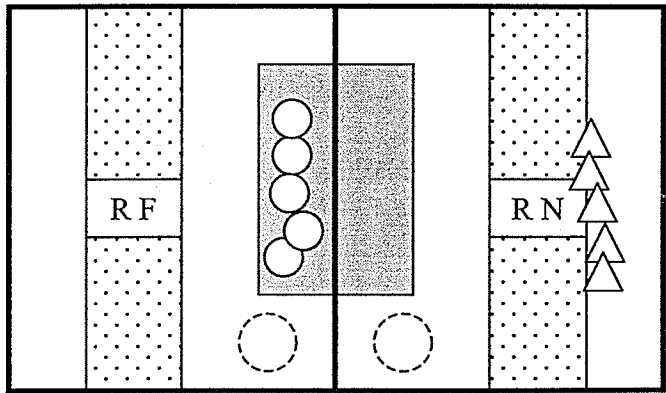
Crate: 1 Crate: 2
 Time: 1:00 Time: 1:00



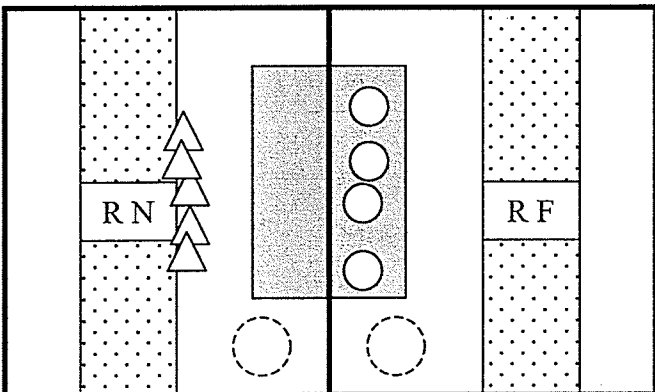
Crate: 1 Crate: 2
 Time: 1:30 Time: 1:30



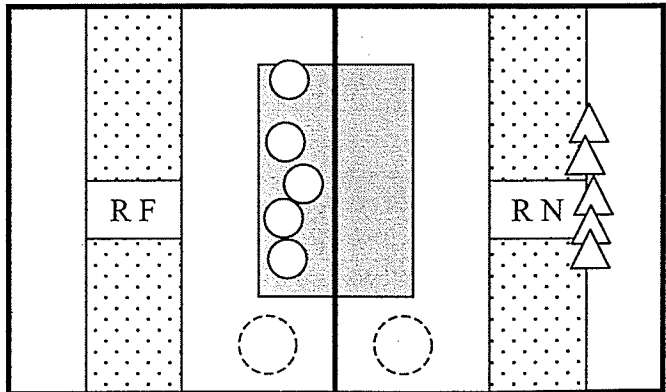
Crate: 1 Crate: 2
 Time: 2:00 Time: 2:00



Crate: 1 Crate: 2
 Time: 2:30 Time: 2:30



Crate: 1 Crate: 2
 Time: 3:00 Time: 3:00

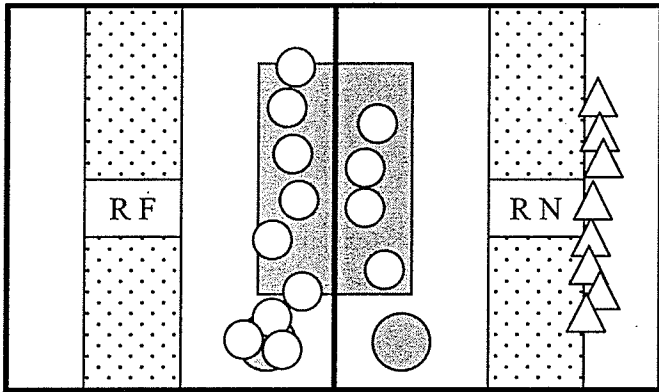


Crate: 1 Crate: 2
 Time: 3:30 Time: 3:30

Behaviour Tests - Summer Farrowing 2001

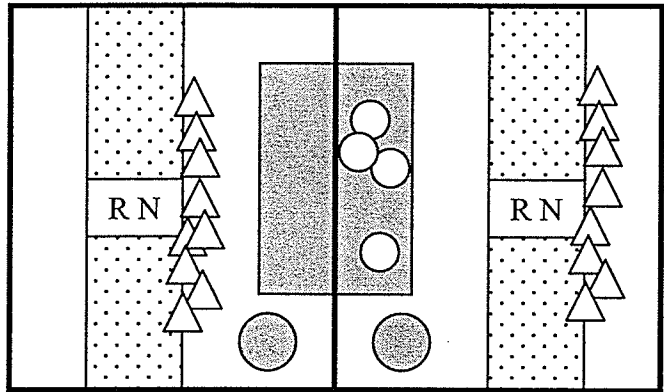
Day 1 - Section B (Heat Lamps On)

May 7, 2001



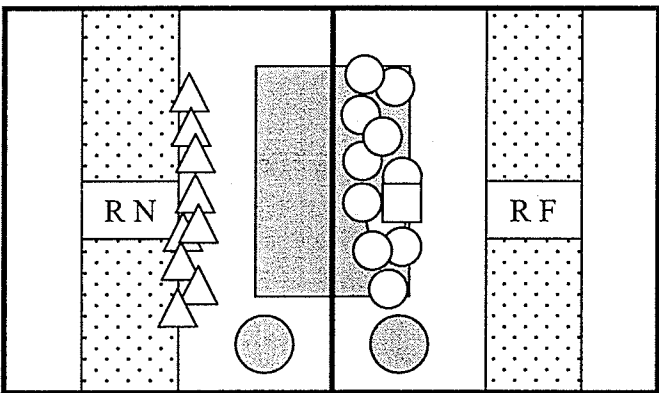
Crate: 9 Crate: 12

Time: 9:00 Time: 9:00



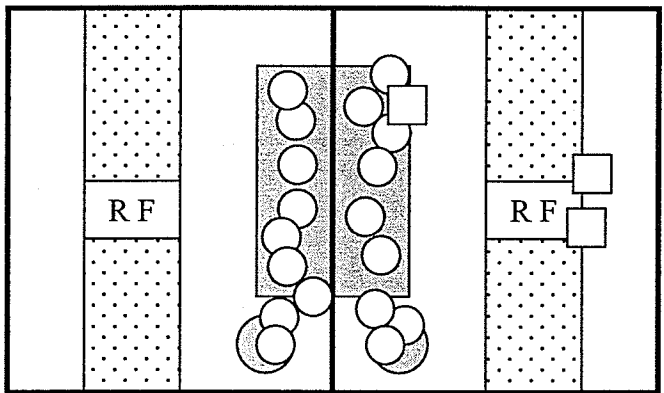
Crate: 9 Crate: 12

Time: 9:30 Time: 9:30



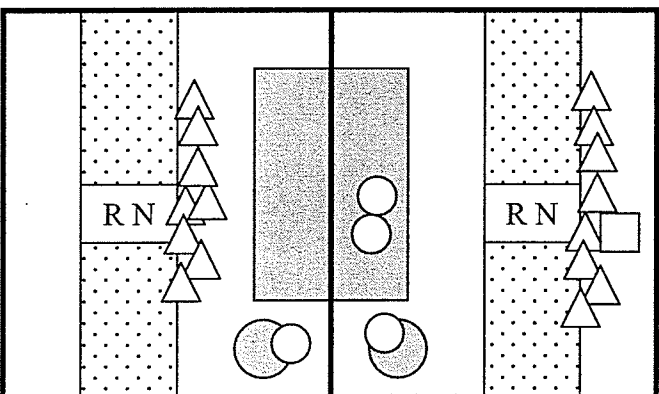
Crate: 9 Crate: 12

Time: 10:00 Time: 10:00



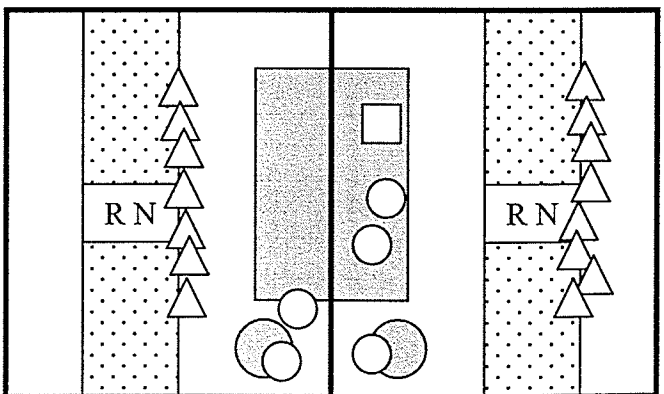
Crate: 9 Crate: 12

Time: 10:30 Time: 10:30



Crate: 9 Crate: 12

Time: 11:00 Time: 11:00



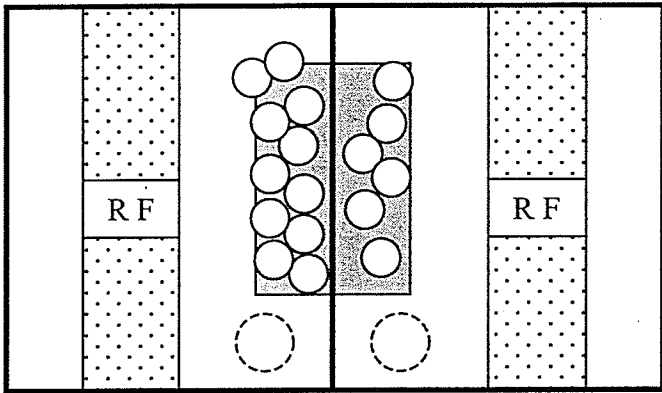
Crate: 9 Crate: 12

Time: 11:30 Time: 11:30

Behaviour Tests - Summer Farrowing 2001

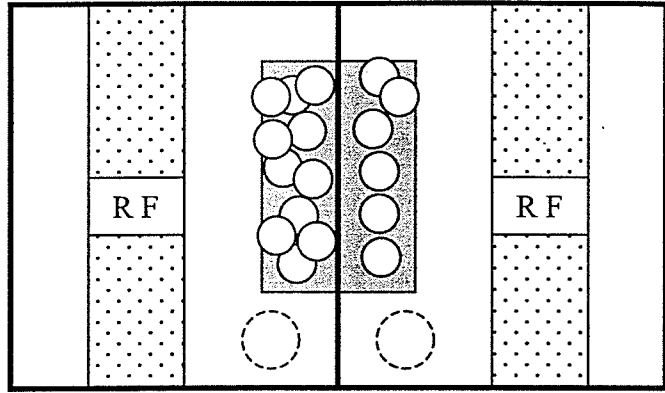
Day 1 - Section C (Heat Lamps Off)

May 16, 2001



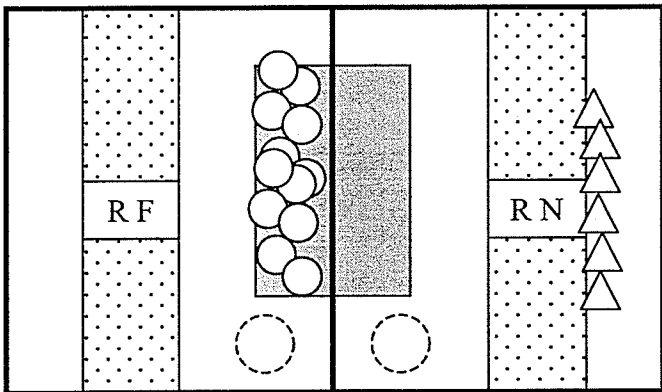
Crate: 21 Crate: 22

Time: 9:00 Time: 9:00



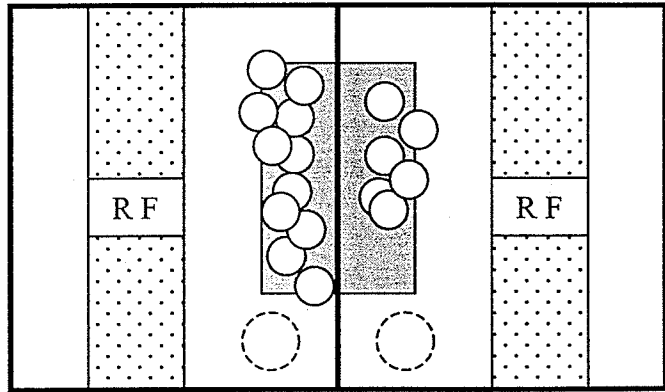
Crate: 21 Crate: 22

Time: 9:30 Time: 9:30



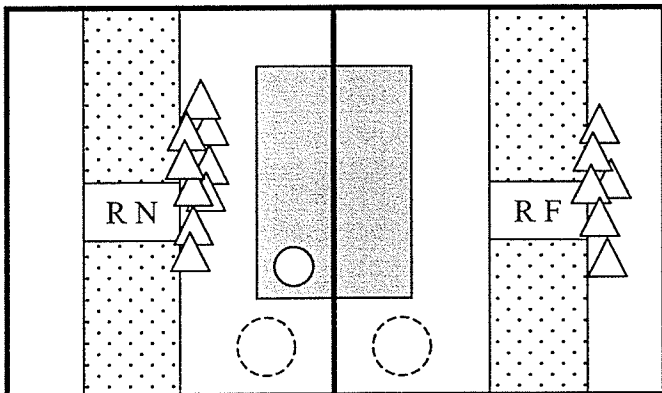
Crate: 21 Crate: 22

Time: 10:00 Time: 10:00



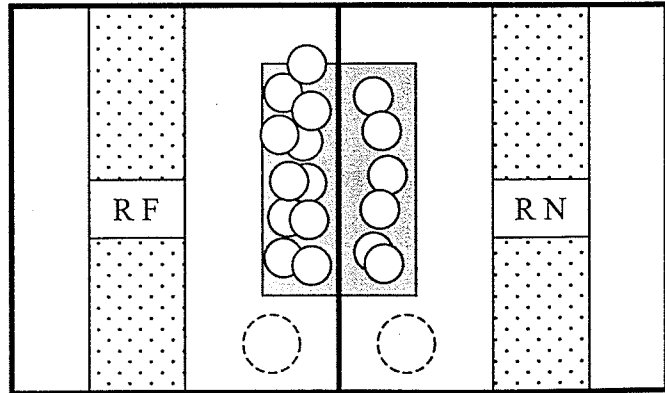
Crate: 21 Crate: 22

Time: 10:30 Time: 10:30



Crate: 21 Crate: 22

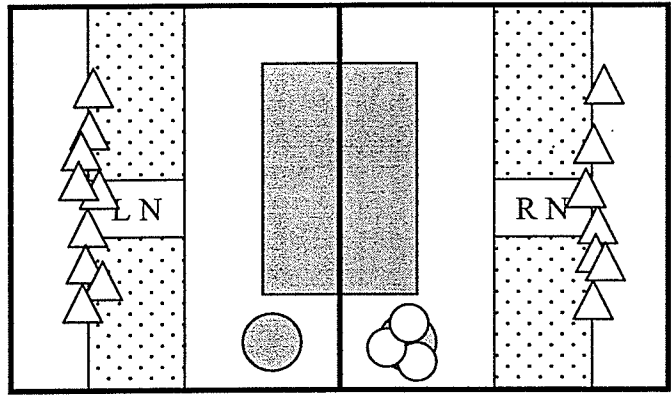
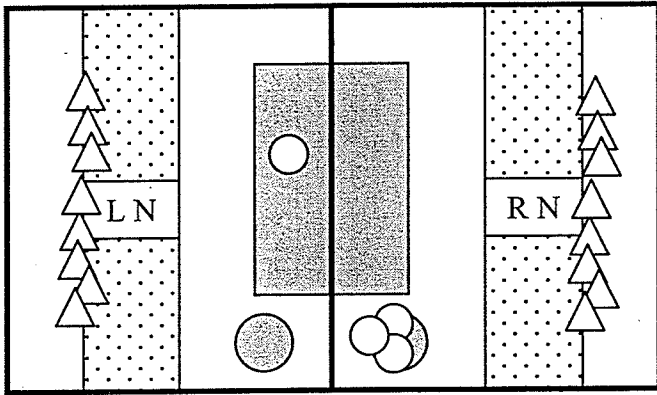
Time: 11:00 Time: 11:00



Crate: 21 Crate: 22

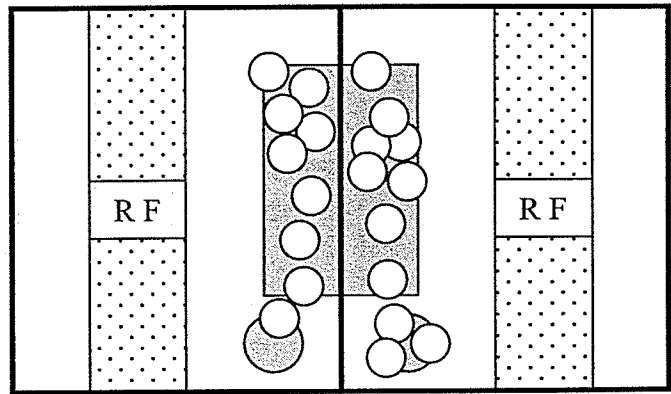
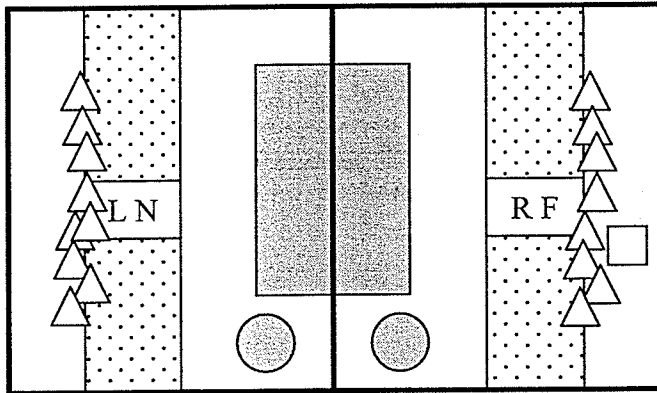
Time: 11:30 Time: 11:30

Behaviour Tests - Summer Farrowing 2001
 Day 1 - Section D (Heat Lamps On)
 May 8, 2001



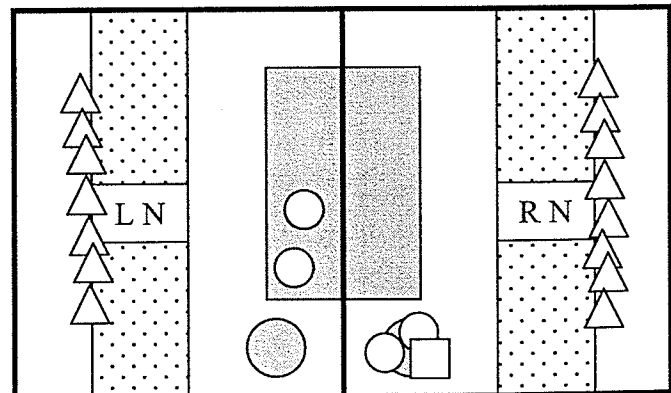
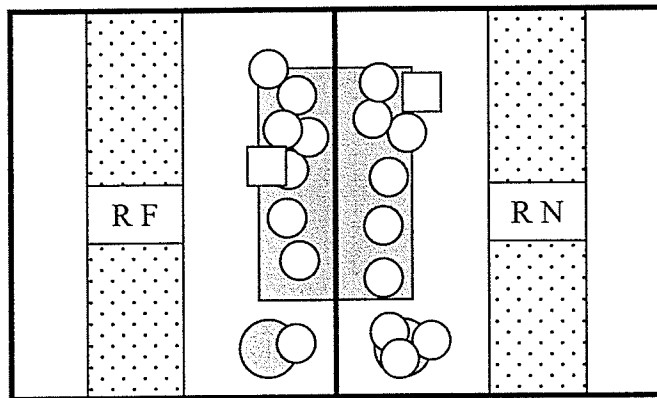
Crate: _____ 35 Crate: _____ 36
 Time: _____ 9:00 Time: _____ 9:00

Crate: _____ 35 Crate: _____ 36
 Time: _____ 9:30 Time: _____ 9:30



Crate: _____ 35 Crate: _____ 36
 Time: _____ 10:00 Time: _____ 10:00

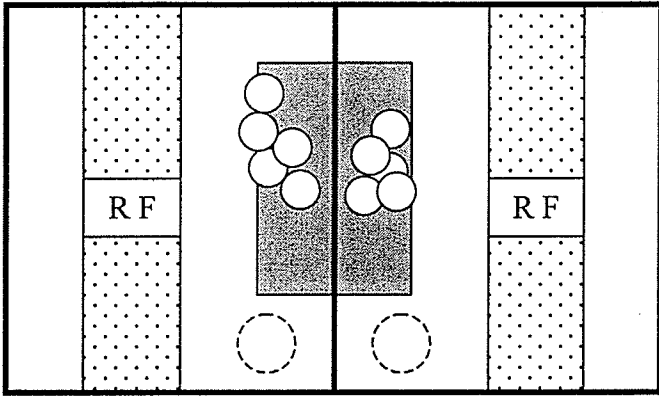
Crate: _____ 35 Crate: _____ 36
 Time: _____ 10:30 Time: _____ 10:30



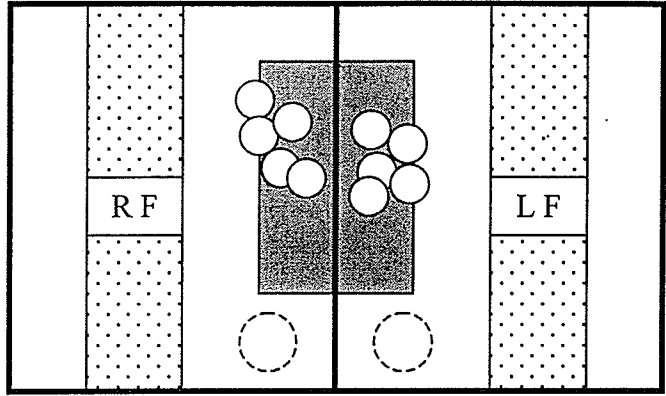
Crate: _____ 35 Crate: _____ 36
 Time: _____ 11:00 Time: _____ 11:00

Crate: _____ 35 Crate: _____ 36
 Time: _____ 11:30 Time: _____ 11:30

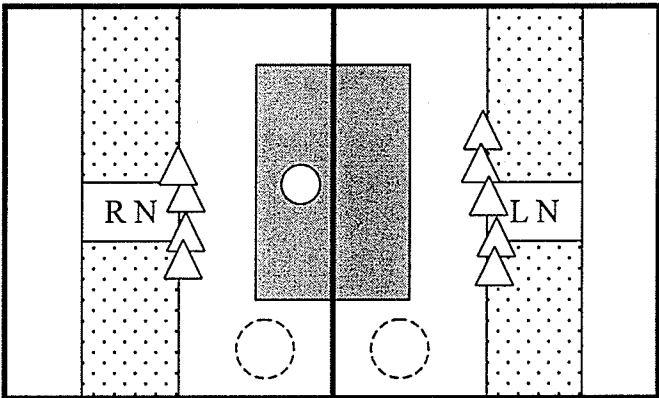
Behaviour Tests - Summer Farrowing 2001
 Day 3 - Section A (Heat Lamps Off)
 May 4-5, 2001



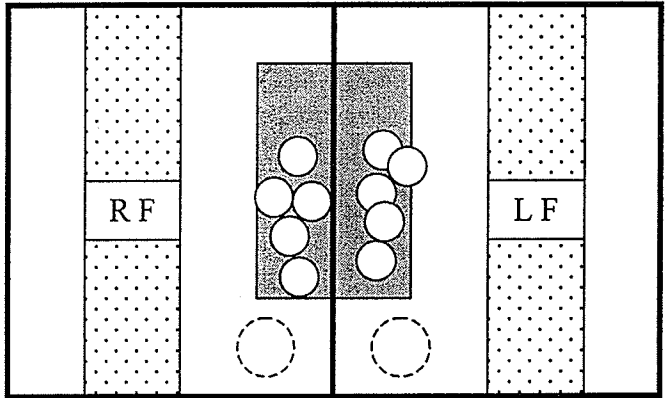
Crate: 1 Crate: 2
 Time: 9:00 Time: 9:00



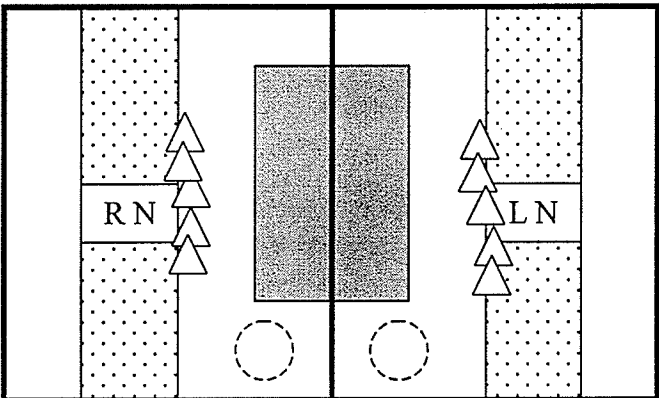
Crate: 1 Crate: 2
 Time: 9:30 Time: 9:30



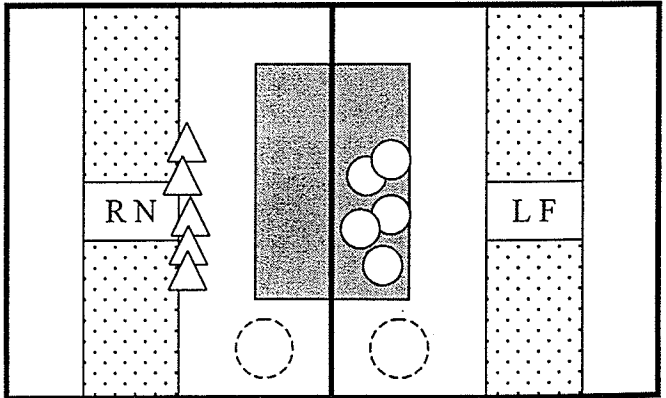
Crate: 1 Crate: 2
 Time: 10:00 Time: 10:00



Crate: 1 Crate: 2
 Time: 10:30 Time: 10:30



Crate: 1 Crate: 2
 Time: 11:00 Time: 11:00

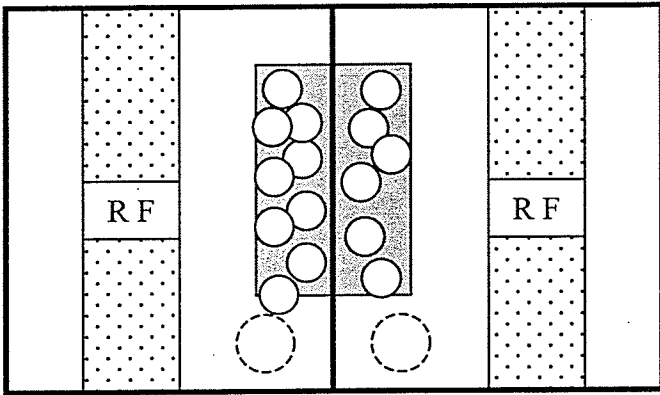


Crate: 1 Crate: 2
 Time: 11:30 Time: 11:30

Behaviour Tests - Summer Farrowing 2001

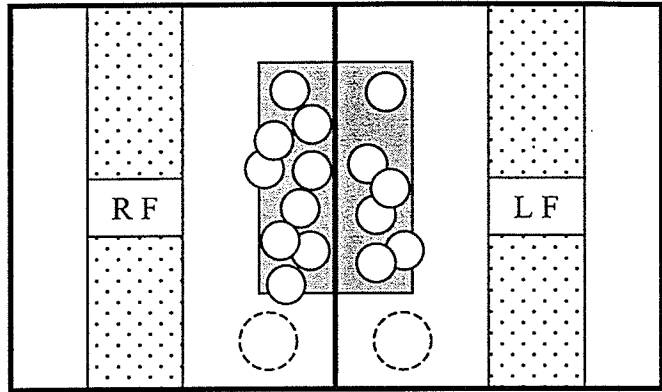
Day 3 - Section B (Heat Lamps Off)

May 10, 2001



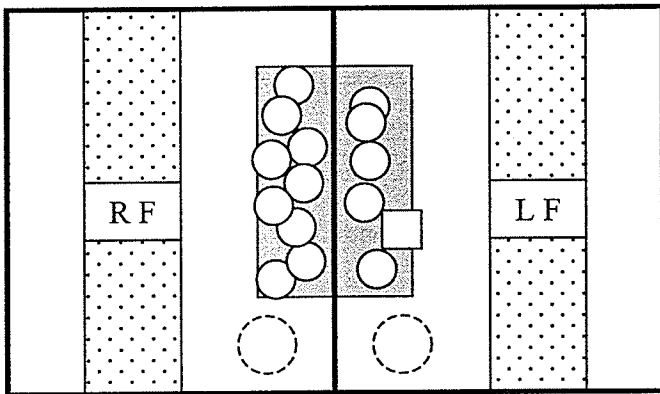
Crate: 9 Crate: 12

Time: 9:00 Time: 9:00



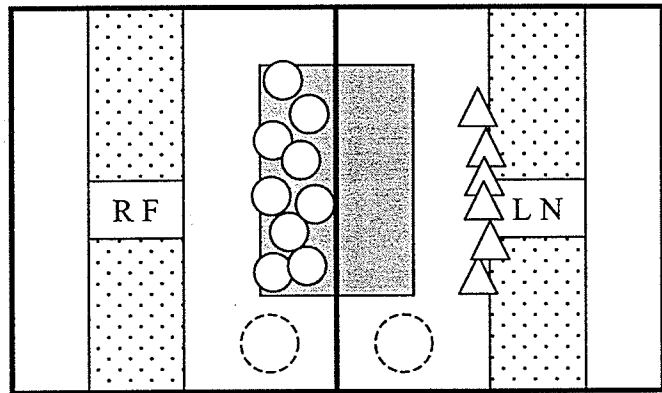
Crate: 9 Crate: 12

Time: 9:30 Time: 9:30



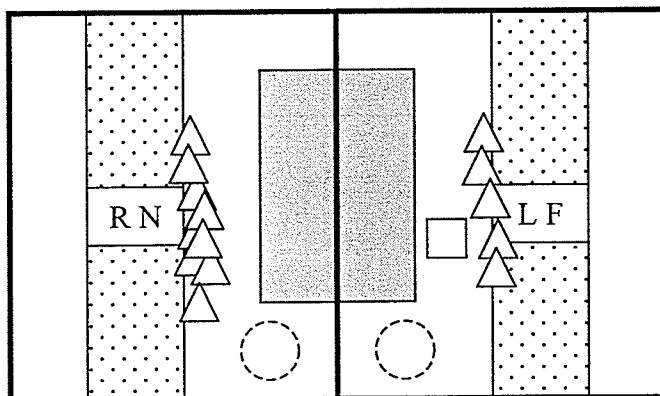
Crate: 9 Crate: 12

Time: 10:00 Time: 10:00



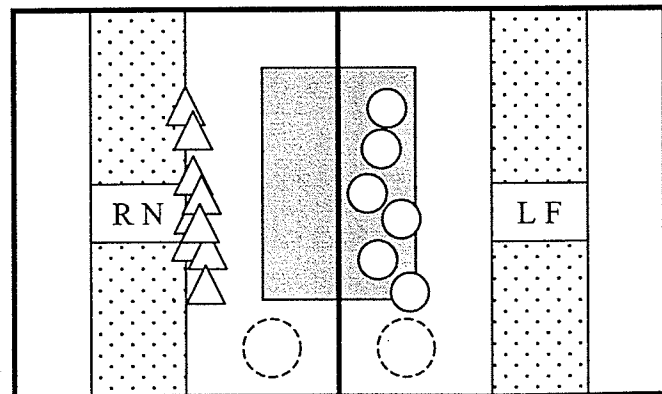
Crate: 9 Crate: 12

Time: 10:30 Time: 10:30



Crate: 9 Crate: 12

Time: 11:00 Time: 11:00



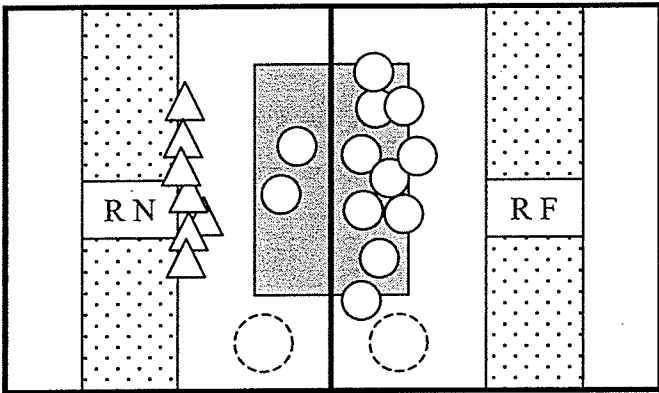
Crate: 9 Crate: 12

Time: 11:30 Time: 11:30

Behaviour Tests - Summer Farrowing 2001

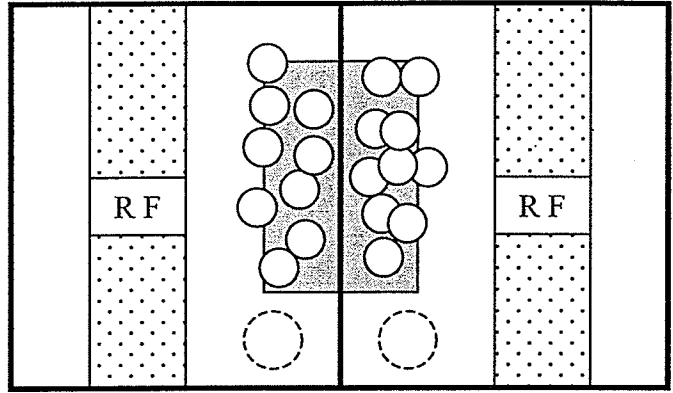
Day 3 - Section C (Heat Lamps Off)

May 19, 2001



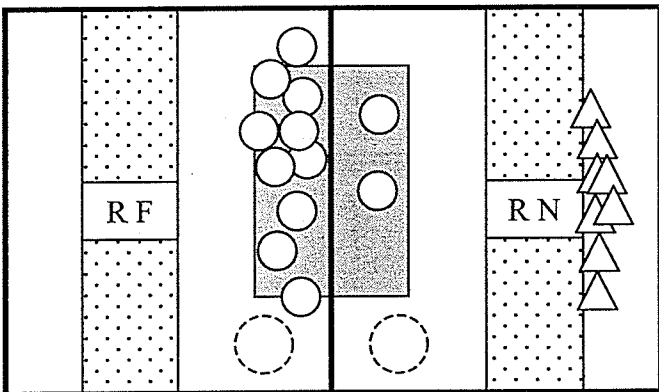
Crate: 21 Crate: 22

Time: 9:00 Time: 9:00



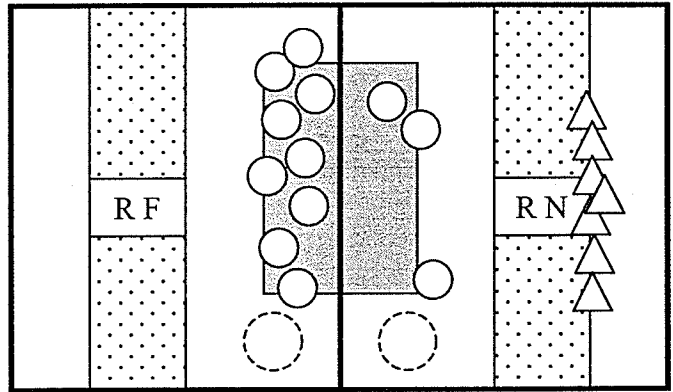
Crate: 21 Crate: 22

Time: 9:30 Time: 9:30



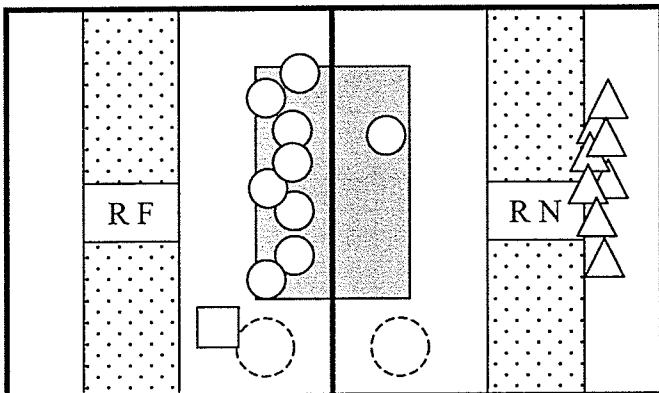
Crate: 21 Crate: 22

Time: 10:00 Time: 10:00



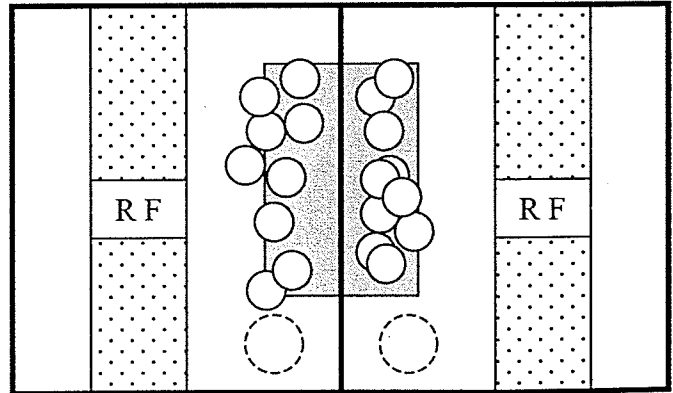
Crate: 21 Crate: 22

Time: 10:30 Time: 10:30



Crate: 21 Crate: 22

Time: 11:00 Time: 11:00



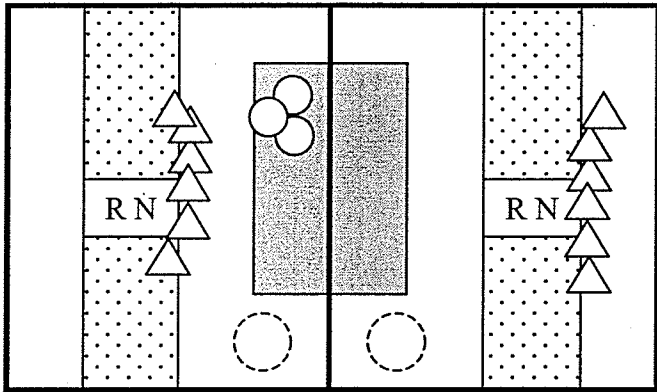
Crate: 21 Crate: 22

Time: 11:30 Time: 11:30

Behaviour Tests - Summer Farrowing 2001

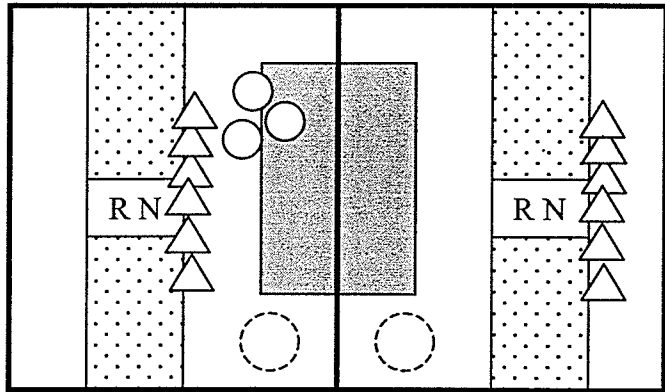
Day 3 - Section D (Heat Lamps Off)

May 11, 2001



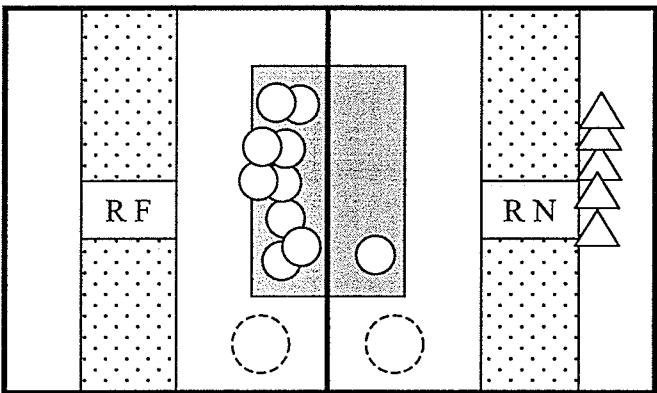
Crate: 35 Crate: 36

Time: 9:30 Time: 9:30



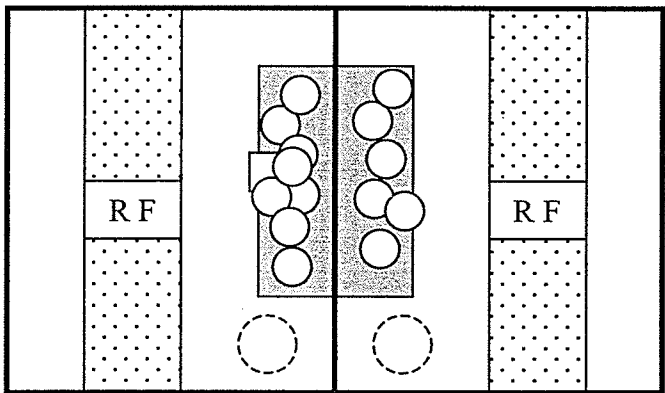
Crate: 35 Crate: 36

Time: 10:00 Time: 10:00



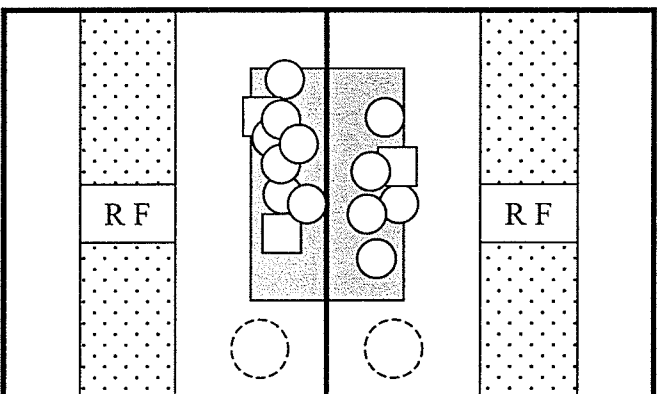
Crate: 35 Crate: 36

Time: 10:30 Time: 10:30



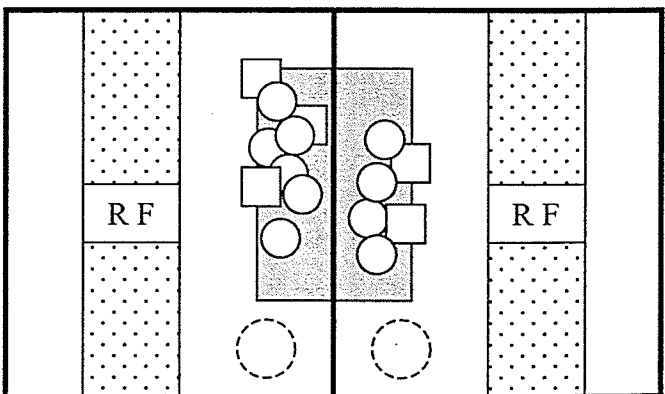
Crate: 35 Crate: 36

Time: 11:00 Time: 11:00



Crate: 35 Crate: 36

Time: 11:30 Time: 11:30



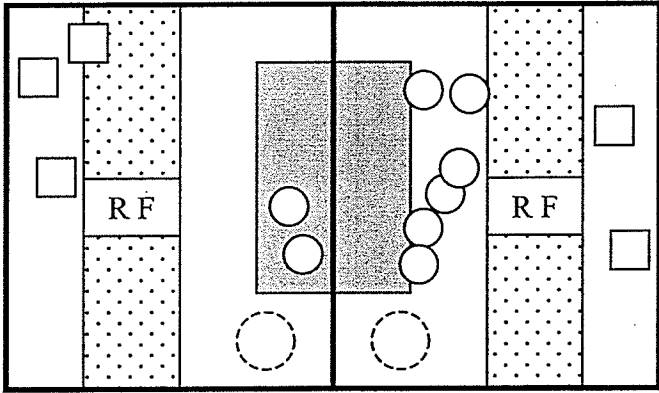
Crate: 35 Crate: 36

Time: 12:00 Time: 12:00

Behaviour Tests - Summer Farrowing 2001

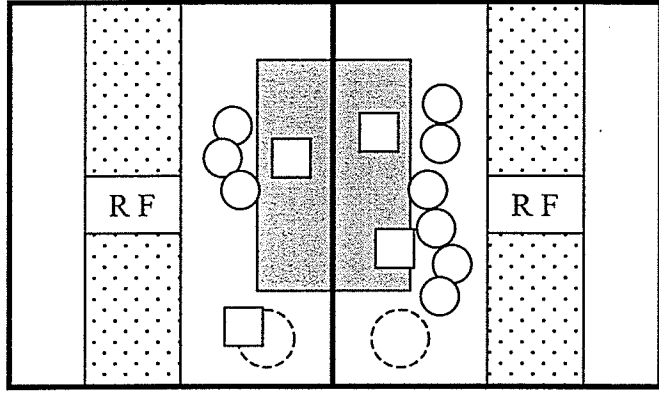
Day 7 - Section A (Heat Lamps Off)

March 9-10, 2001



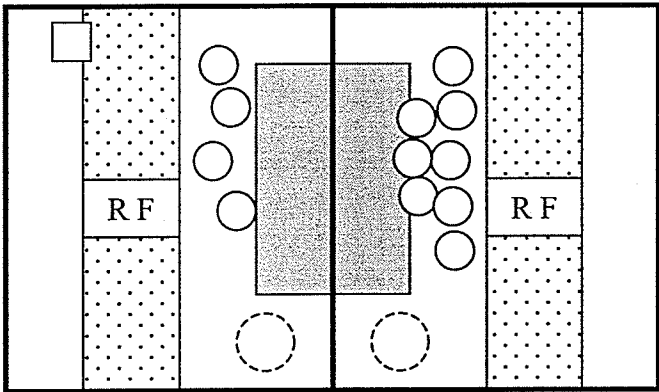
Crate: 1 Crate: 2

Time: 9:30 Time: 9:30



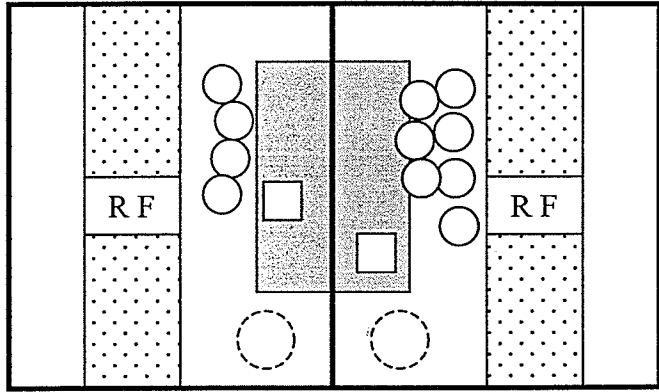
Crate: 1 Crate: 2

Time: 10:00 Time: 10:00



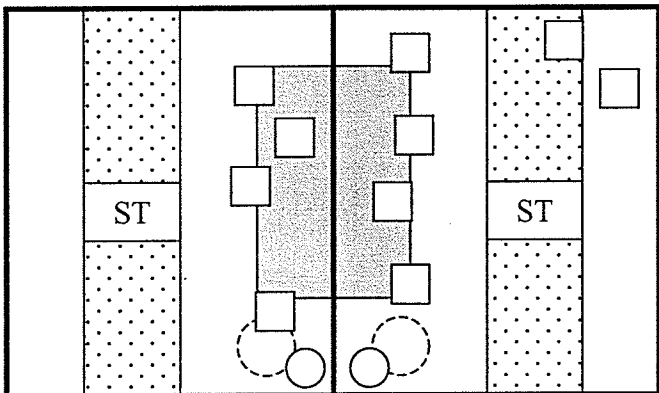
Crate: 1 Crate: 2

Time: 10:30 Time: 10:30



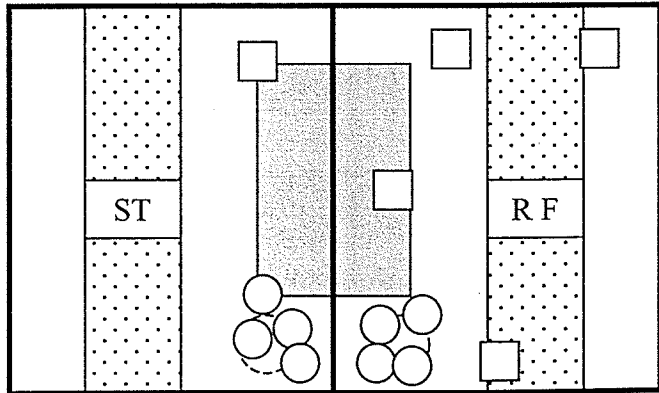
Crate: 1 Crate: 2

Time: 11:00 Time: 11:00



Crate: 1 Crate: 2

Time: 11:30 Time: 11:30



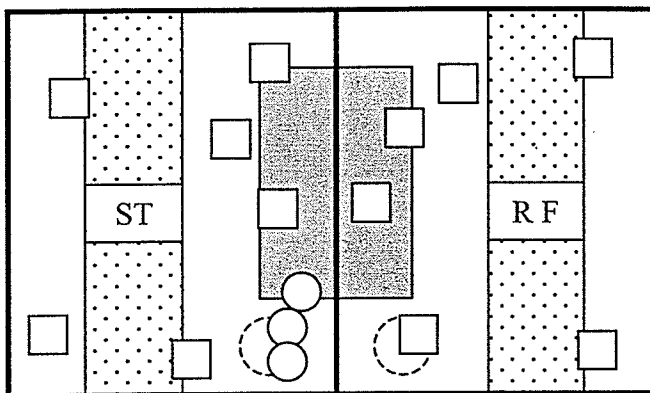
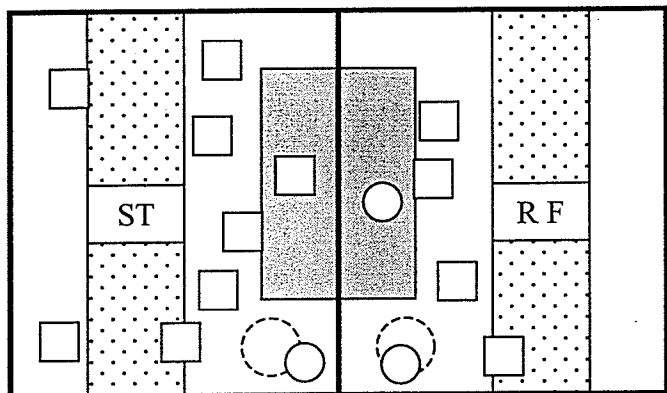
Crate: 1 Crate: 2

Time: 12:00 Time: 12:00

Behaviour Tests - Summer Farrowing 2001

Day 7 - Section B (Heat Lamps Off)

May 14, 2001

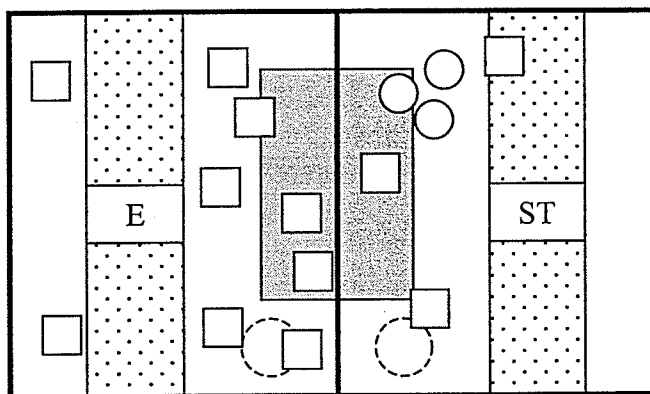
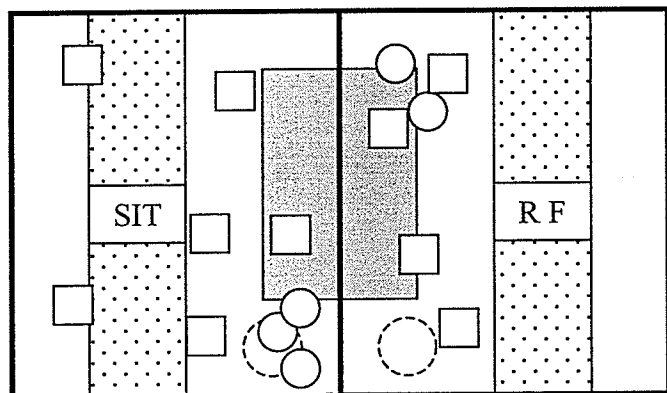


Crate: 9 Crate: 12

Crate: 9 Crate: 12

Time: 1:00 Time: 1:00

Time: 1:30 Time: 1:30

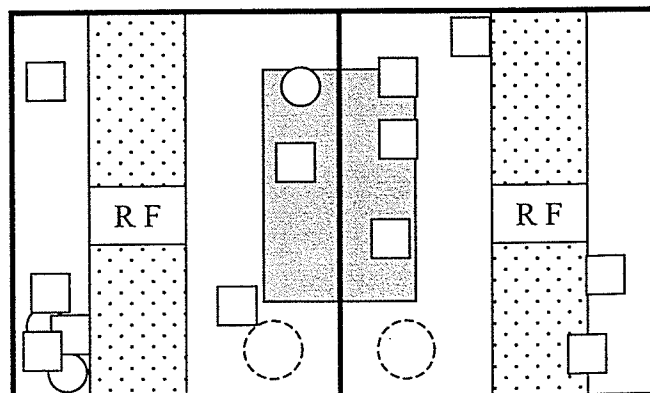
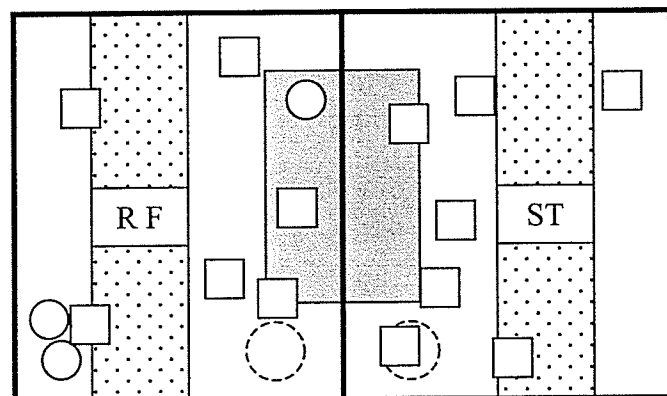


Crate: 9 Crate: 12

Crate: 9 Crate: 12

Time: 2:00 Time: 2:00

Time: 2:30 Time: 2:30



Crate: 9 Crate: 12

Crate: 9 Crate: 12

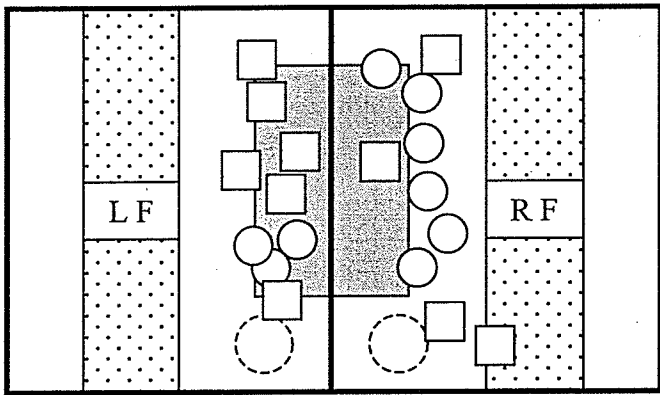
Time: 3:00 Time: 3:00

Time: 3:30 Time: 3:30

Behaviour Tests - Summer Farrowing 2001

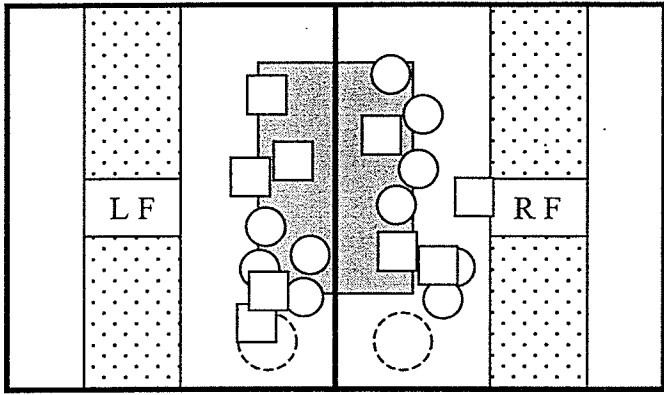
Day 7 - Section C (Heat Lamps Off)

March 23, 2001



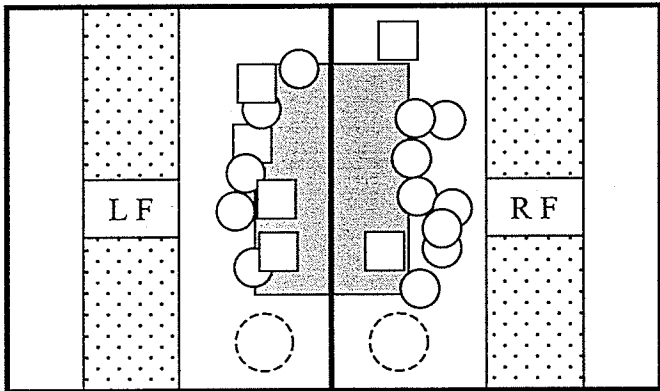
Crate: 21 Crate: 22

Time: 9:30 Time: 9:30



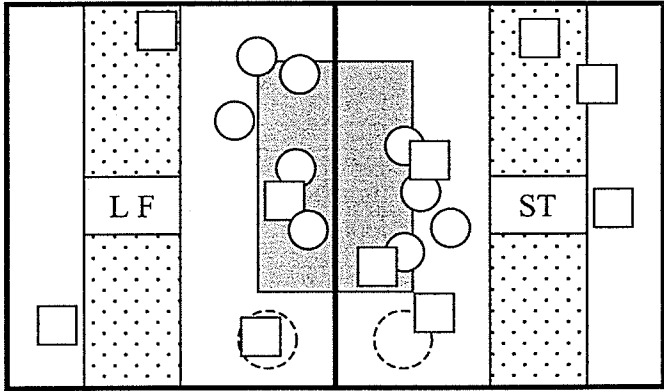
Crate: 21 Crate: 22

Time: 10:00 Time: 10:00



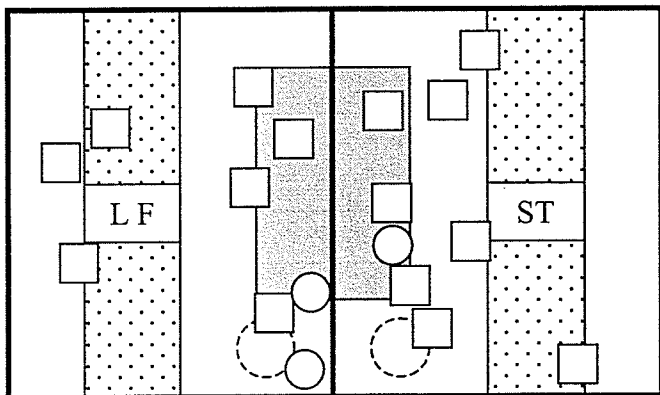
Crate: 21 Crate: 22

Time: 10:30 Time: 10:30



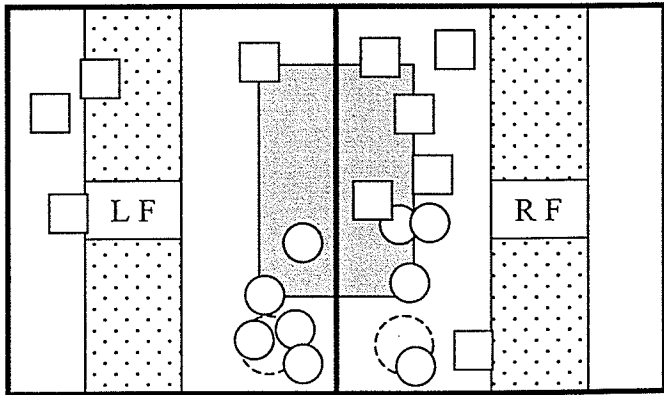
Crate: 21 Crate: 22

Time: 11:00 Time: 11:00



Crate: 21 Crate: 22

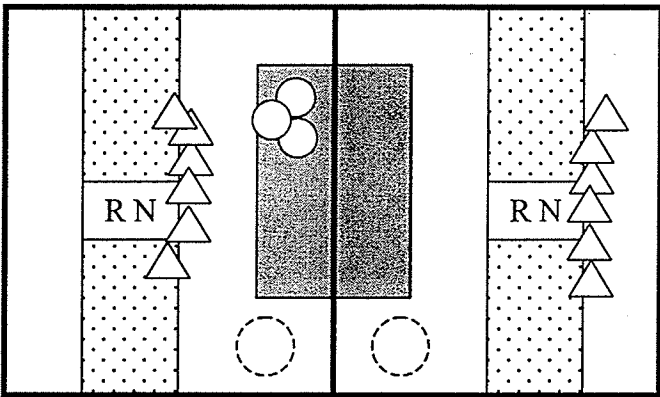
Time: 11:30 Time: 11:30



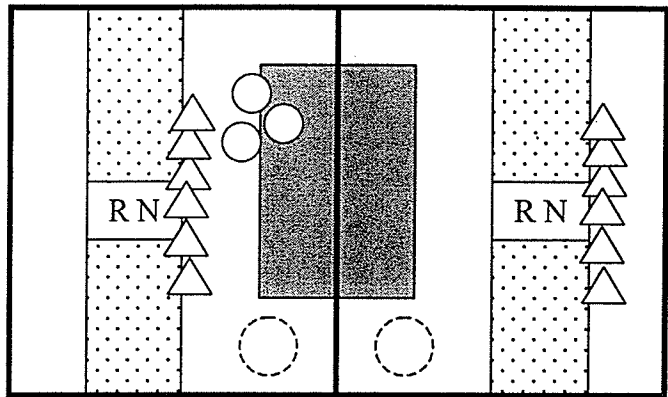
Crate: 21 Crate: 22

Time: 12:00 Time: 12:00

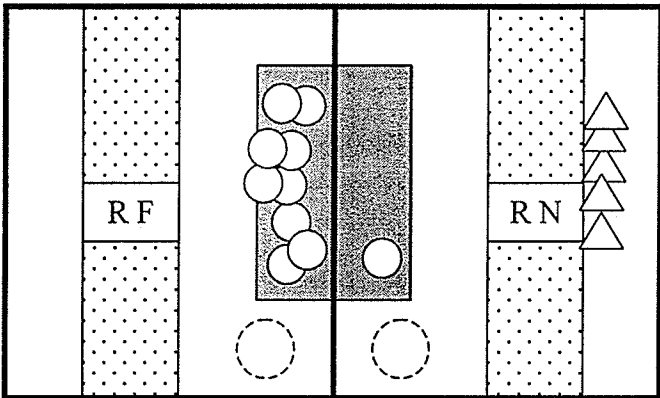
Behaviour Tests - Summer Farrowing 2001
 Day 7 - Section D (Heat Lamps Off)
 May 15, 2001



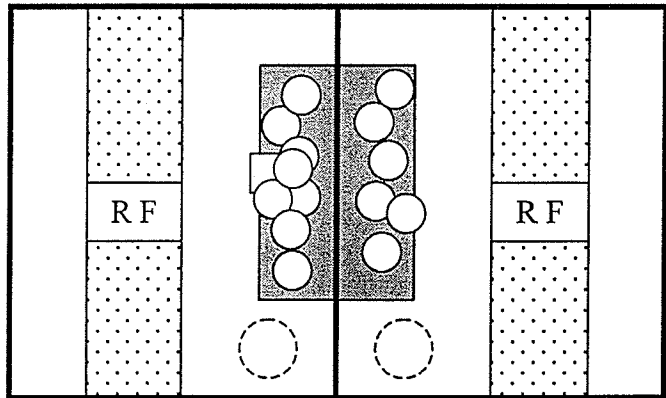
Crate: 35 Crate: 36
 Time: 9:30 Time: 9:30



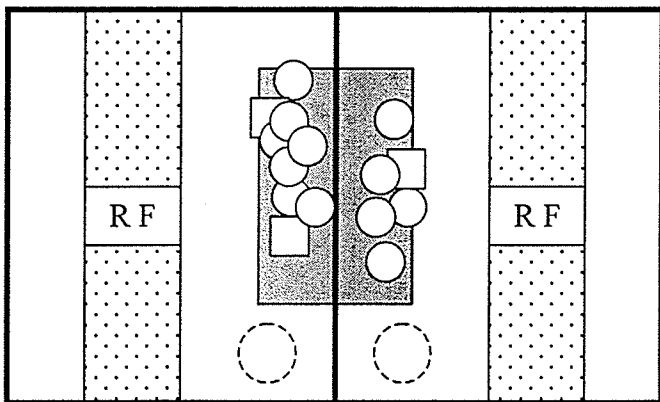
Crate: 35 Crate: 36
 Time: 10:00 Time: 10:00



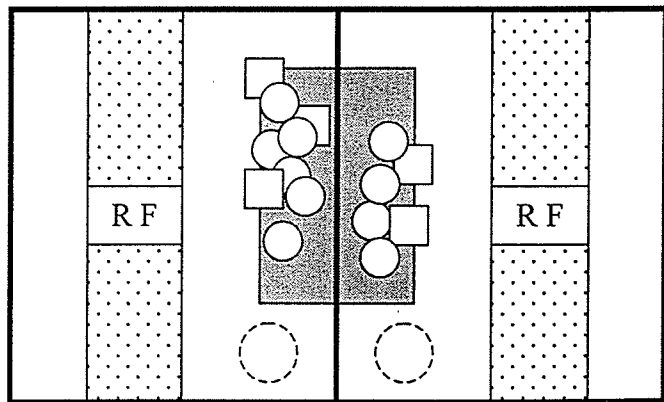
Crate: 35 Crate: 36
 Time: 10:30 Time: 10:30



Crate: 35 Crate: 36
 Time: 11:00 Time: 11:00



Crate: 35 Crate: 36
 Time: 11:30 Time: 11:30

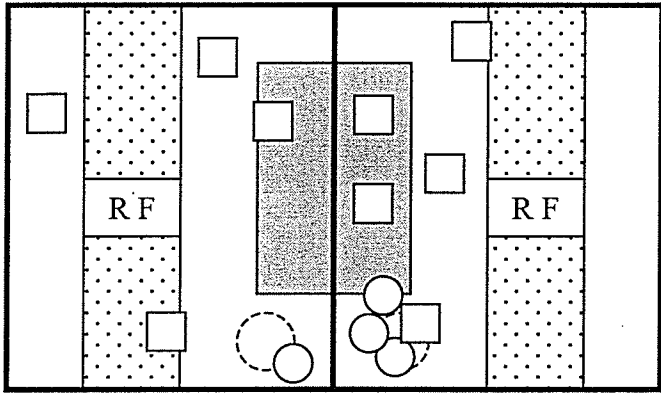


Crate: 35 Crate: 36
 Time: 12:00 Time: 12:00

Behaviour Tests - Summer Farrowing 2001

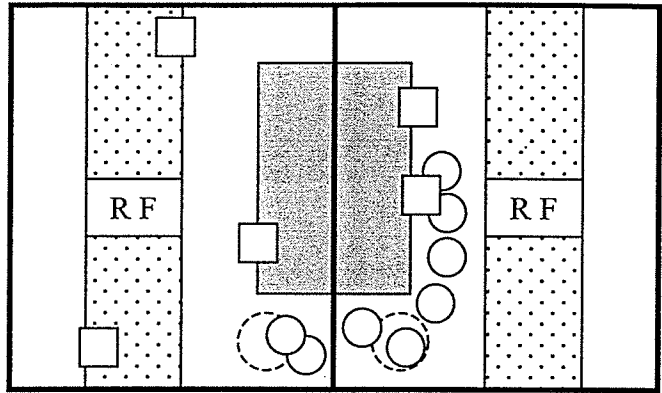
Day 16 - Section A (Heat Lamps Off)

March 18-19, 2001



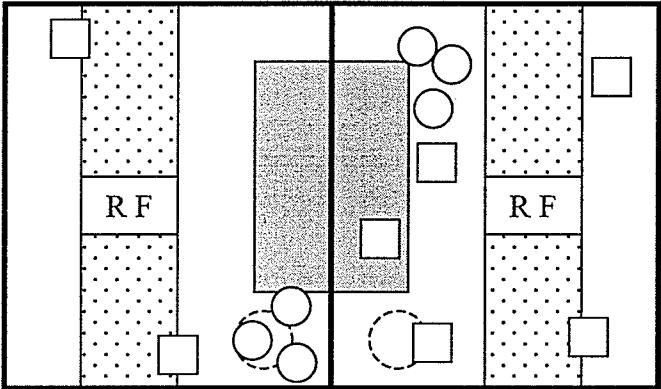
Crate: 1 Crate: 2

Time: 9:30 Time: 9:30



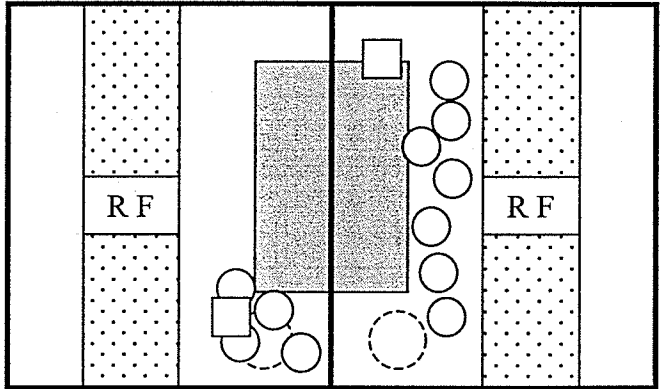
Crate: 1 Crate: 2

Time: 10:00 Time: 10:00



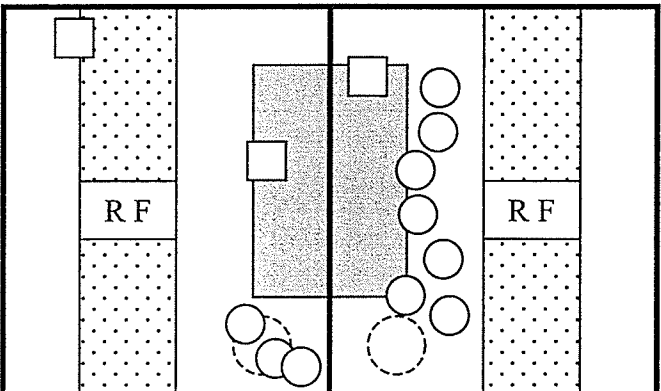
Crate: 1 Crate: 2

Time: 10:30 Time: 10:30



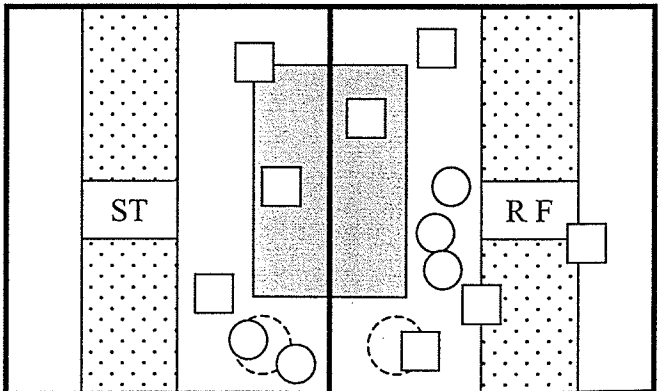
Crate: 1 Crate: 2

Time: 11:00 Time: 11:00



Crate: 1 Crate: 2

Time: 11:30 Time: 11:30



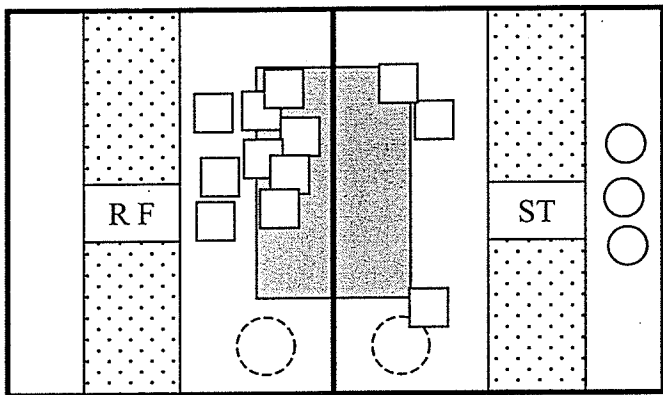
Crate: 1 Crate: 2

Time: 12:00 Time: 12:00

Behaviour Tests - Summer Farrowing 2001

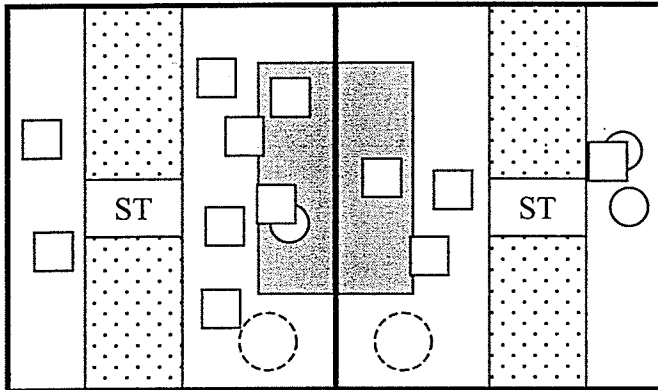
Day 16 - Section B (Heat Lamps Off)

May 23, 2001



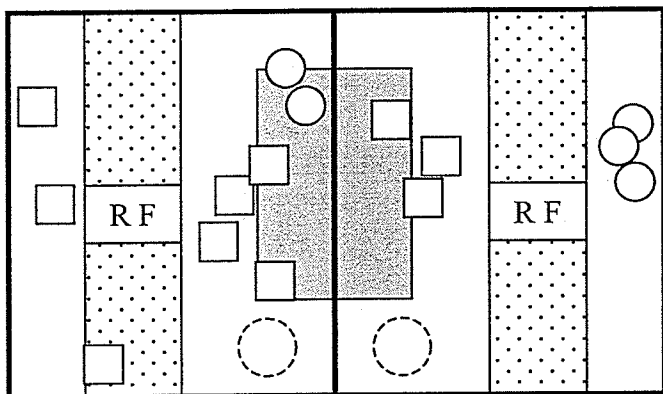
Crate: 9 Crate: 12

Time: 1:30 Time: 1:30



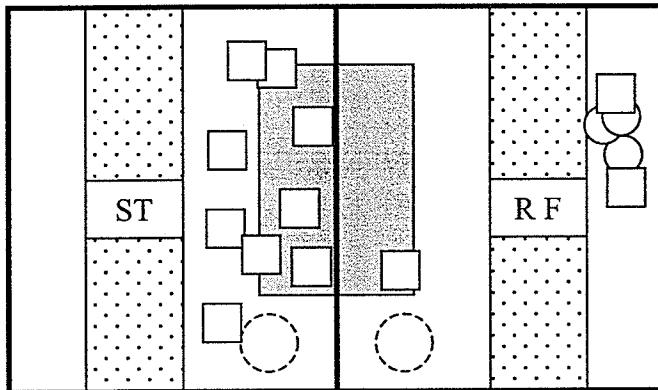
Crate: 9 Crate: 12

Time: 2:00 Time: 2:00



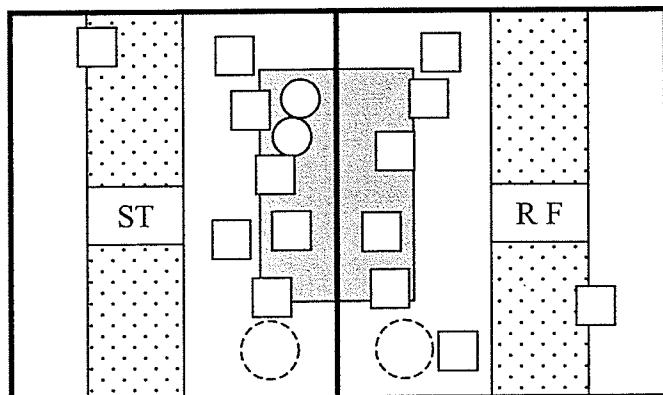
Crate: 9 Crate: 12

Time: 2:30 Time: 2:30



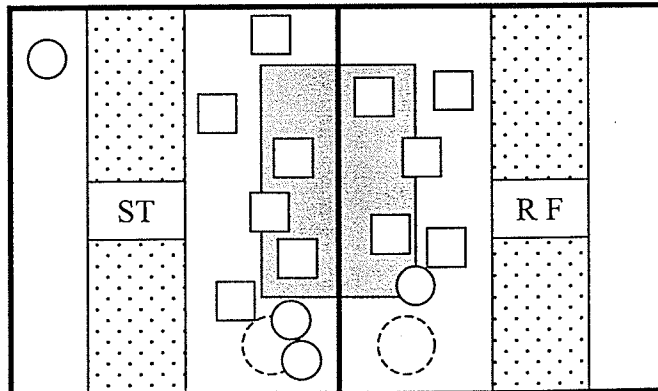
Crate: 9 Crate: 12

Time: 3:00 Time: 3:00



Crate: 9 Crate: 12

Time: 3:30 Time: 3:30



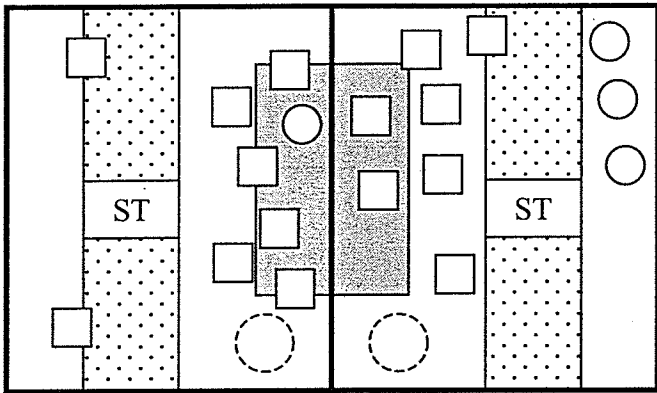
Crate: 9 Crate: 12

Time: 4:00 Time: 4:00

Behaviour Tests - Summer Farrowing 2001

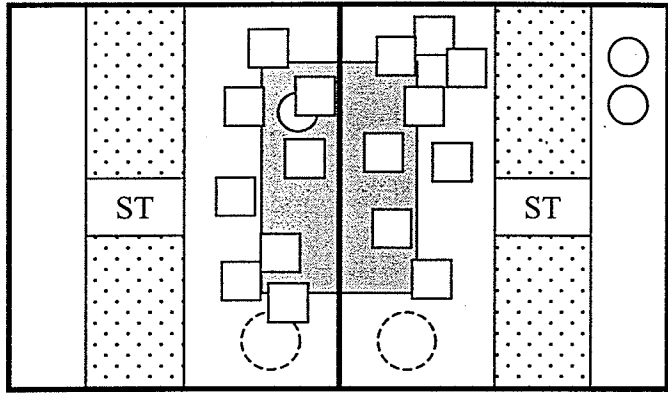
Day 16 - Section C (Heat Lamps Off)

April 1, 2001



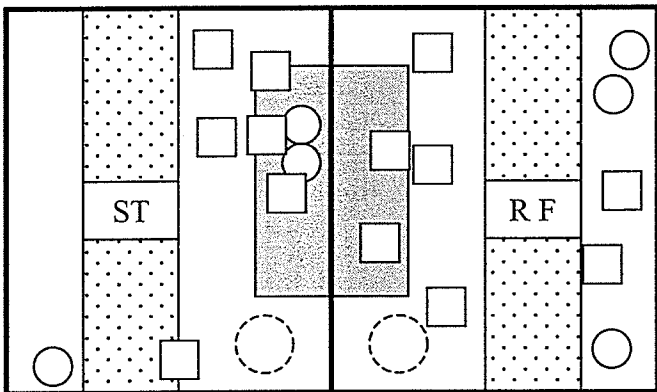
Crate: 21 Crate: 22

Time: 1:30 Time: 1:30



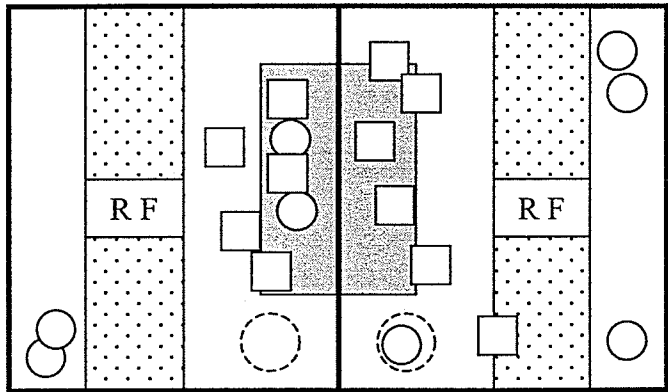
Crate: 21 Crate: 22

Time: 2:00 Time: 2:00



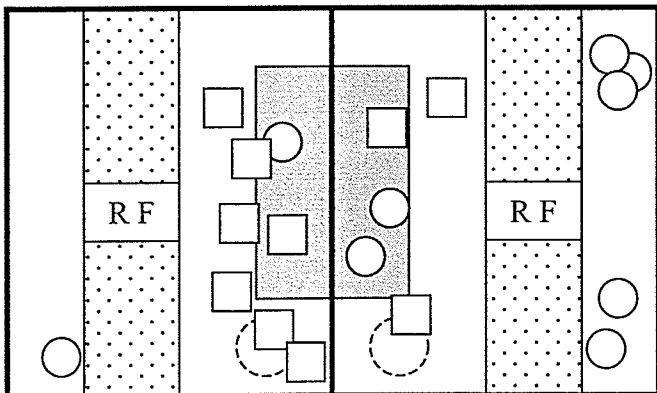
Crate: 21 Crate: 22

Time: 2:30 Time: 2:30



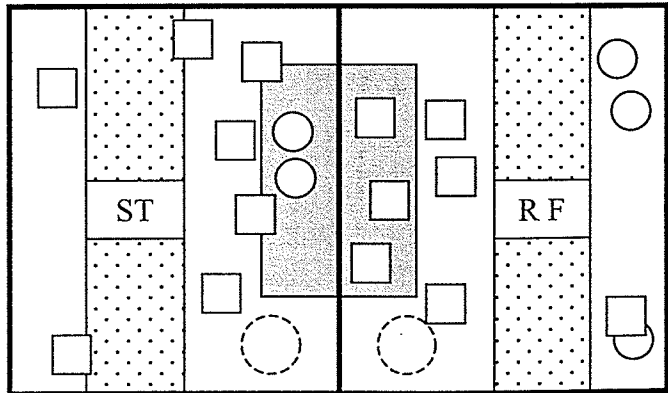
Crate: 21 Crate: 22

Time: 3:00 Time: 3:00



Crate: 21 Crate: 22

Time: 3:30 Time: 3:30



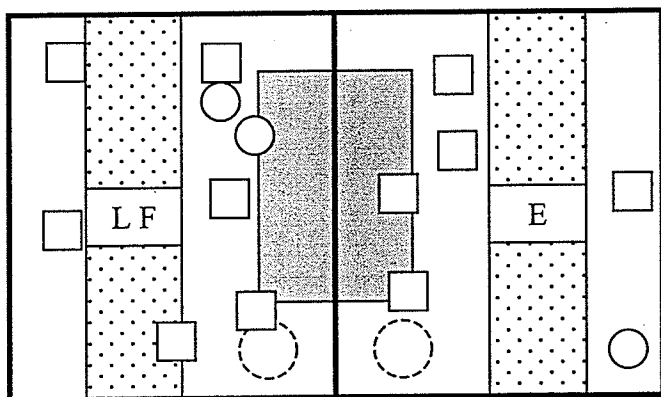
Crate: 21 Crate: 22

Time: 4:00 Time: 4:00

Behaviour Tests - Summer Farrowing 2001

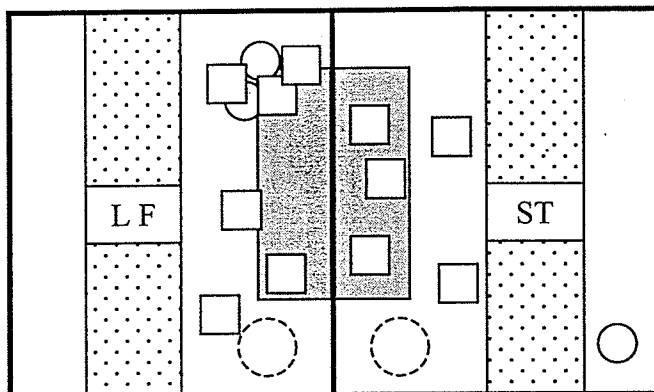
Day 16 - Section D (Heat Lamps Off)

May 24, 2001



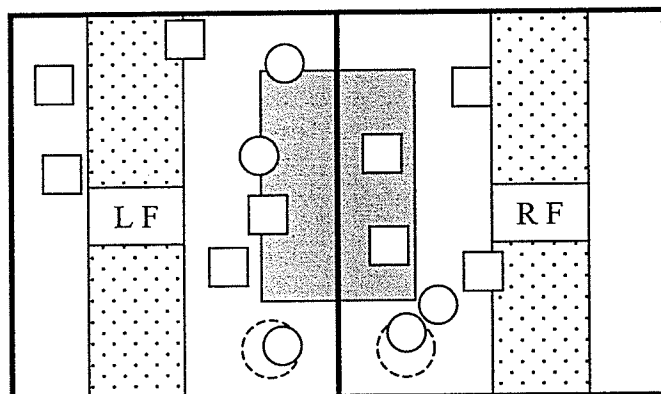
Crate: 35 Crate: 36

Time: 8:30 Time: 8:30



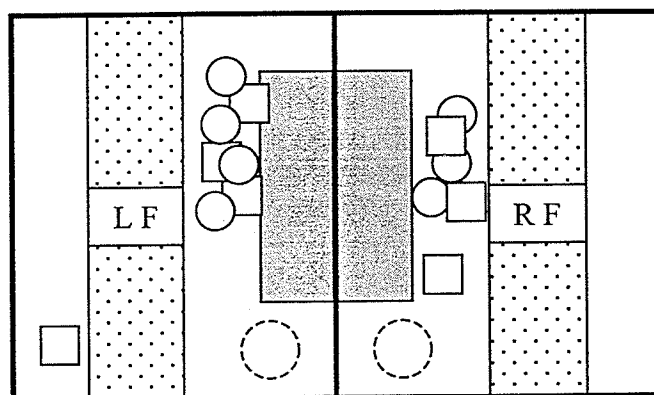
Crate: 35 Crate: 36

Time: 9:00 Time: 9:00



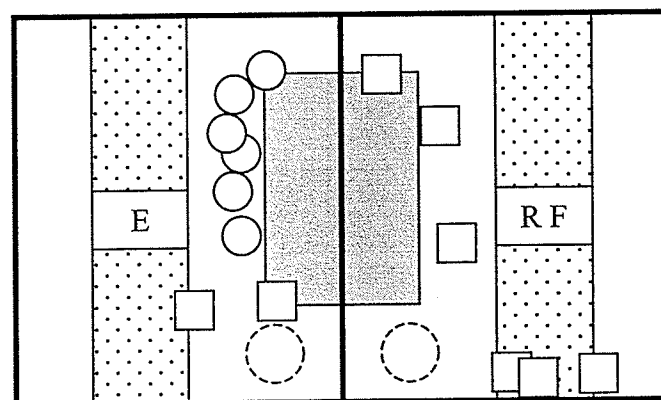
Crate: 35 Crate: 36

Time: 9:30 Time: 9:30



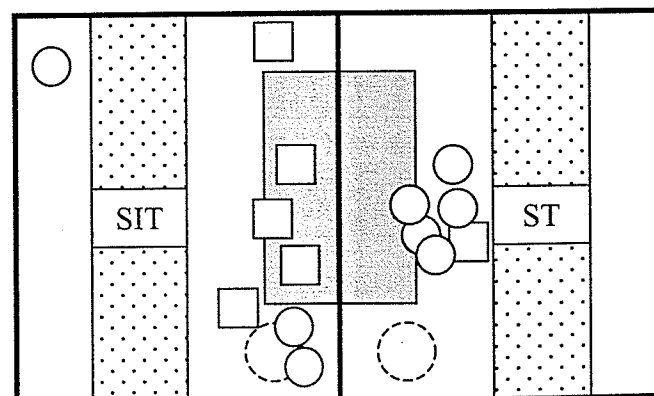
Crate: 35 Crate: 36

Time: 10:00 Time: 10:00



Crate: 35 Crate: 36

Time: 10:30 Time: 10:30



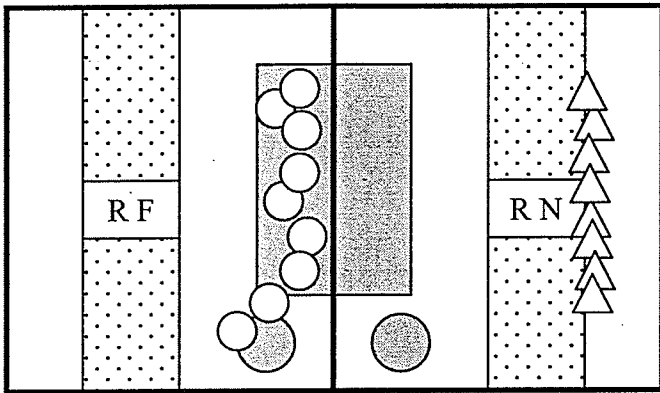
Crate: 35 Crate: 36

Time: 11:00 Time: 11:00

Behaviour Tests - Winter Farrowing 2001

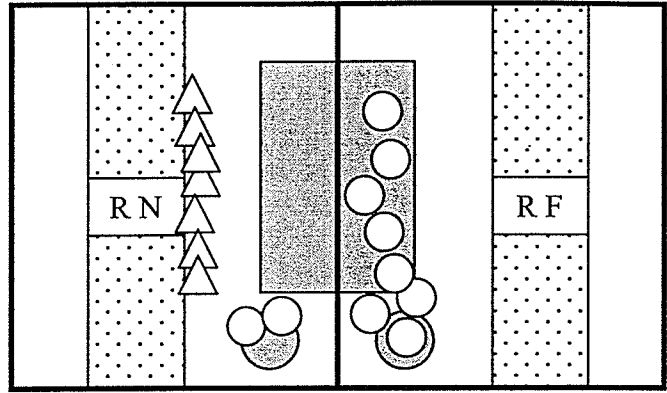
Day 1 - Section A (Heat Lamps On)

December 9-10, 2001



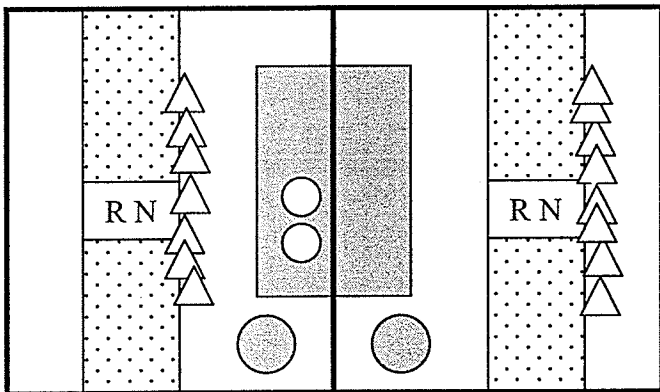
Crate: 4 Crate: 5

Time: 9:30 Time: 9:30



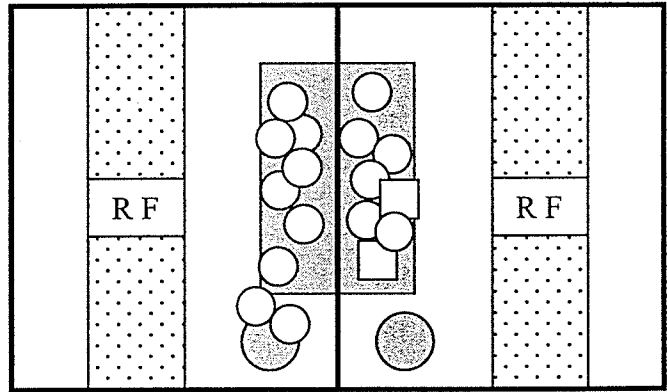
Crate: 4 Crate: 5

Time: 10:00 Time: 10:00



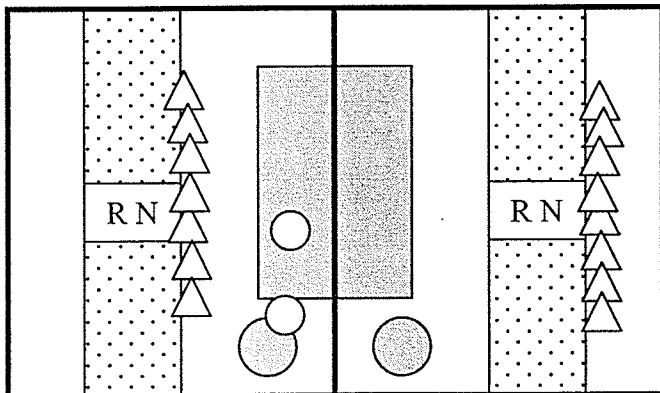
Crate: 4 Crate: 5

Time: 10:30 Time: 10:30



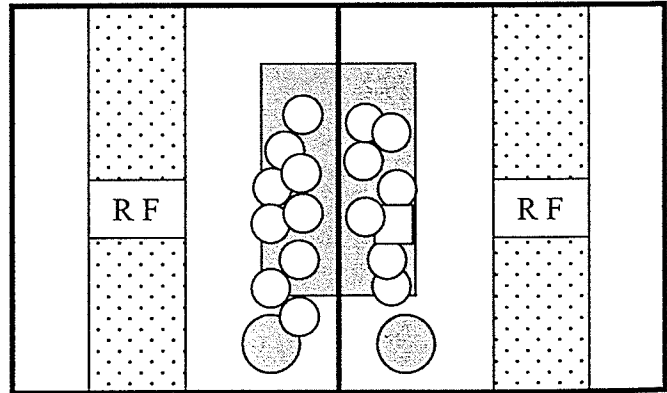
Crate: 4 Crate: 5

Time: 11:00 Time: 11:00



Crate: 4 Crate: 5

Time: 12:00 Time: 12:00



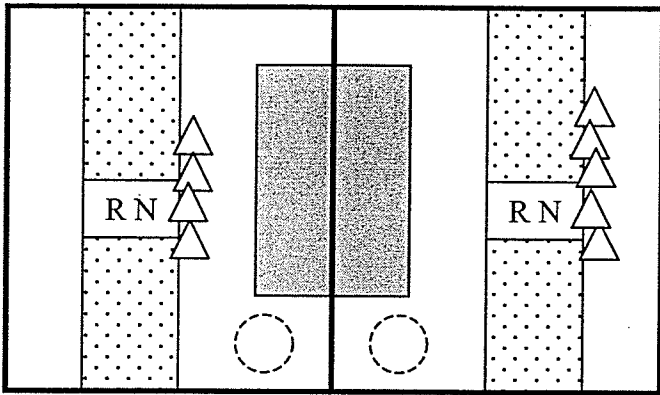
Crate: 4 Crate: 5

Time: 12:30 Time: 12:30

Behaviour Tests - Winter Farrowing 2001

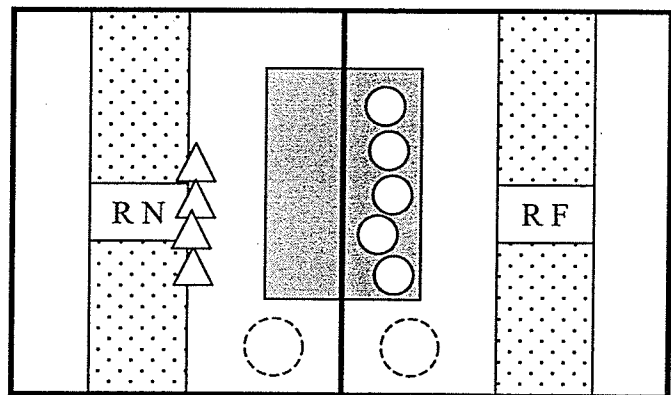
Day 1 - Section B (Heat Lamps Off)

December 28, 2001



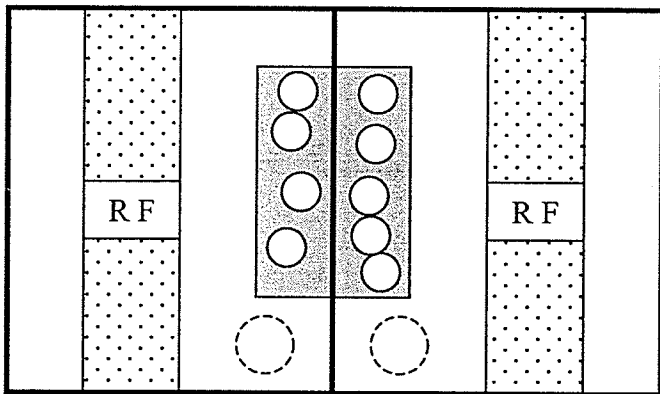
Crate: 11 Crate: 10

Time: 9:00 Time: 9:00



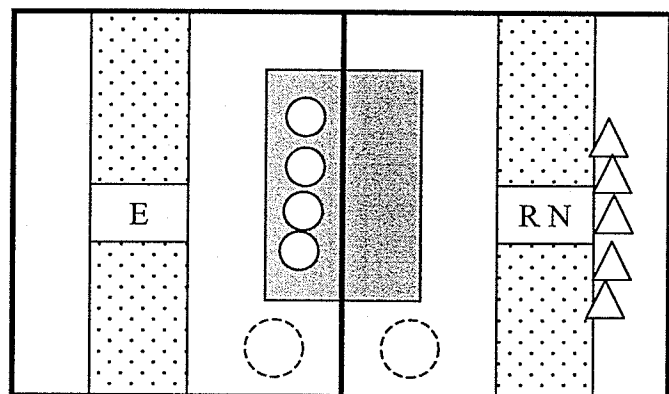
Crate: 11 Crate: 10

Time: 9:30 Time: 9:30



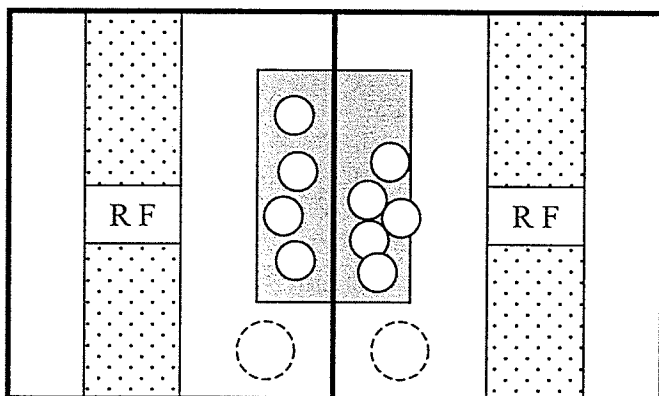
Crate: 11 Crate: 10

Time: 10:00 Time: 10:00



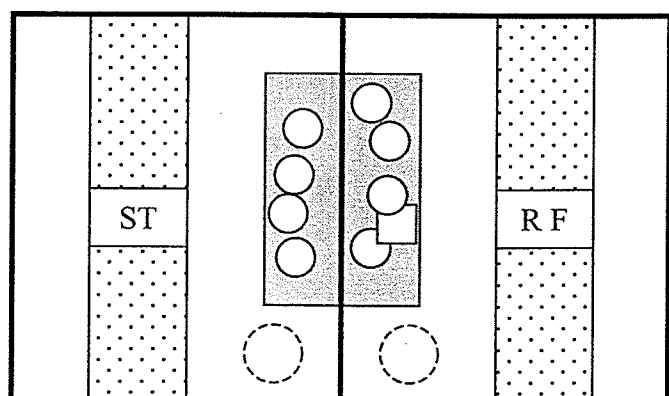
Crate: 11 Crate: 10

Time: 10:30 Time: 10:30



Crate: 11 Crate: 10

Time: 11:00 Time: 11:00



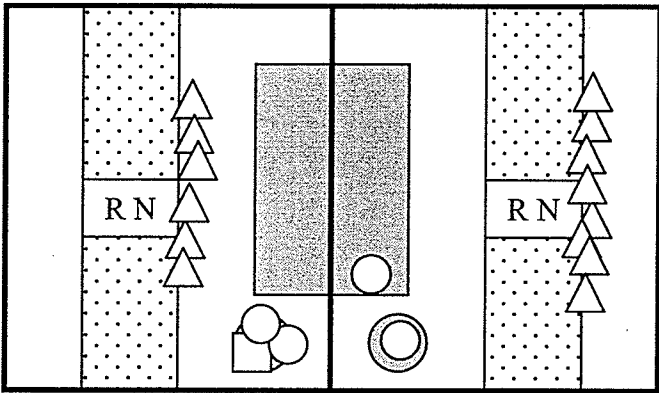
Crate: 11 Crate: 10

Time: 11:30 Time: 11:30

Behaviour Tests - Winter Farrowing 2001

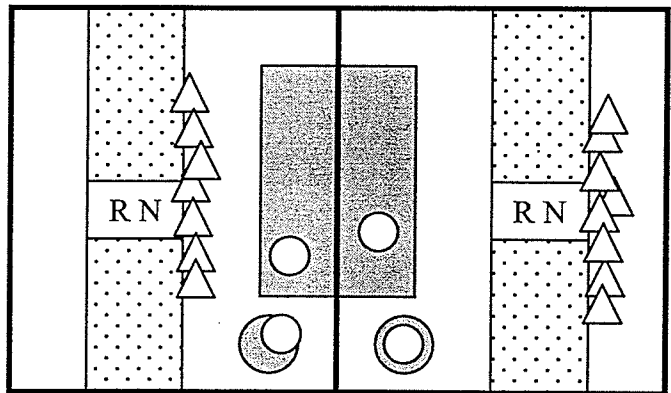
Day 1 - Section C (Heat Lamps On)

December 23, 2001



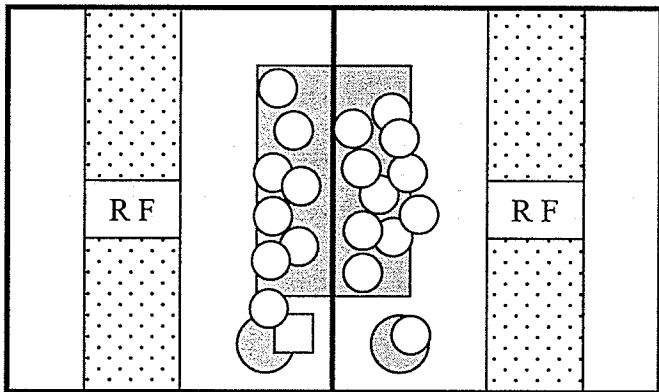
Crate: 23 Crate: 22

Time: 9:30 Time: 9:30



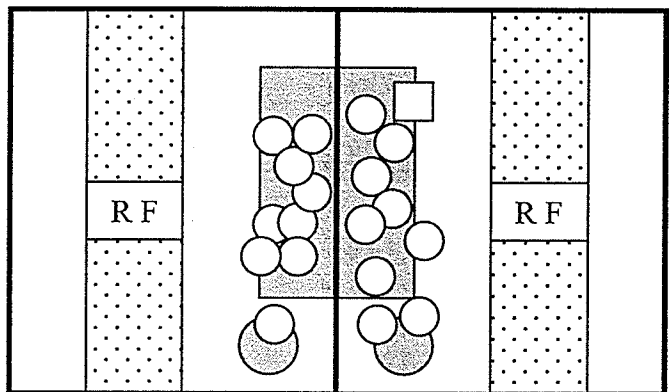
Crate: 23 Crate: 22

Time: 10:00 Time: 10:00



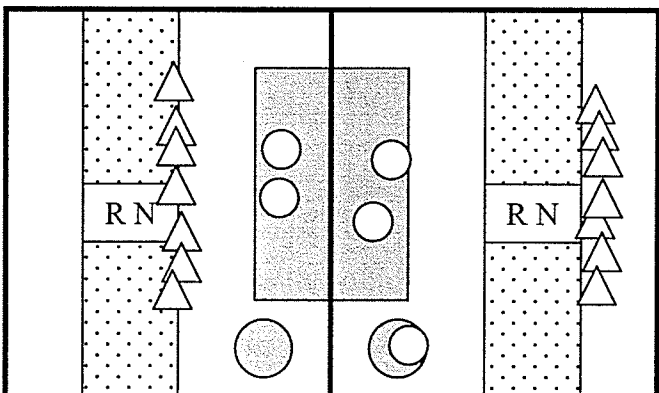
Crate: 23 Crate: 22

Time: 10:30 Time: 10:30



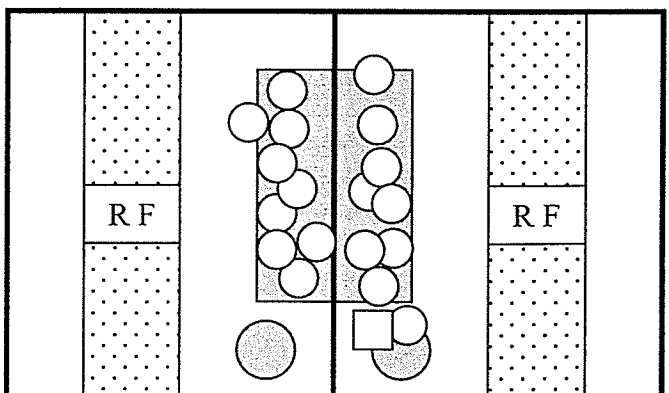
Crate: 23 Crate: 22

Time: 11:00 Time: 11:00



Crate: 23 Crate: 22

Time: 12:00 Time: 12:00



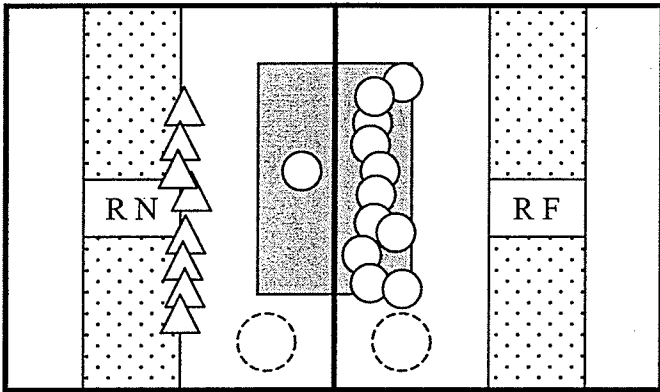
Crate: 23 Crate: 22

Time: 12:30 Time: 12:30

Behaviour Tests - Winter Farrowing 2001

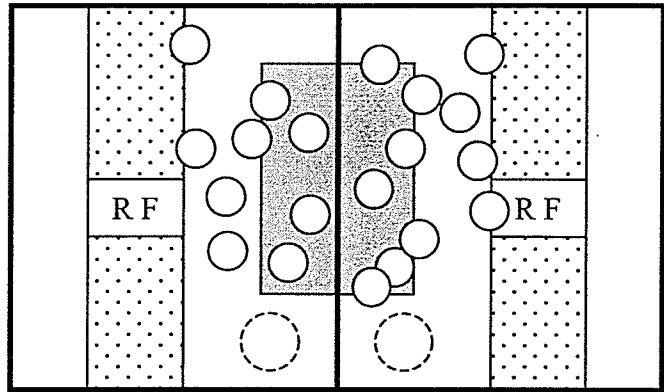
Day 1 - Section D (Heat Lamps Off)

December 12, 2001



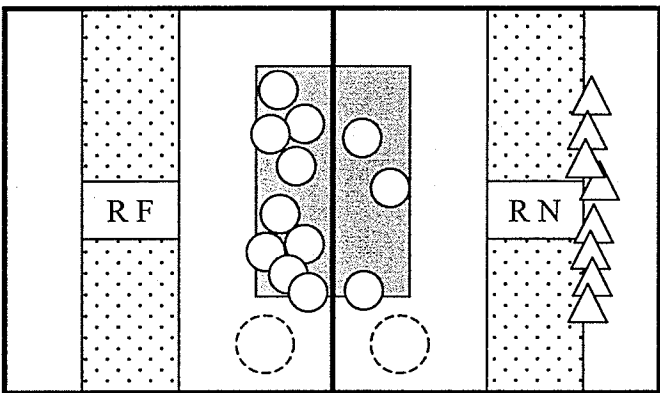
Crate: 33 Crate: 34

Time: 10:30 Time: 10:30



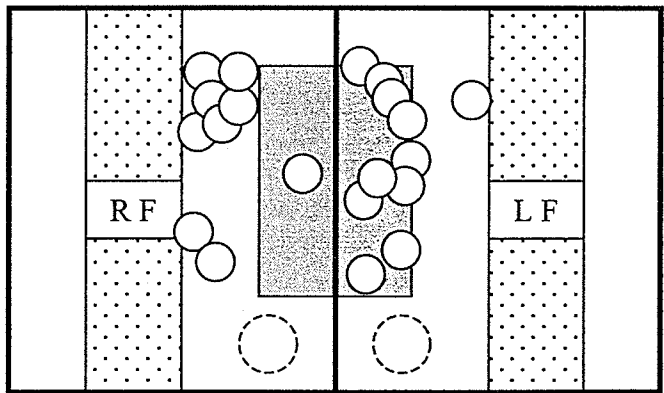
Crate: 33 Crate: 34

Time: 11:00 Time: 11:00



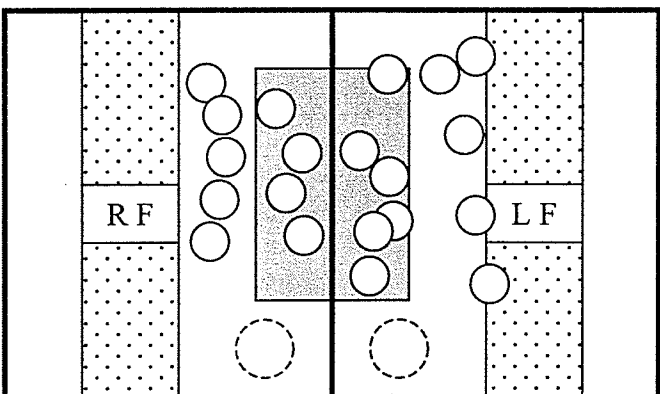
Crate: 33 Crate: 34

Time: 11:30 Time: 11:30



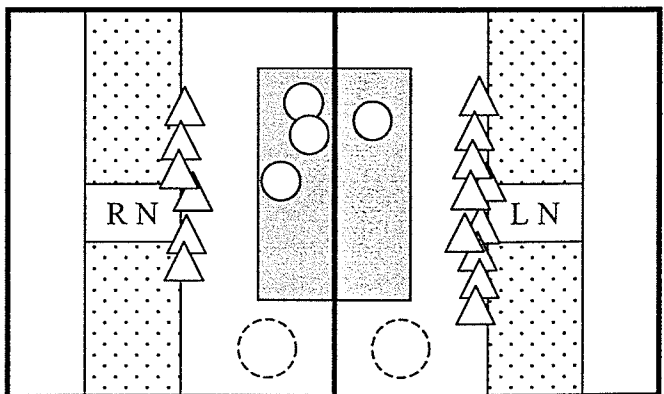
Crate: 33 Crate: 34

Time: 12:00 Time: 12:00



Crate: 33 Crate: 34

Time: 12:30 Time: 12:30



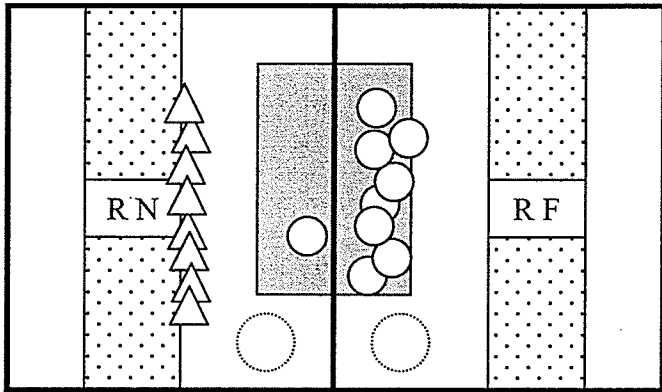
Crate: 33 Crate: 34

Time: 1:00 Time: 1:00

Behaviour Tests - Winter Farrowing 2001

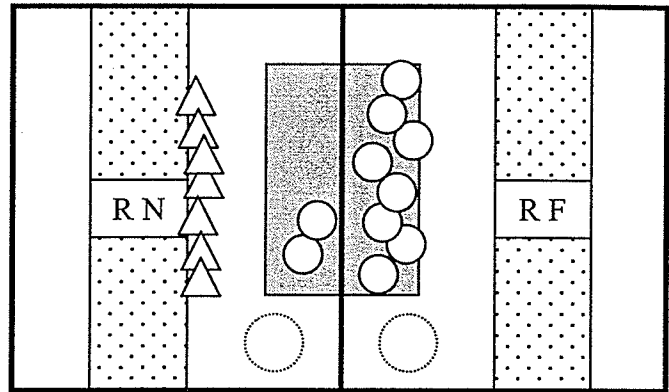
Day 3 - Section A (Heat Lamps Off)

December 12-13, 2001



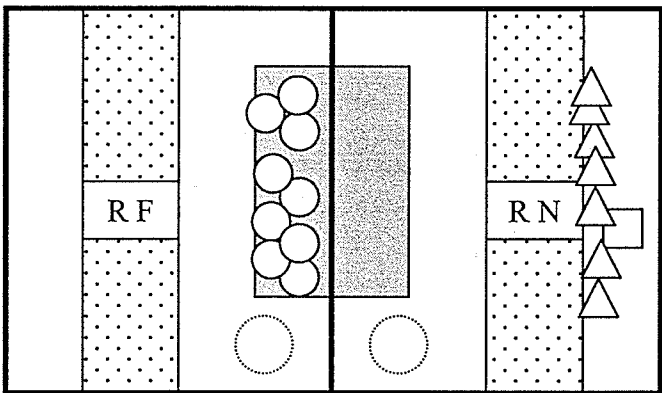
Crate: 4 Crate: 5

Time: 9:00 Time: 9:00



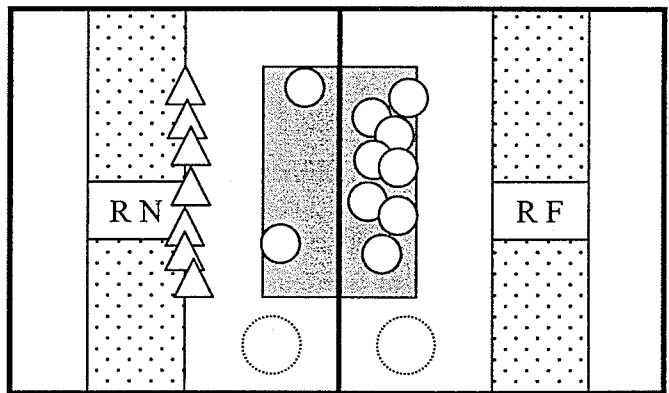
Crate: 4 Crate: 5

Time: 9:30 Time: 9:30



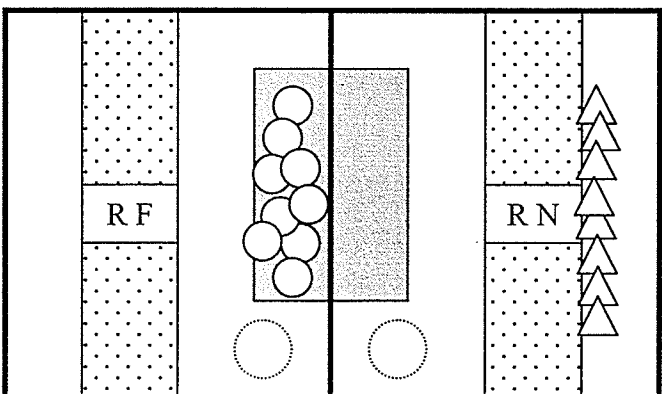
Crate: 4 Crate: 5

Time: 10:00 Time: 10:00



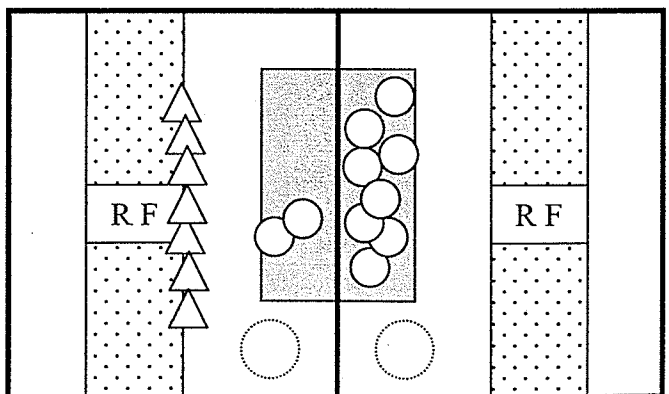
Crate: 4 Crate: 5

Time: 10:30 Time: 10:30



Crate: 4 Crate: 5

Time: 11:00 Time: 11:00



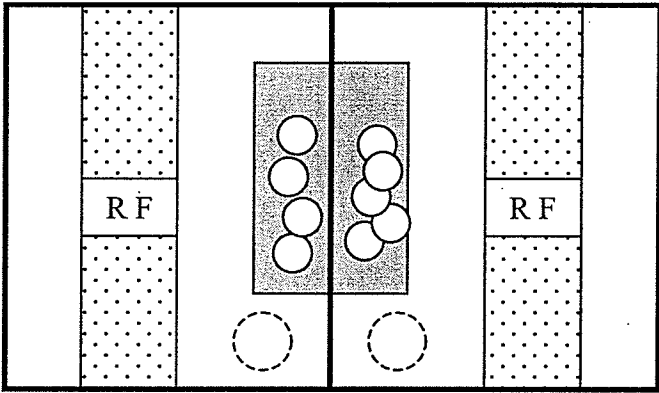
Crate: 4 Crate: 5

Time: 11:30 Time: 11:30

Behaviour Tests - Winter Farrowing 2001

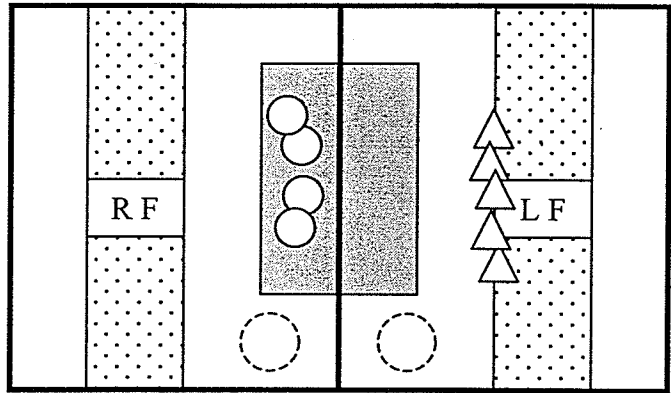
Day 3 - Section B (Heat Lamps Off)

December 31, 2001



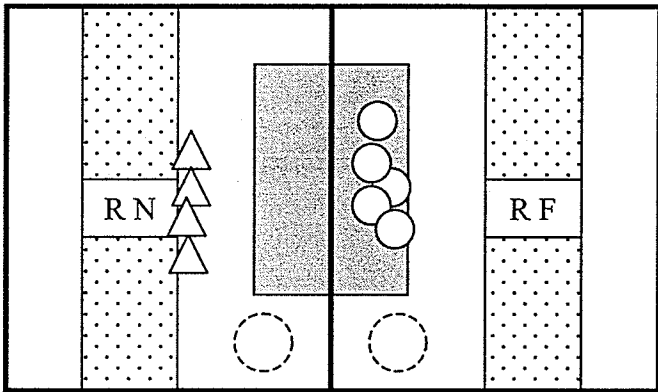
Crate: 11 Crate: 10

Time: 9:00 Time: 9:00



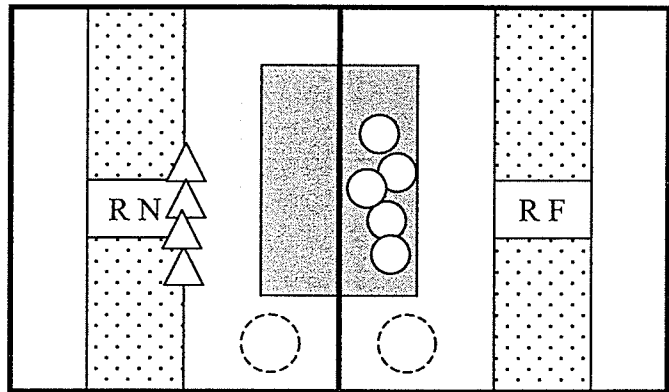
Crate: 11 Crate: 10

Time: 9:30 Time: 9:30



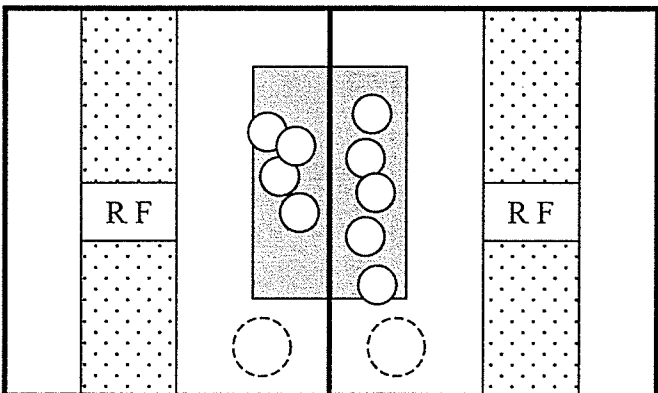
Crate: 11 Crate: 10

Time: 10:00 Time: 10:00



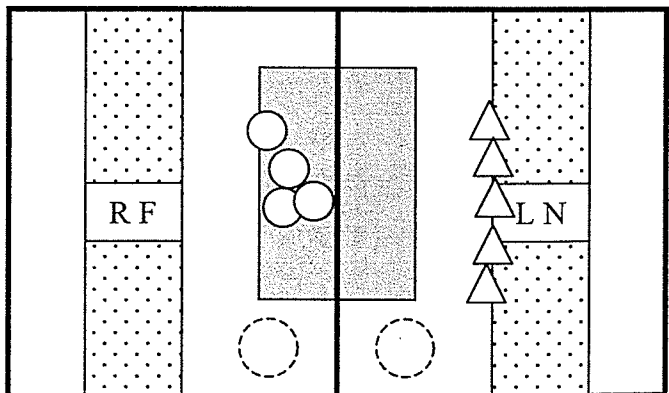
Crate: 11 Crate: 10

Time: 10:30 Time: 10:30



Crate: 11 Crate: 10

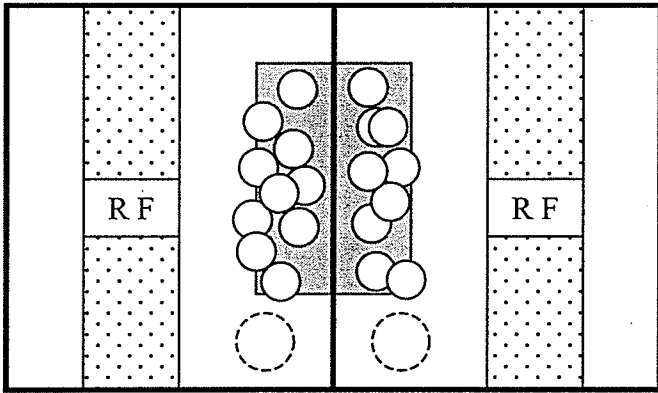
Time: 11:00 Time: 11:00



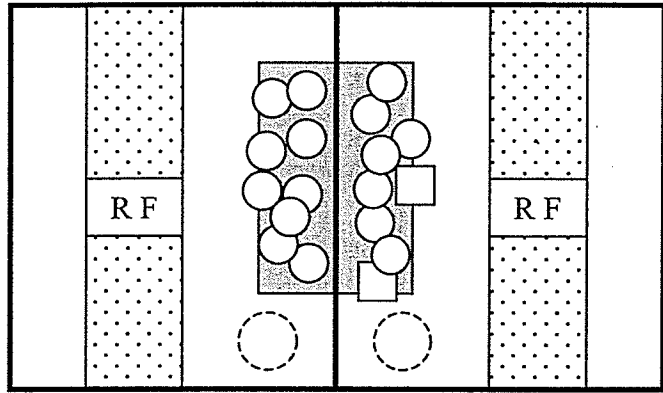
Crate: 11 Crate: 10

Time: 11:30 Time: 11:30

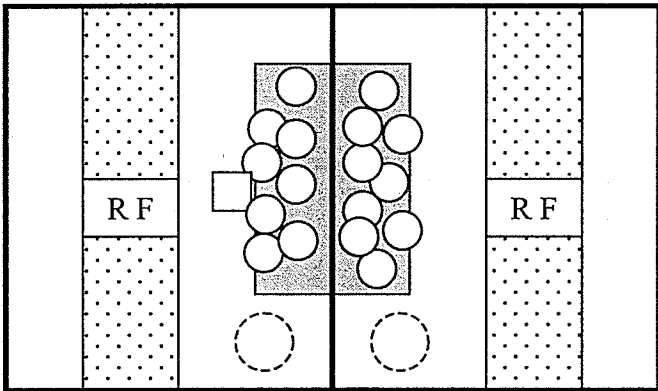
Behaviour Tests - Winter Farrowing 2001
 Day 3 - Section C (Heat Lamps Off)
 December 27, 2001



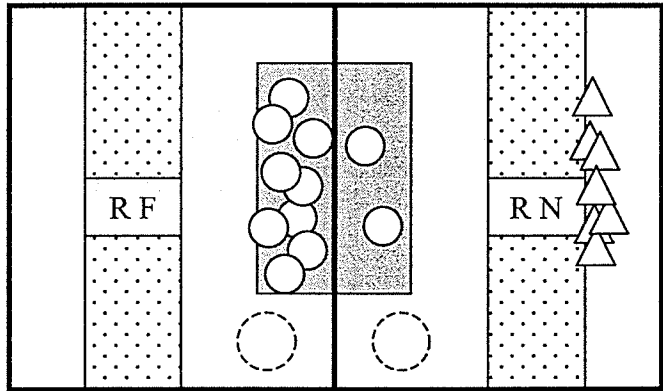
Crate: 23 Crate: 22
 Time: 9:00 Time: 9:00



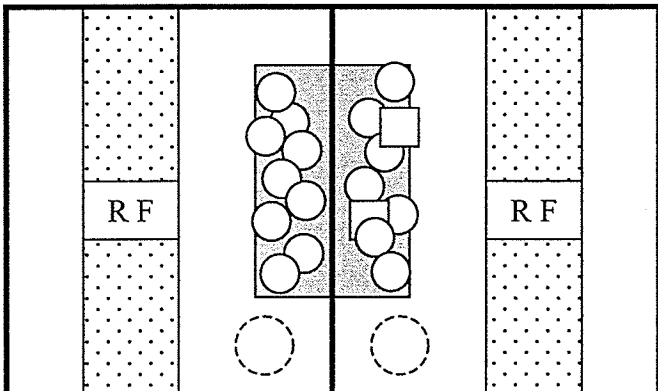
Crate: 23 Crate: 22
 Time: 9:30 Time: 9:30



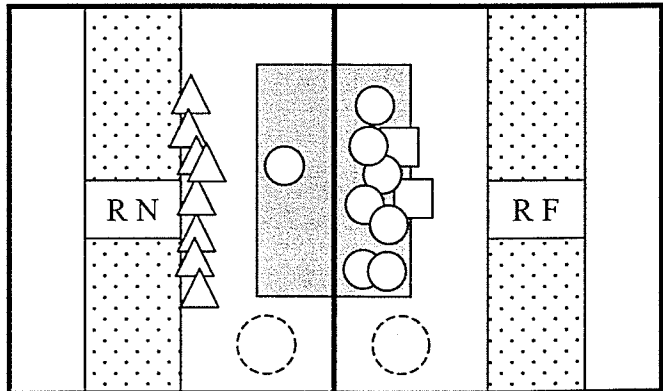
Crate: 23 Crate: 22
 Time: 10:00 Time: 10:00



Crate: 23 Crate: 22
 Time: 10:30 Time: 10:30

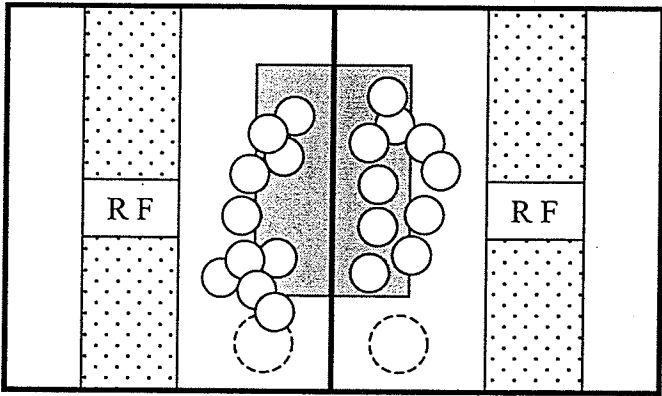


Crate: 23 Crate: 22
 Time: 11:00 Time: 11:00

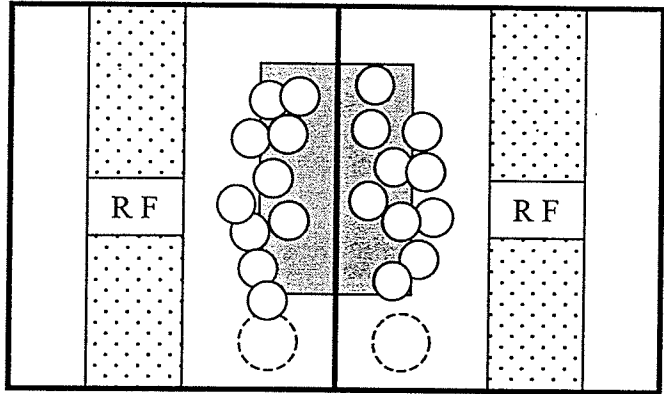


Crate: 23 Crate: 22
 Time: 12:30 Time: 12:30

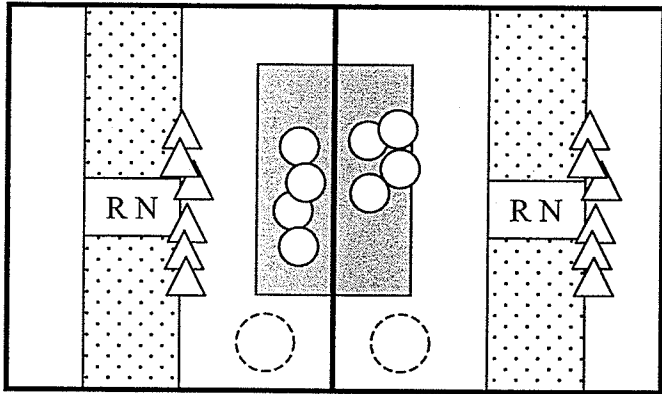
Behaviour Tests - Winter Farrowing 2001
 Day 3 - Section D (Heat Lamps Off)
 December 15, 2001



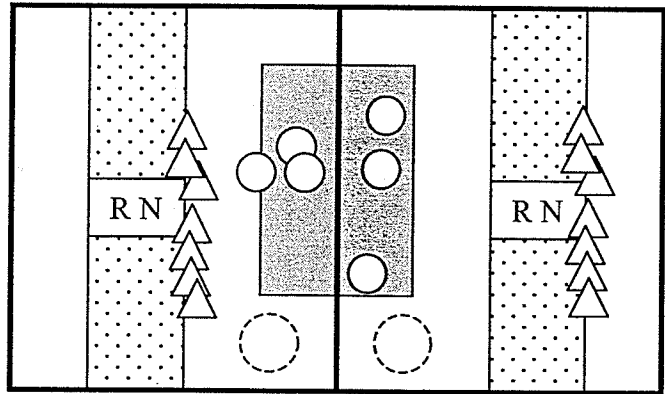
Crate: 33 Crate: 34
 Time: 9:00 Time: 9:00



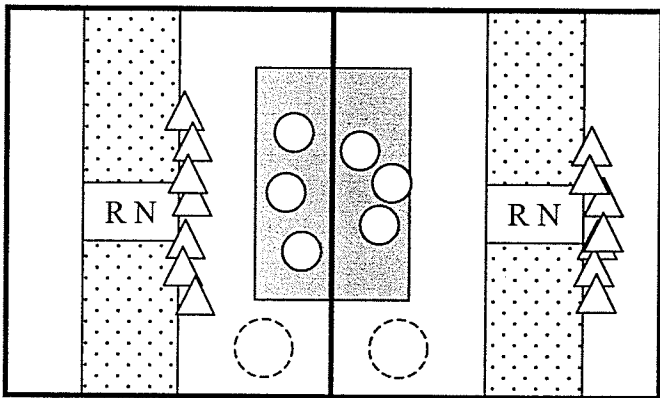
Crate: 33 Crate: 34
 Time: 9:30 Time: 9:30



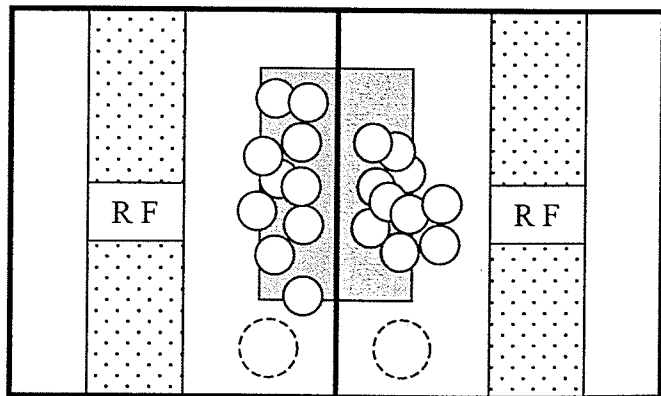
Crate: 33 Crate: 34
 Time: 10:00 Time: 10:00



Crate: 33 Crate: 34
 Time: 10:30 Time: 10:30

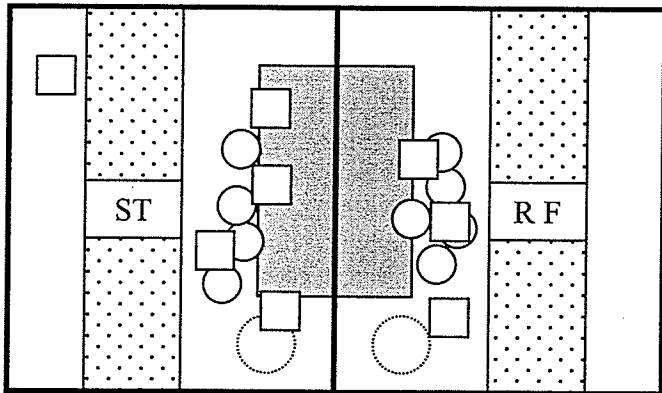


Crate: 33 Crate: 34
 Time: 11:00 Time: 11:00

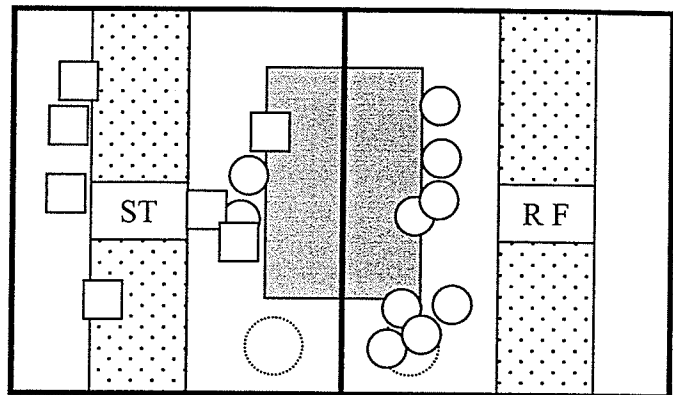


Crate: 33 Crate: 34
 Time: 11:30 Time: 11:30

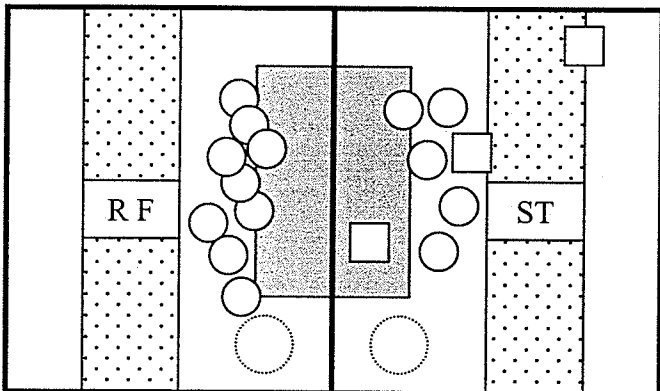
Behaviour Tests - Winter Farrowing 2001
 Day 7 - Section A (Heat Lamps Off)
 December 16-17, 2001



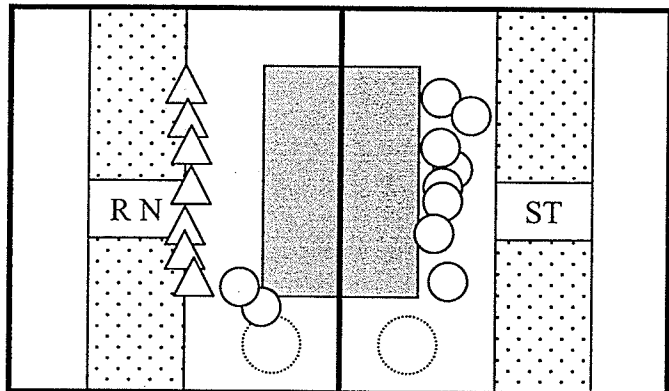
Crate: 4 Crate: 5
 Time: 9:00 Time: 9:00



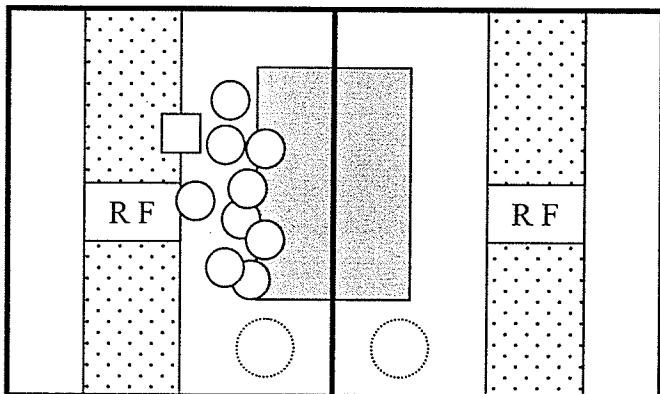
Crate: 4 Crate: 5
 Time: 9:30 Time: 9:30



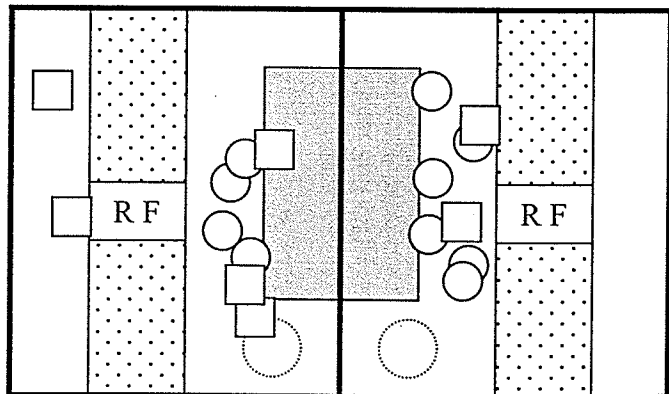
Crate: 4 Crate: 5
 Time: 10:00 Time: 10:00



Crate: 4 Crate: 5
 Time: 10:30 Time: 10:30

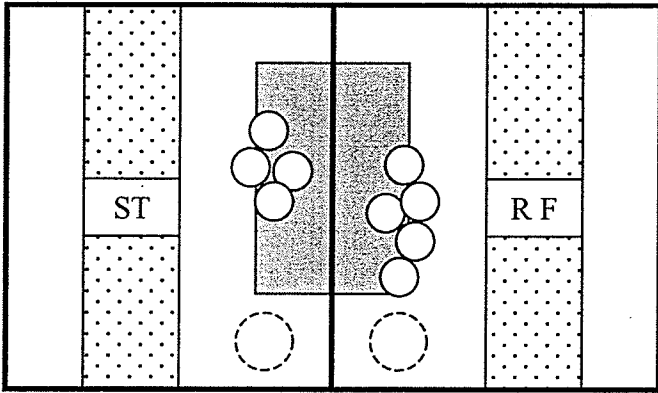


Crate: 4 Crate: 5
 Time: 11:00 Time: 11:00

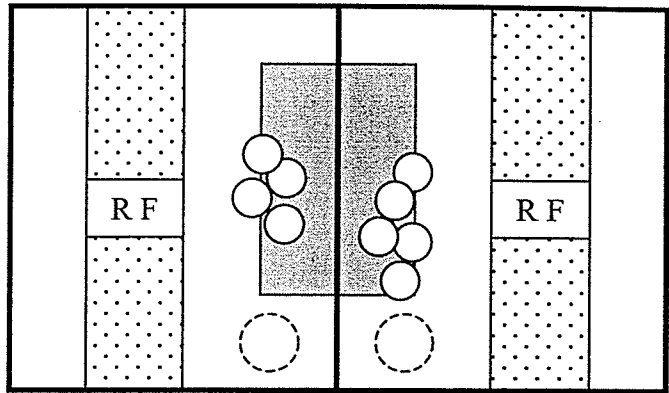


Crate: 4 Crate: 5
 Time: 11:30 Time: 11:30

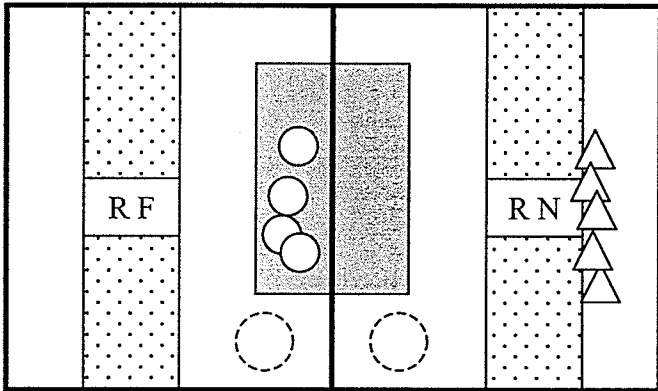
Behaviour Tests - Winter Farrowing 2001
 Day 7 - Section B (Heat Lamps Off)
 January 5, 2002



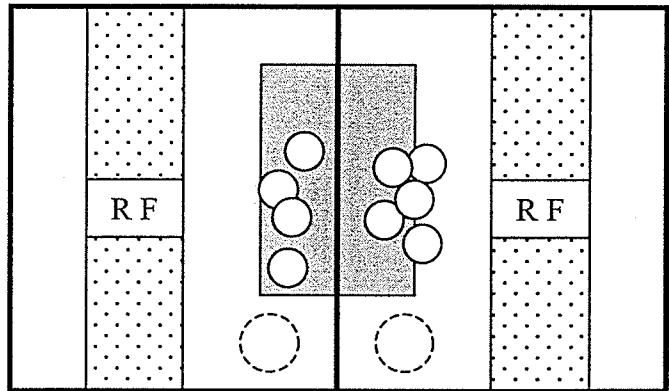
Crate: 11 Crate: 10
 Time: 1:00 Time: 1:00



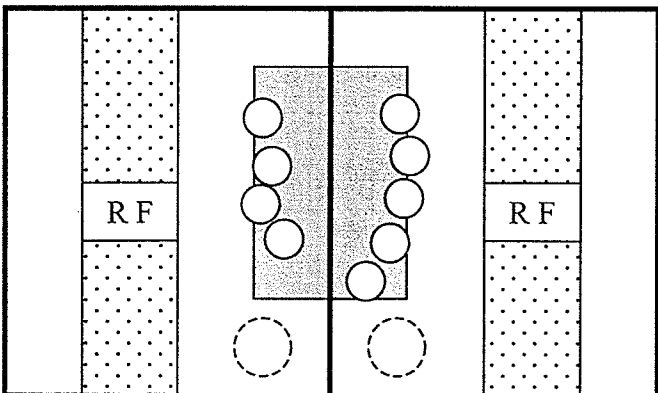
Crate: 11 Crate: 10
 Time: 1:30 Time: 1:30



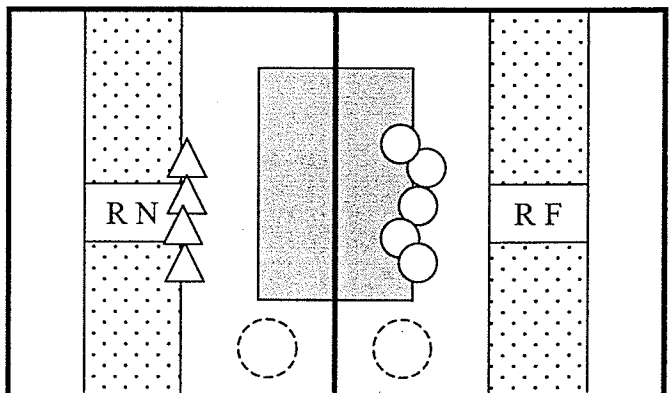
Crate: 11 Crate: 10
 Time: 2:00 Time: 2:00



Crate: 11 Crate: 10
 Time: 2:30 Time: 2:30

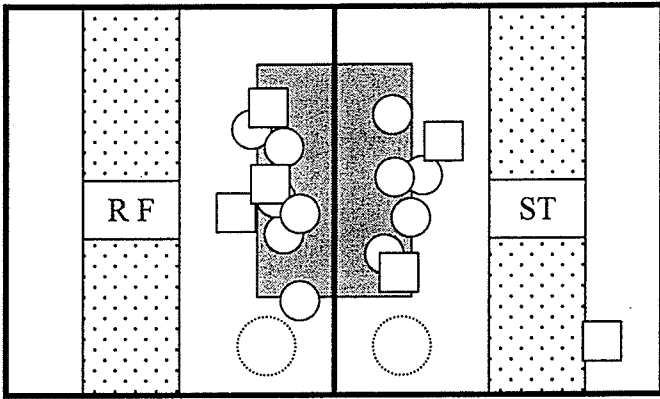


Crate: 11 Crate: 10
 Time: 3:00 Time: 3:00

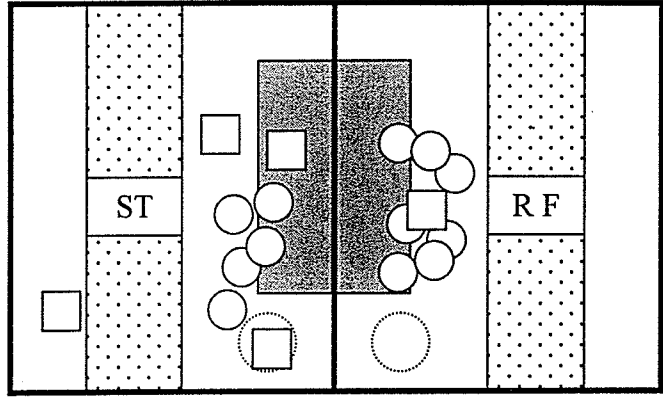


Crate: 11 Crate: 10
 Time: 3:30 Time: 3:30

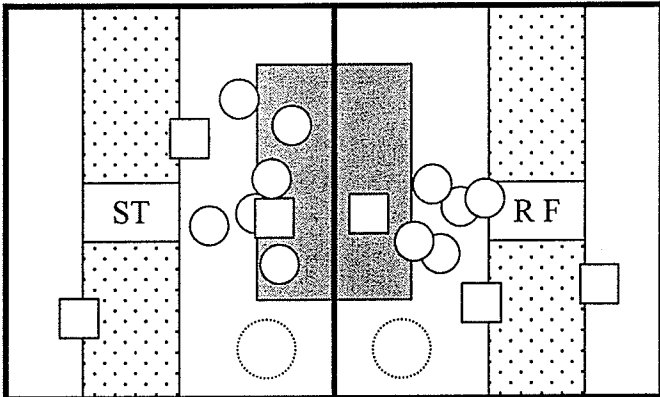
Behaviour Tests - Winter Farrowing 2001
 Day 7 - Section C (Heat Lamps Off)
 December 30, 2001



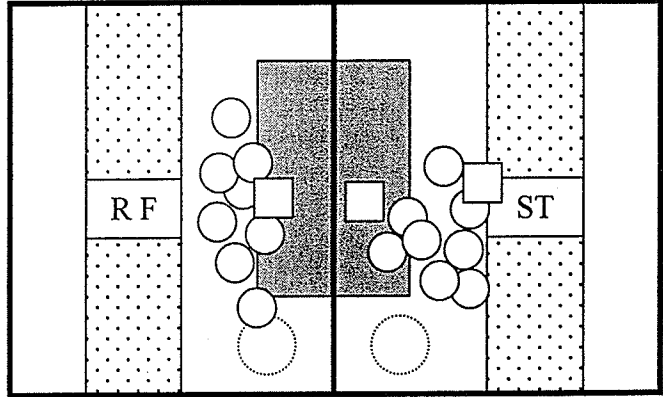
Crate: 23 Crate: 22
 Time: 9:00 Time: 9:00



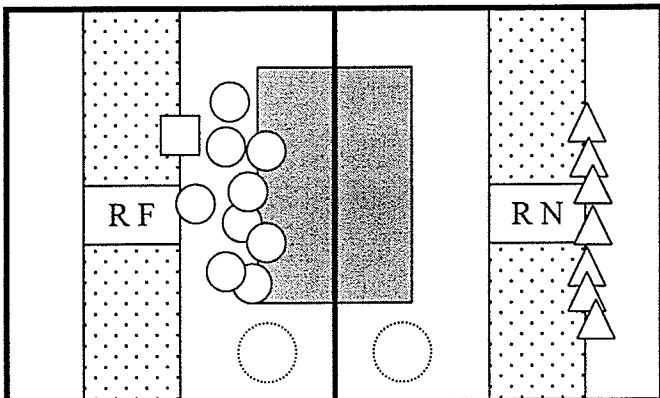
Crate: 23 Crate: 22
 Time: 9:30 Time: 9:30



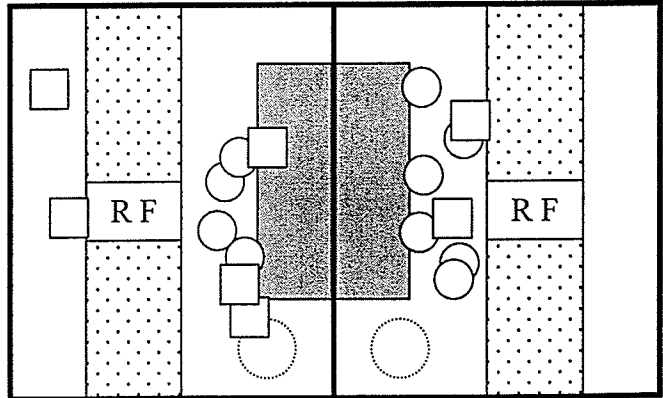
Crate: 23 Crate: 22
 Time: 10:00 Time: 10:00



Crate: 23 Crate: 22
 Time: 10:30 Time: 10:30

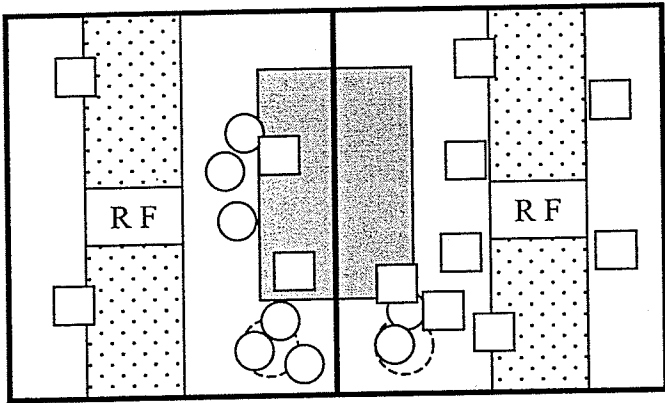


Crate: 23 Crate: 22
 Time: 11:00 Time: 11:00

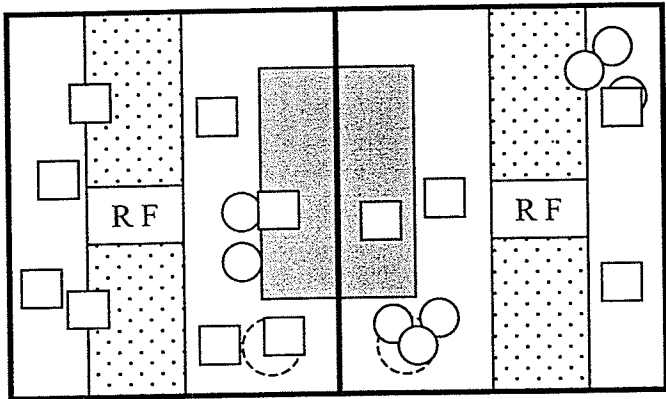


Crate: 23 Crate: 22
 Time: 11:30 Time: 11:30

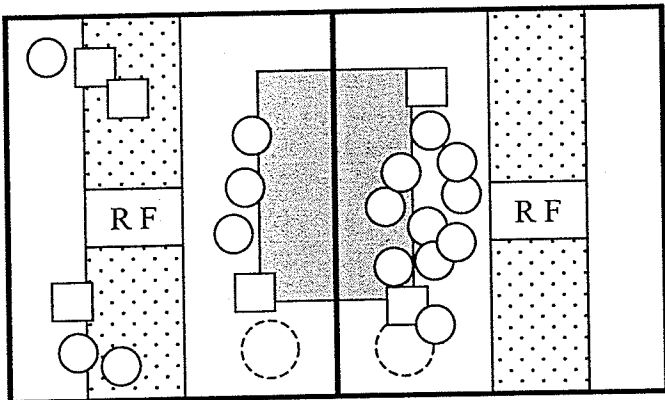
Behaviour Tests - Winter Farrowing 2001
 Day 7 - Section D (Heat Lamps Off)
 December 19, 2001



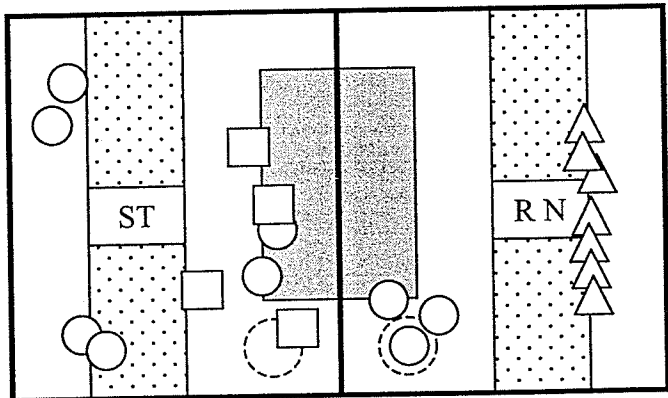
Crate: 33 Crate: 34
 Time: 9:00 Time: 9:00



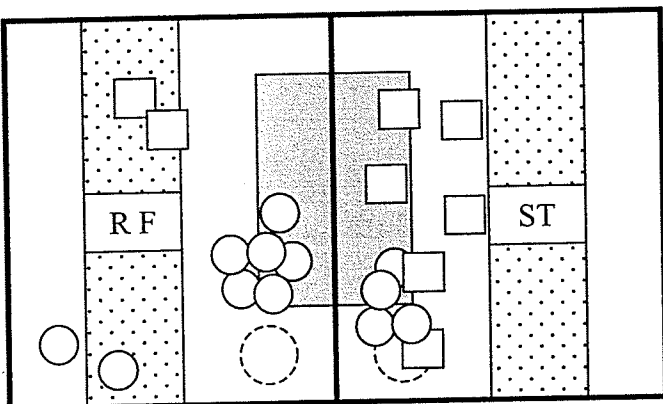
Crate: 33 Crate: 34
 Time: 9:30 Time: 9:30



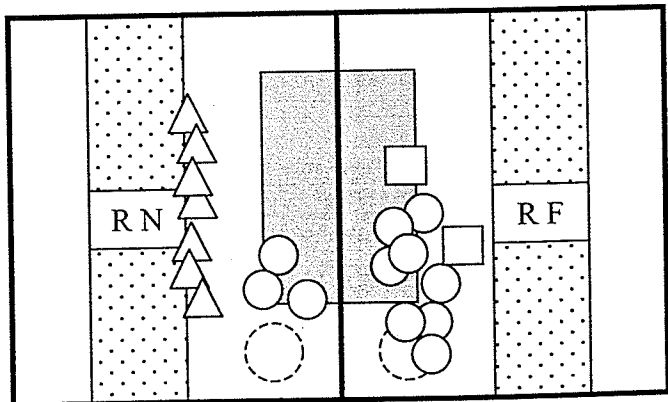
Crate: 33 Crate: 34
 Time: 10:00 Time: 10:00



Crate: 33 Crate: 34
 Time: 10:30 Time: 10:30

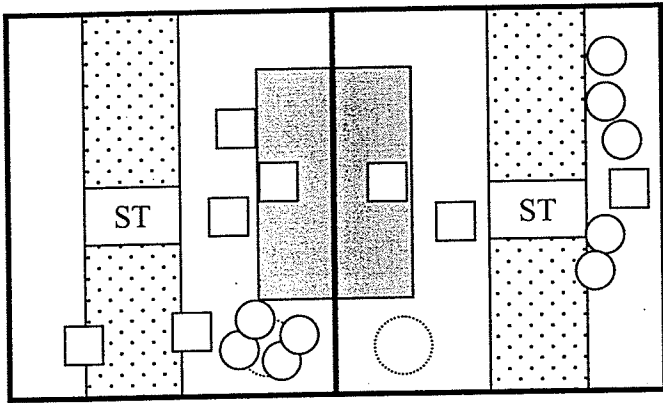


Crate: 33 Crate: 34
 Time: 11:00 Time: 11:00

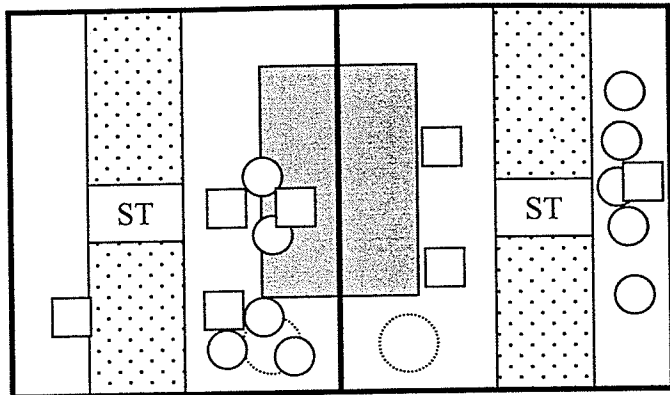


Crate: 33 Crate: 34
 Time: 11:30 Time: 11:30

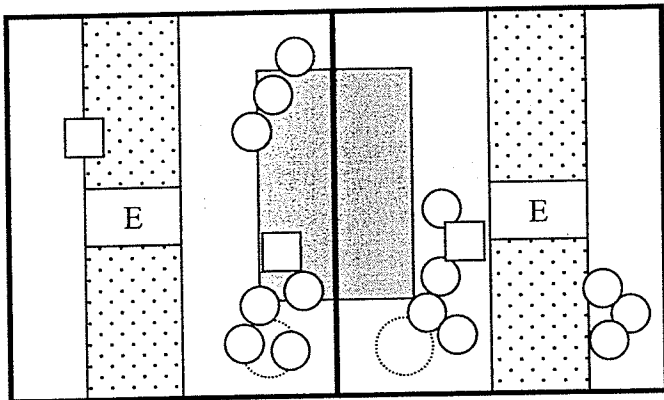
Behaviour Tests - Winter Farrowing 2001
 Day 16 - Section A (Heat Lamps Off)
 December 28, 2001



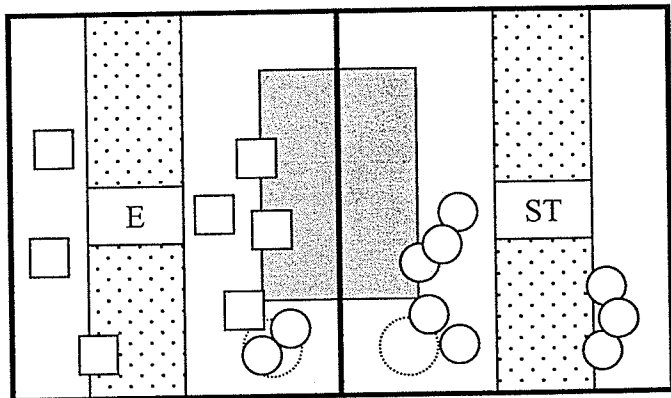
Crate: 4 Crate: 5
 Time: 1:00 Time: 1:00



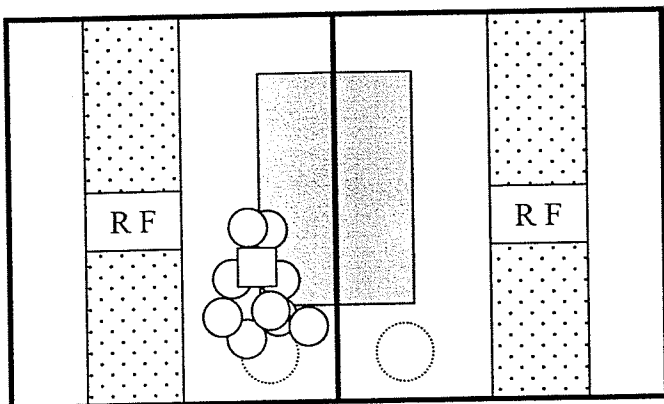
Crate: 4 Crate: 5
 Time: 1:30 Time: 1:30



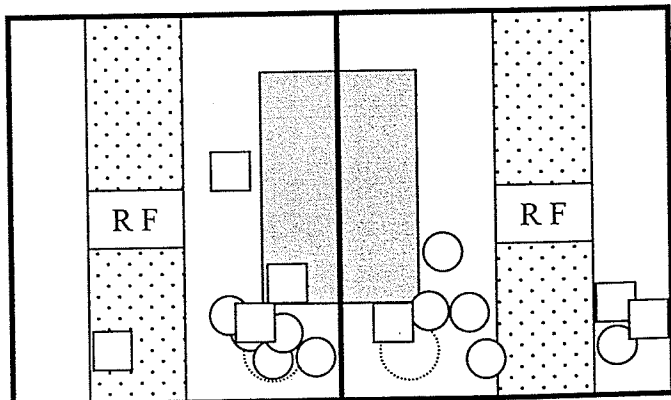
Crate: 4 Crate: 5
 Time: 2:00 Time: 2:00



Crate: 4 Crate: 5
 Time: 2:30 Time: 2:30

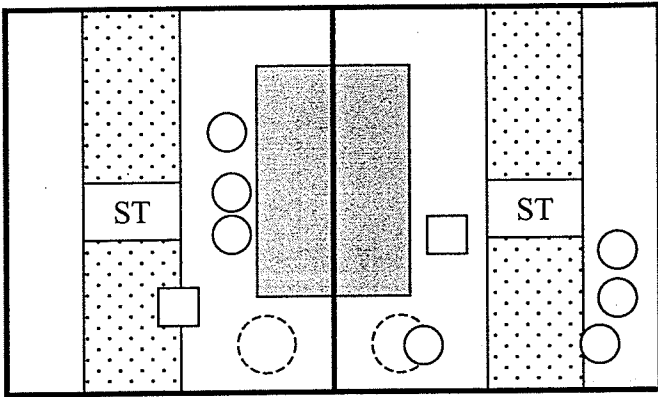


Crate: 4 Crate: 5
 Time: 3:00 Time: 3:00

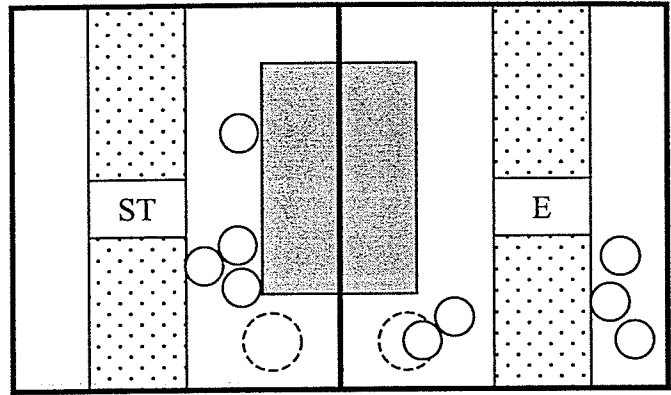


Crate: 4 Crate: 5
 Time: 3:30 Time: 3:30

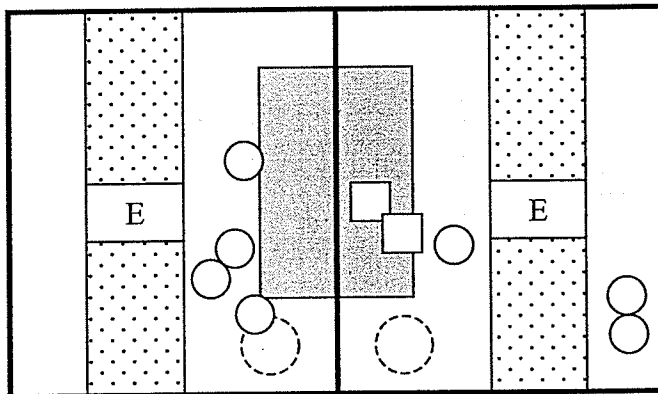
Behaviour Tests - Winter Farrowing 2001
 Day 16 - Section B (Heat Lamps Off)
 January 13, 2002



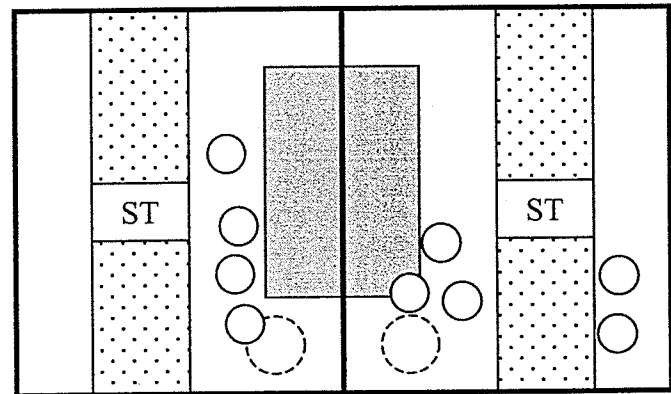
Crate: 11 Crate: 10
 Time: 1:00 Time: 1:00



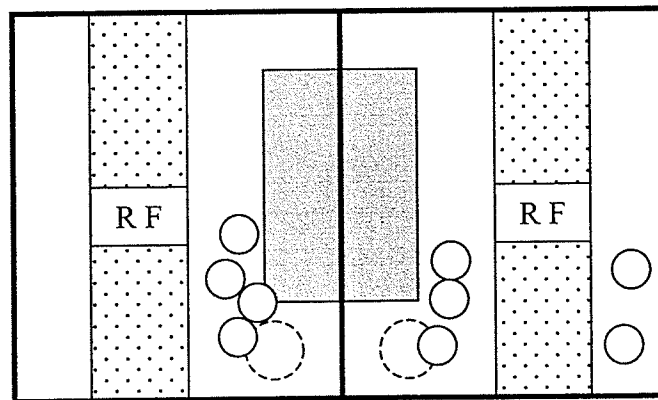
Crate: 11 Crate: 10
 Time: 1:30 Time: 1:30



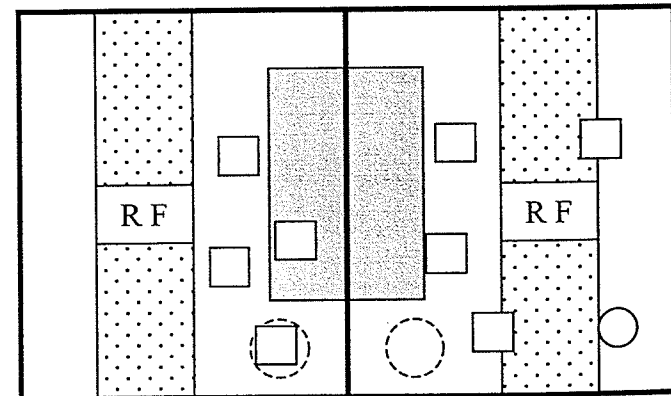
Crate: 11 Crate: 10
 Time: 2:00 Time: 2:00



Crate: 11 Crate: 10
 Time: 2:30 Time: 2:30

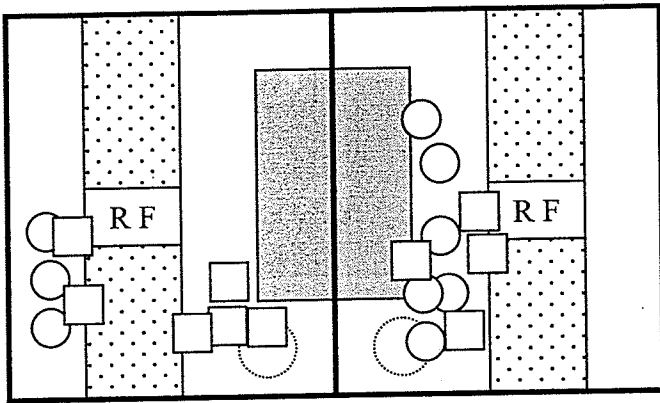


Crate: 11 Crate: 10
 Time: 3:00 Time: 3:00

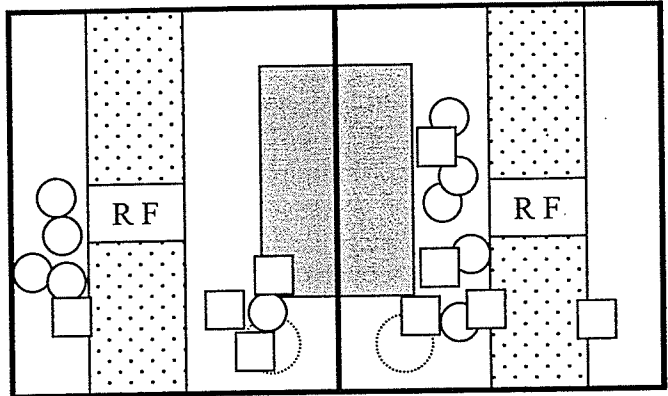


Crate: 11 Crate: 10
 Time: 3:30 Time: 3:30

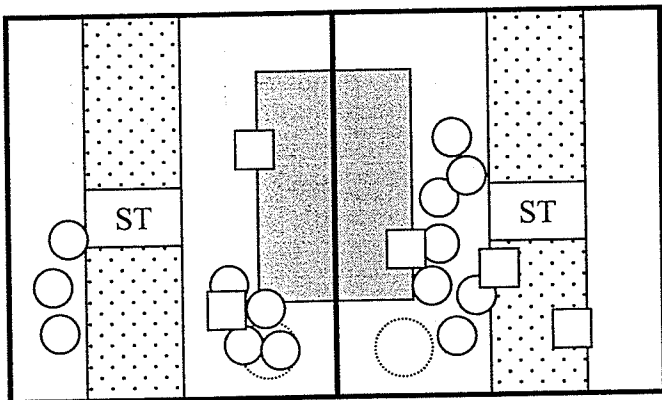
Behaviour Tests - Winter Farrowing 2001
 Day 16 - Section C (Heat Lamps Off)
 January 8, 2002



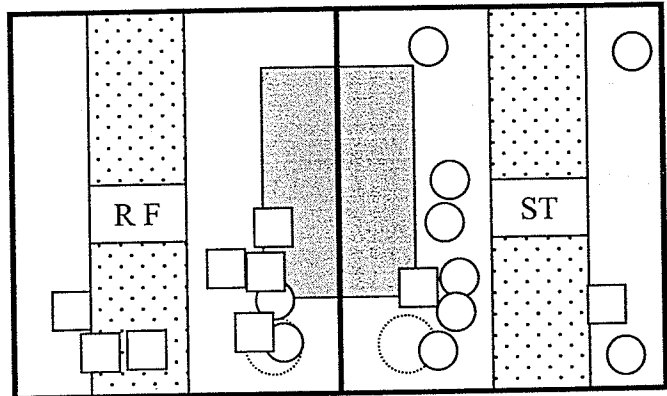
Crate: 23 Crate: 22
 Time: 9:00 Time: 9:00



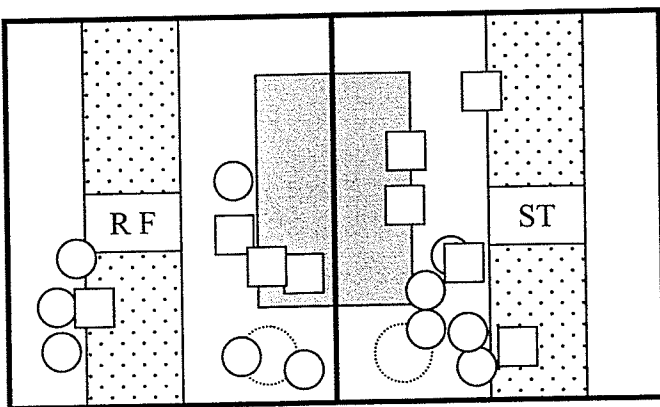
Crate: 23 Crate: 22
 Time: 9:30 Time: 9:30



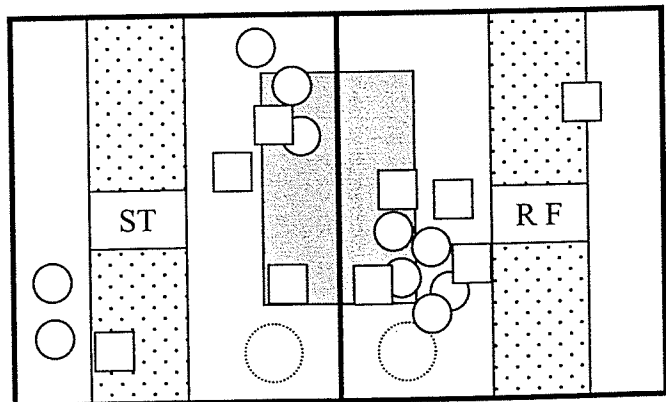
Crate: 23 Crate: 22
 Time: 10:00 Time: 10:00



Crate: 23 Crate: 22
 Time: 10:30 Time: 10:30

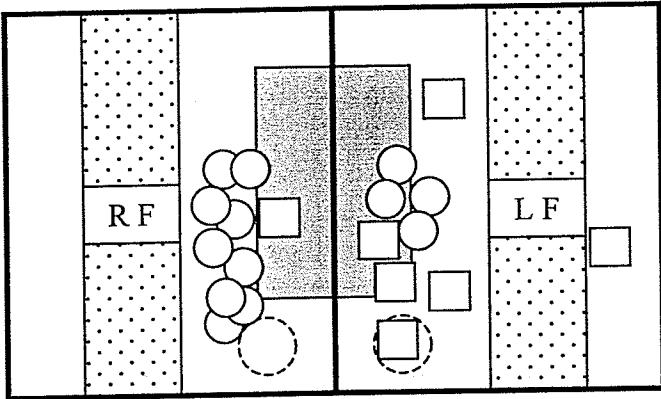


Crate: 23 Crate: 22
 Time: 11:00 Time: 11:00

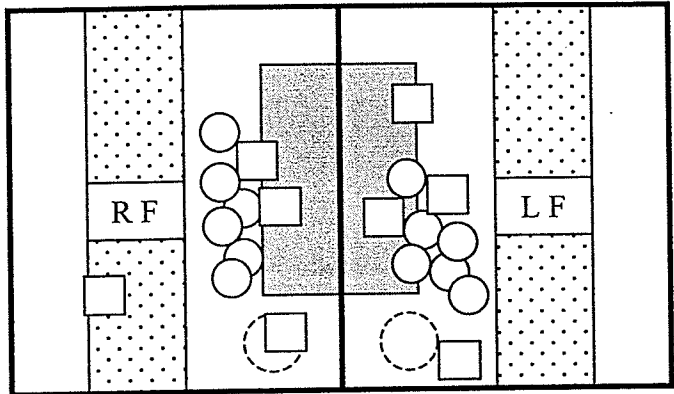


Crate: 23 Crate: 22
 Time: 11:30 Time: 11:30

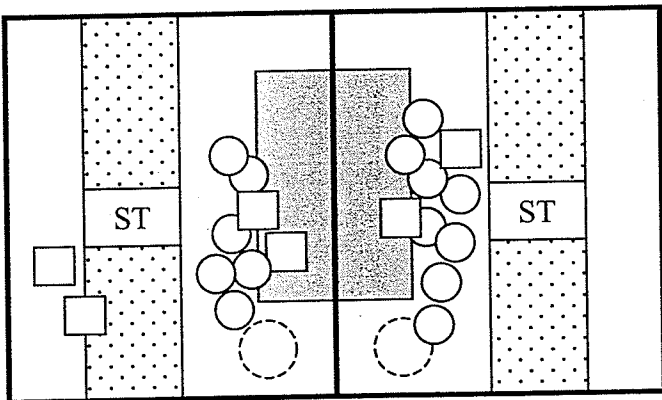
Behaviour Tests - Winter Farrowing 2001
 Day 16 - Section D (Heat Lamps Off)
 December 28, 2001



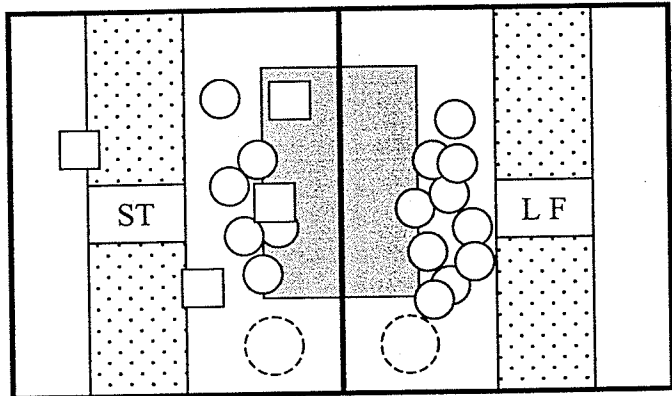
Crate: 33 Crate: 34
 Time: 1:00 Time: 1:00



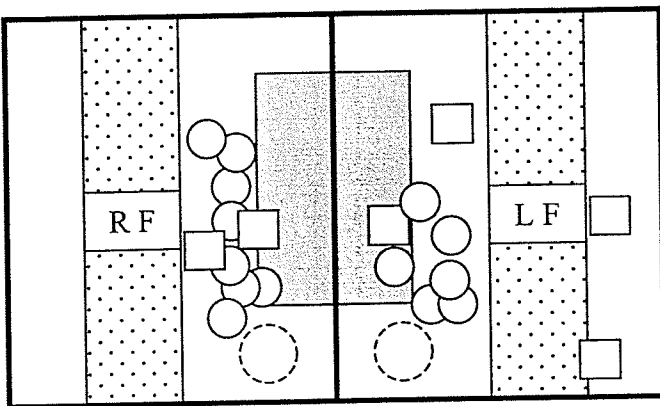
Crate: 33 Crate: 34
 Time: 1:30 Time: 1:30



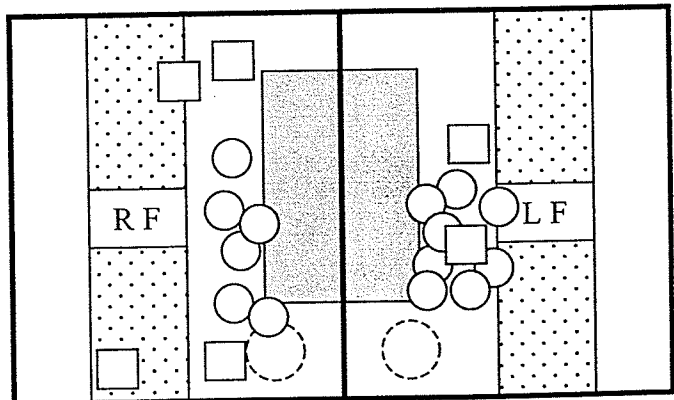
Crate: 33 Crate: 34
 Time: 2:00 Time: 2:00



Crate: 33 Crate: 34
 Time: 2:30 Time: 2:30

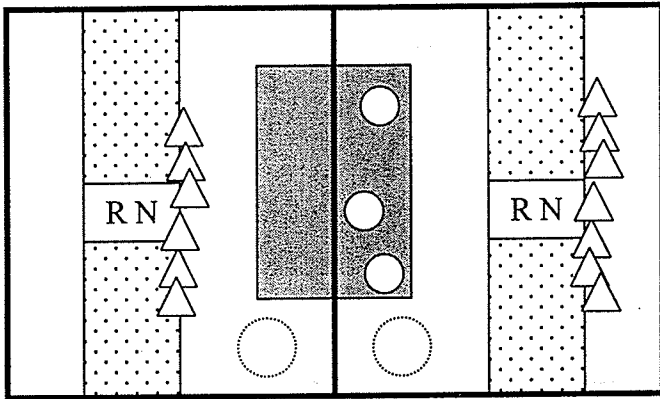


Crate: 33 Crate: 34
 Time: 3:00 Time: 3:00

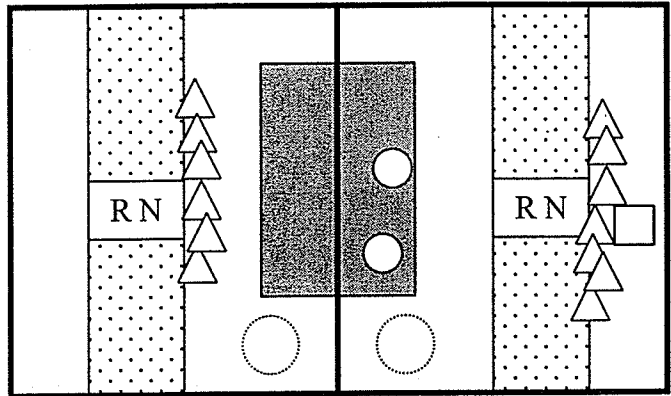


Crate: 33 Crate: 34
 Time: 3:30 Time: 3:30

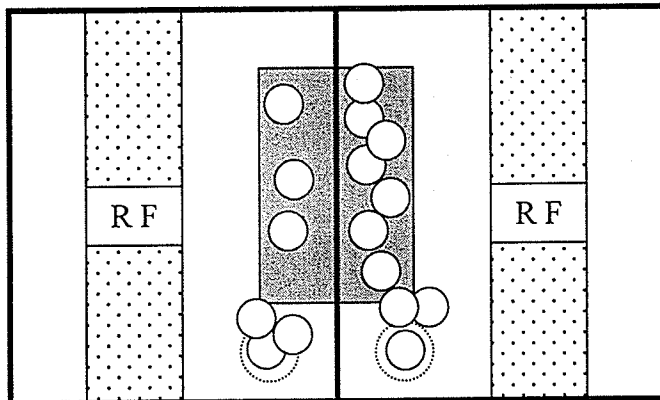
Behaviour Tests - Spring Farrowing 2002
 Day 1 - Section A (Heat Lamps Off)
 February 11, 2002



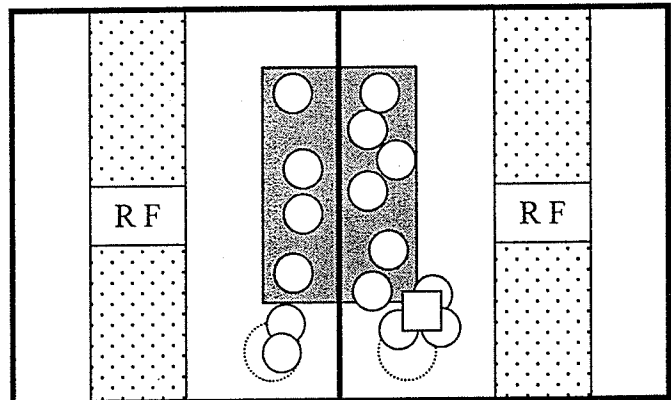
Crate: 3 Crate: 2
 Time: 9:00 Time: 9:00



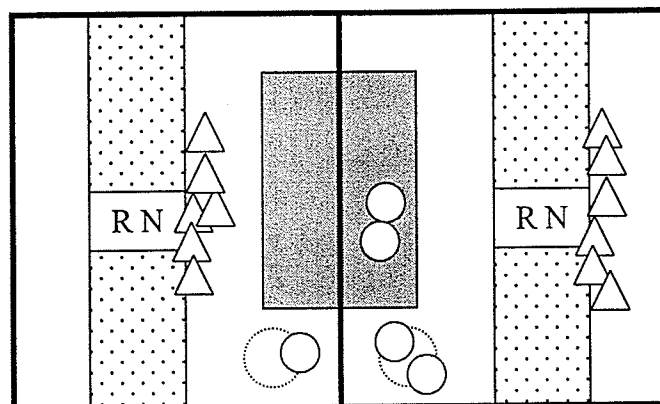
Crate: 3 Crate: 2
 Time: 9:30 Time: 9:30



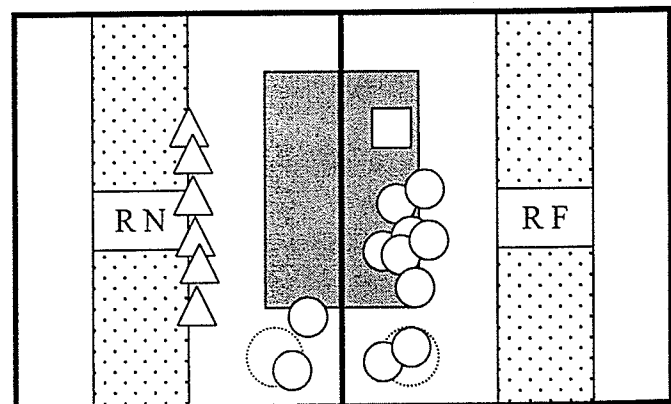
Crate: 3 Crate: 2
 Time: 10:00 Time: 10:00



Crate: 3 Crate: 2
 Time: 10:30 Time: 10:30

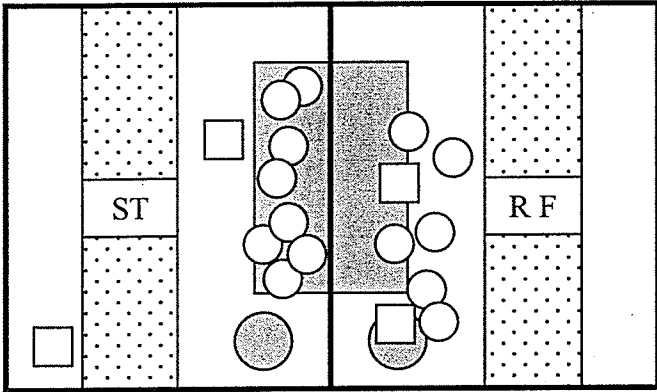


Crate: 3 Crate: 2
 Time: 11:00 Time: 11:00

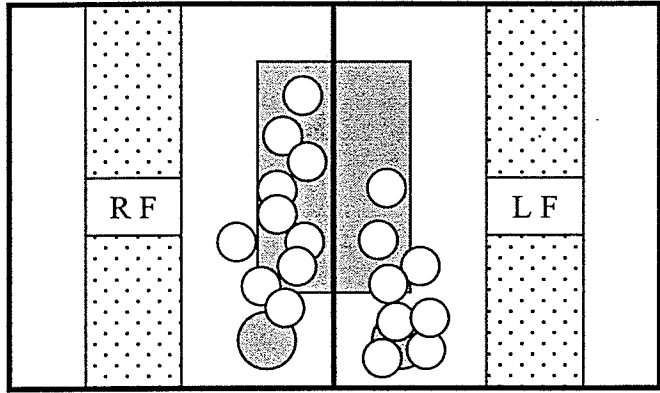


Crate: 3 Crate: 2
 Time: 11:30 Time: 11:30

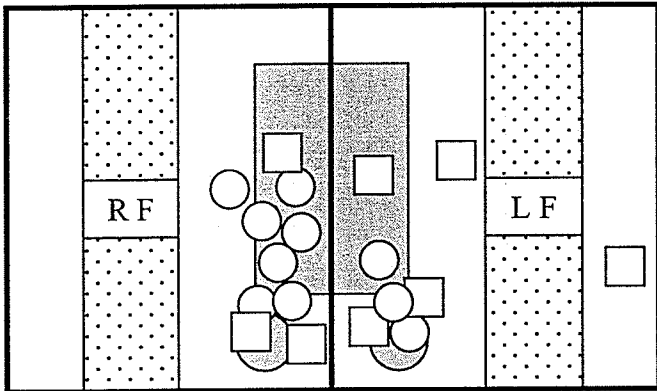
Behaviour Tests - Spring Farrowing 2002
 Day 1 - Section B (Heat Lamps On)
 February 15-16, 2002



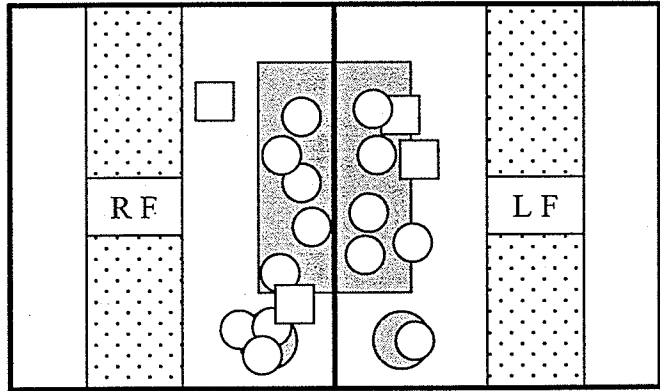
Crate: 11 Crate: 12
 Time: 10:30 Time: 10:30



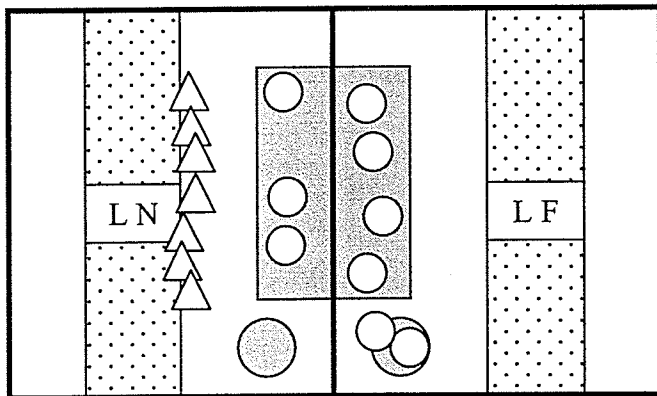
Crate: 11 Crate: 12
 Time: 11:00 Time: 11:00



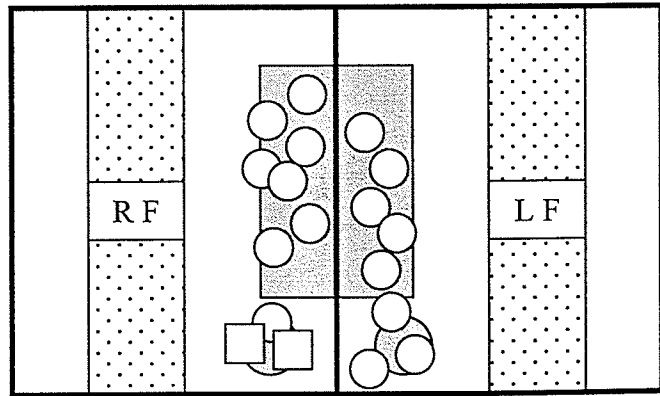
Crate: 11 Crate: 12
 Time: 11:30 Time: 11:30



Crate: 11 Crate: 12
 Time: 12:00 Time: 12:00

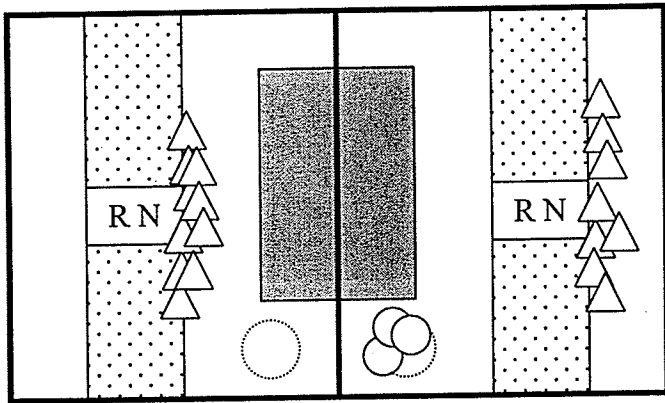


Crate: 11 Crate: 12
 Time: 12:30 Time: 12:30

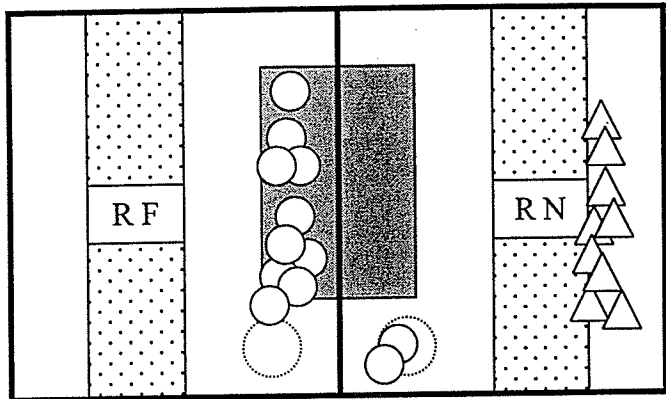


Crate: 11 Crate: 12
 Time: 1:00 Time: 1:00

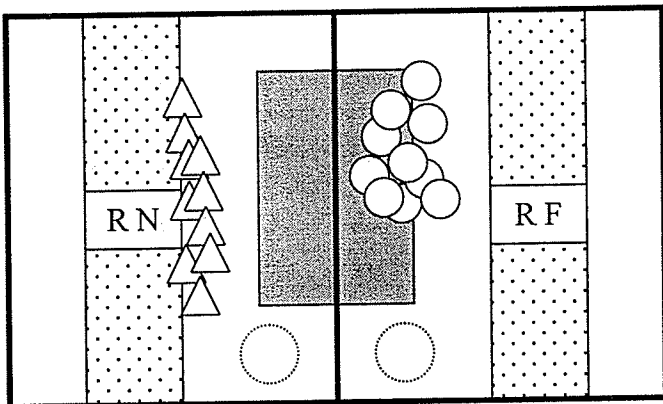
Behaviour Tests - Spring Farrowing 2002
 Day 1 - Section C (Heat Lamps Off)
 February 20, 2002



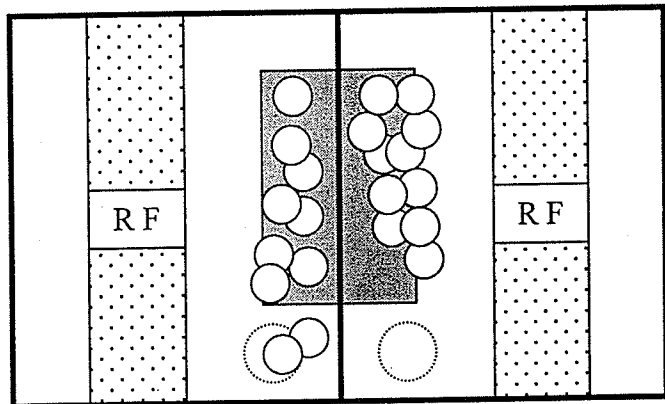
Crate: 25 Crate: 26
 Time: 9:00 Time: 9:00



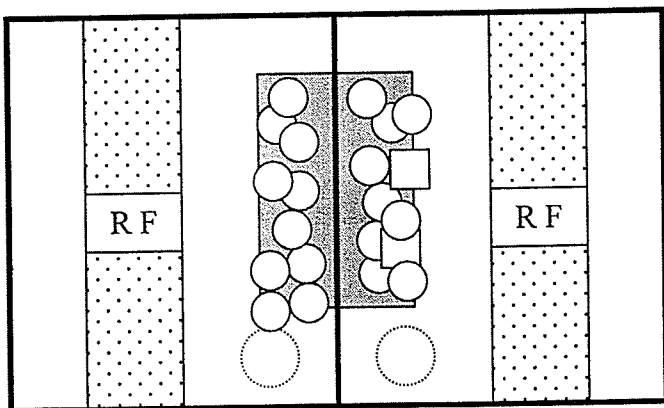
Crate: 25 Crate: 26
 Time: 9:30 Time: 9:30



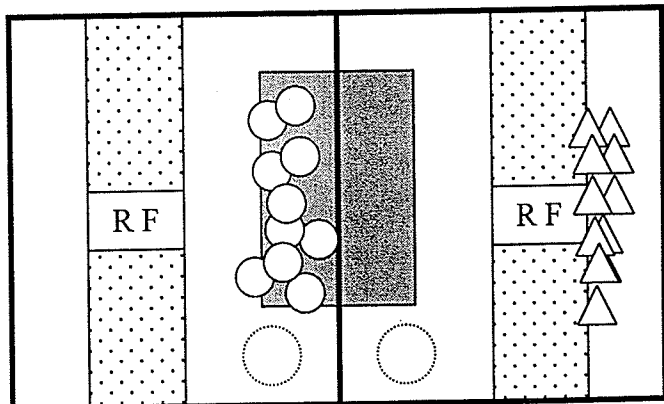
Crate: 25 Crate: 26
 Time: 10:00 Time: 10:00



Crate: 25 Crate: 26
 Time: 10:30 Time: 10:30



Crate: 25 Crate: 26
 Time: 11:00 Time: 11:00

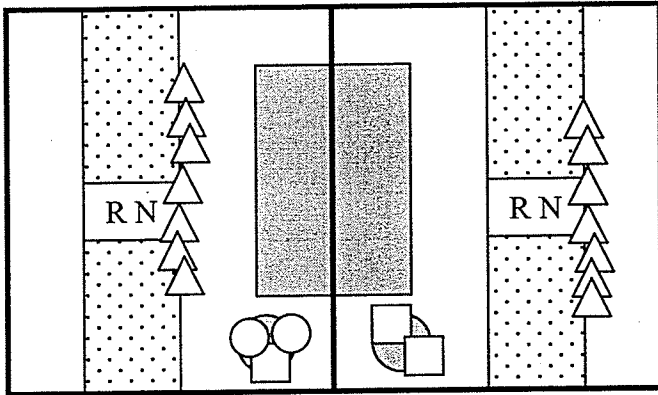


Crate: 25 Crate: 26
 Time: 11:30 Time: 11:30

Behaviour Tests - Spring Farrowing 2002

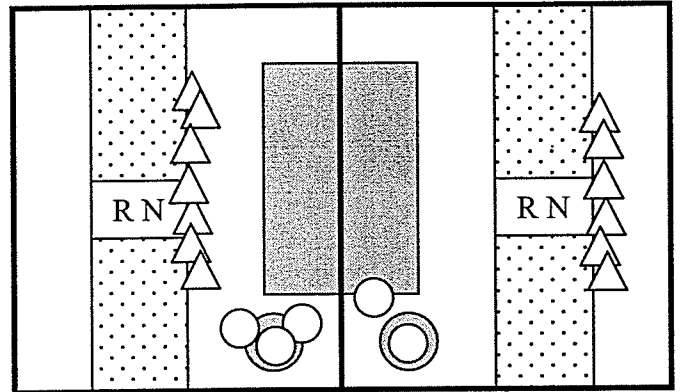
Day 1 - Section D (Heat Lamps On)

February 13-14, 2002



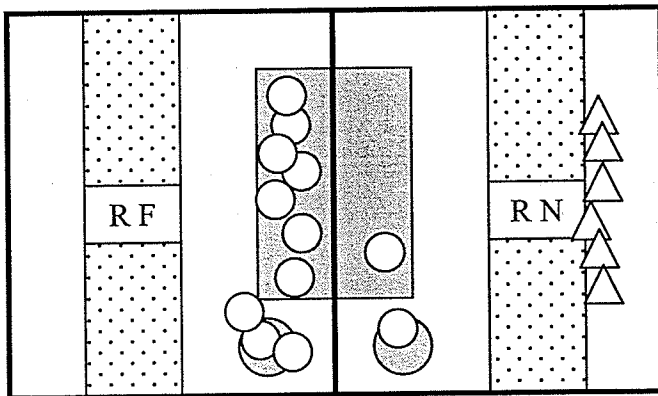
Crate: 33 Crate: 34

Time: 10:30 Time: 10:30



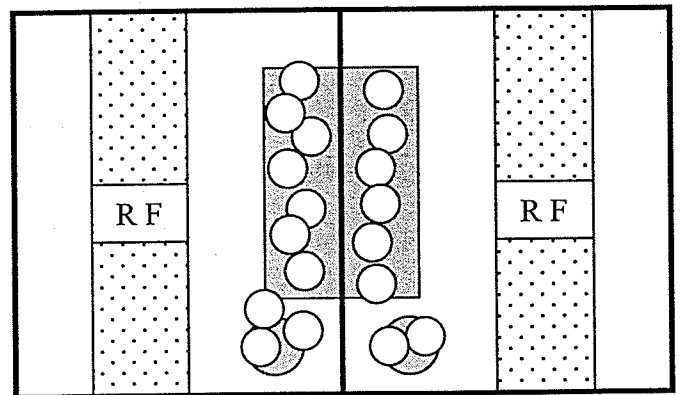
Crate: 33 Crate: 34

Time: 11:00 Time: 11:00



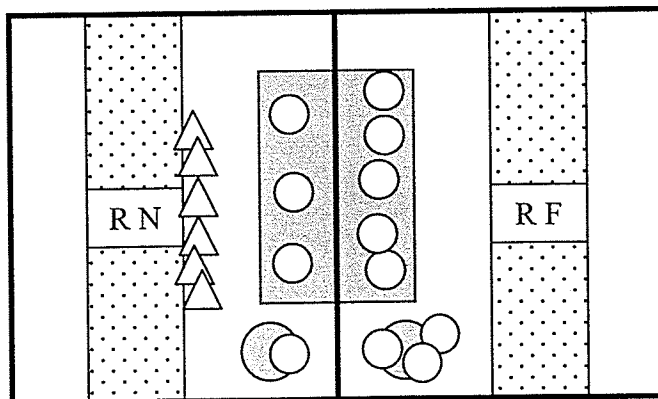
Crate: 33 Crate: 34

Time: 11:30 Time: 11:30



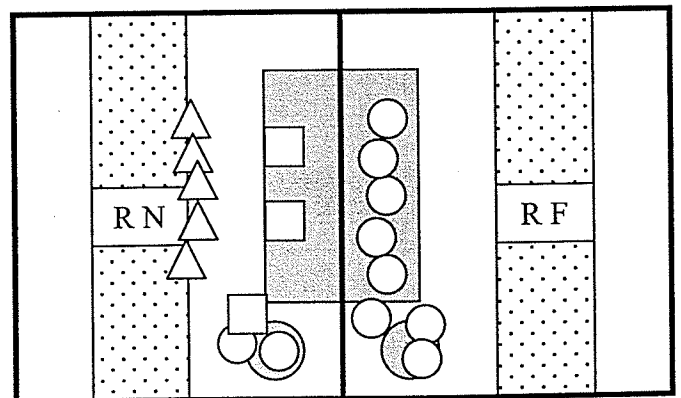
Crate: 33 Crate: 34

Time: 12:00 Time: 12:00



Crate: 33 Crate: 34

Time: 12:30 Time: 12:30



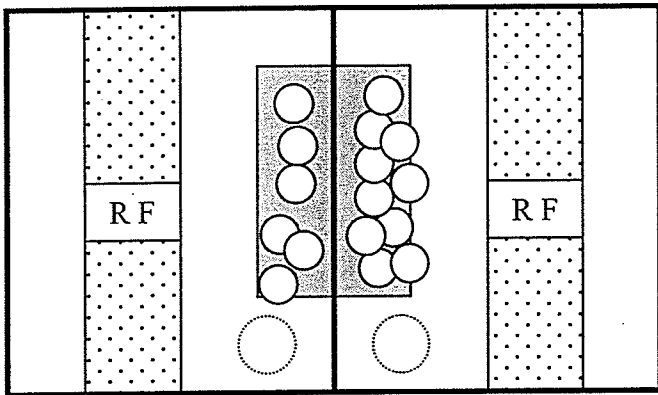
Crate: 33 Crate: 34

Time: 1:00 Time: 1:00

Behaviour Tests - Spring Farrowing 2002

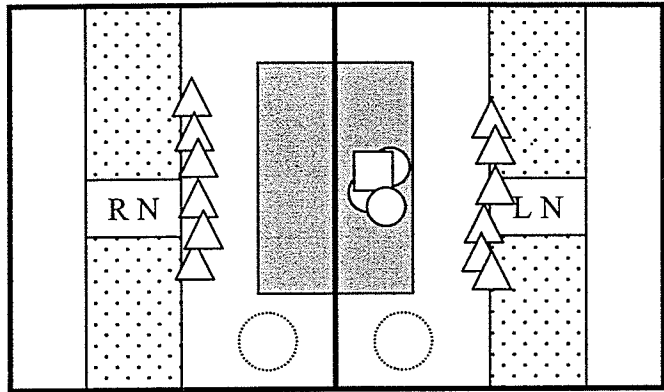
Day 3 - Section A (Heat Lamps Off)

February 13, 2002



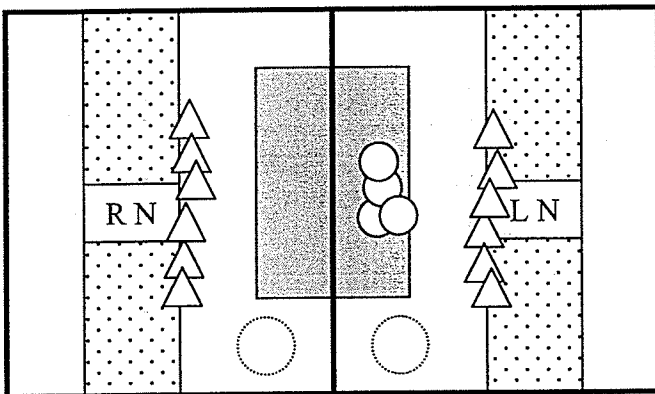
Crate: 3 Crate: 2

Time: 1:00 Time: 1:00



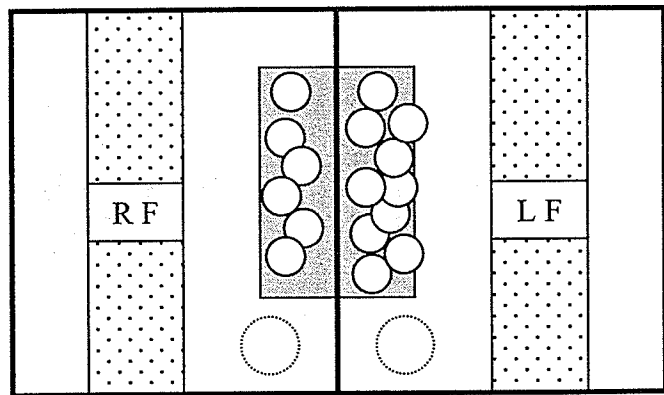
Crate: 3 Crate: 2

Time: 1:30 Time: 1:30



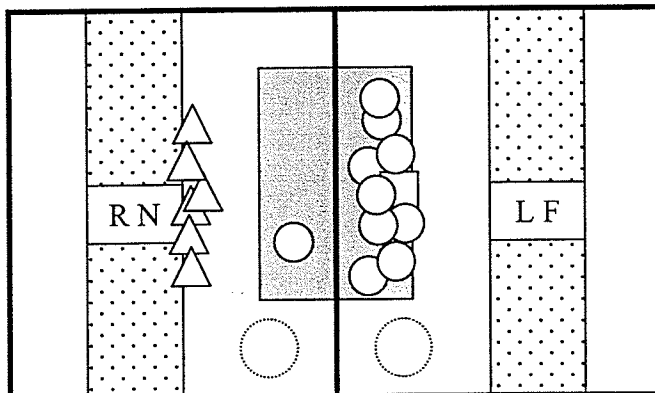
Crate: 3 Crate: 2

Time: 2:00 Time: 2:00



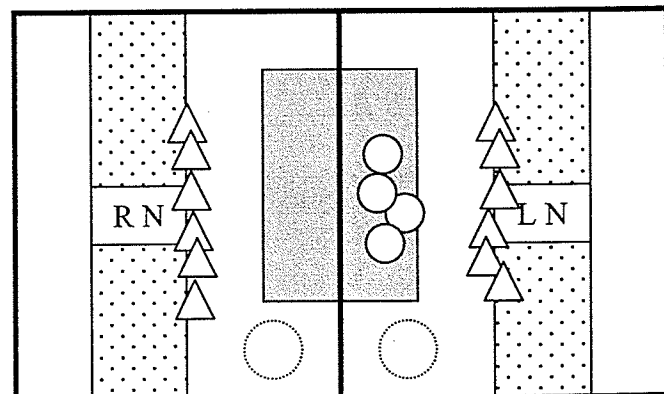
Crate: 3 Crate: 2

Time: 2:30 Time: 2:30



Crate: 3 Crate: 2

Time: 3:00 Time: 3:00



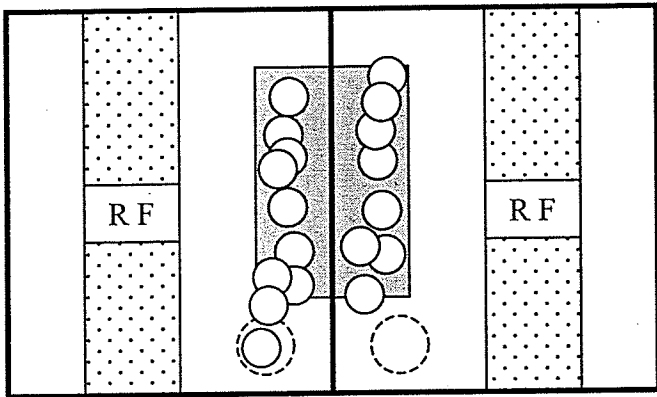
Crate: 3 Crate: 2

Time: 3:30 Time: 3:30

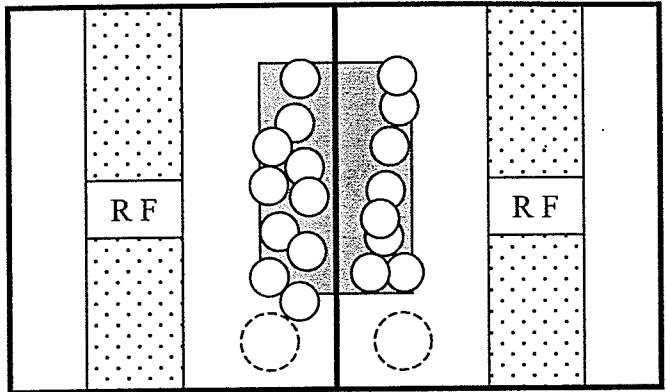
Behaviour Tests - Spring Farrowing 2002

Day 3 - Section B (Heat Lamps Off)

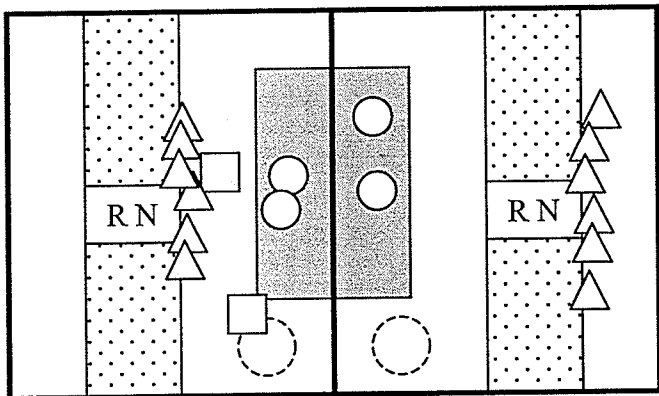
February 17-18, 2002



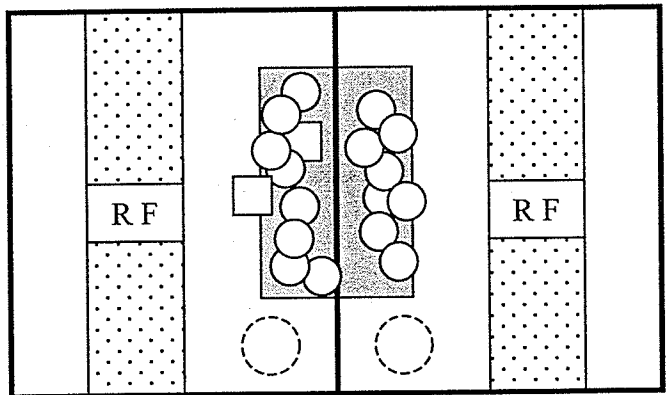
Crate: 11 Crate: 12
 Time: 1:00 Time: 1:00



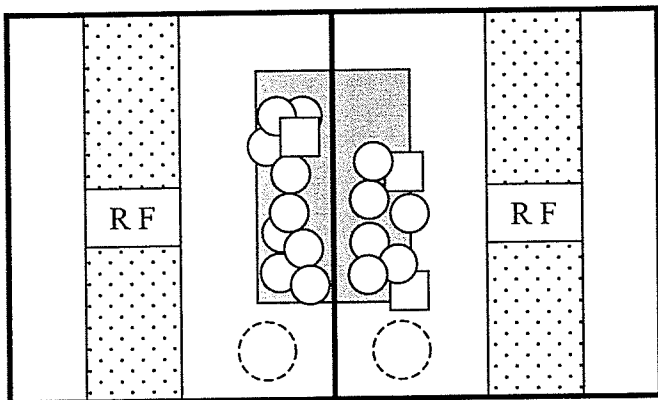
Crate: 11 Crate: 12
 Time: 1:30 Time: 1:30



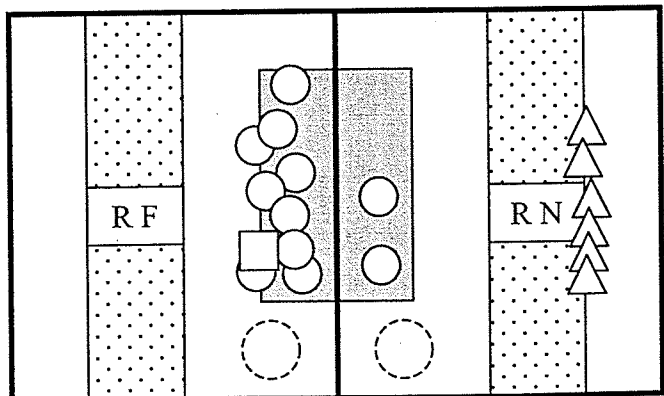
Crate: 11 Crate: 12
 Time: 2:00 Time: 2:00



Crate: 11 Crate: 12
 Time: 2:30 Time: 2:30



Crate: 11 Crate: 12
 Time: 3:00 Time: 3:00

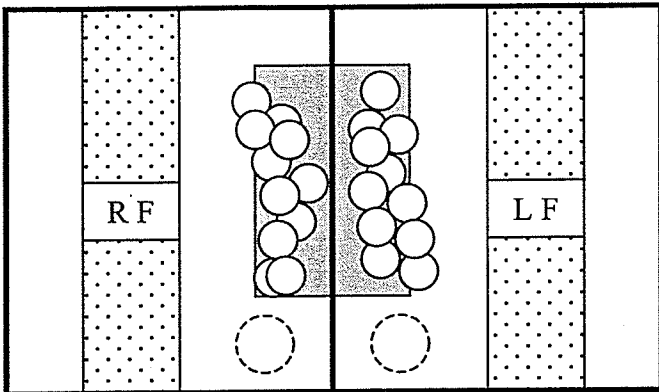


Crate: 11 Crate: 12
 Time: 3:30 Time: 3:30

Behaviour Tests - Spring Farrowing 2002

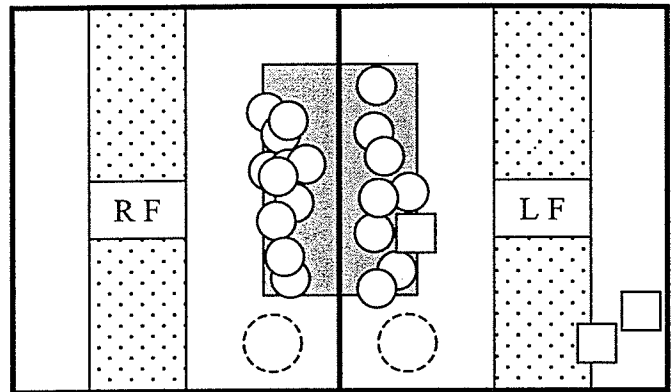
Day 3 - Section C (Heat Lamps Off)

February 23, 2002



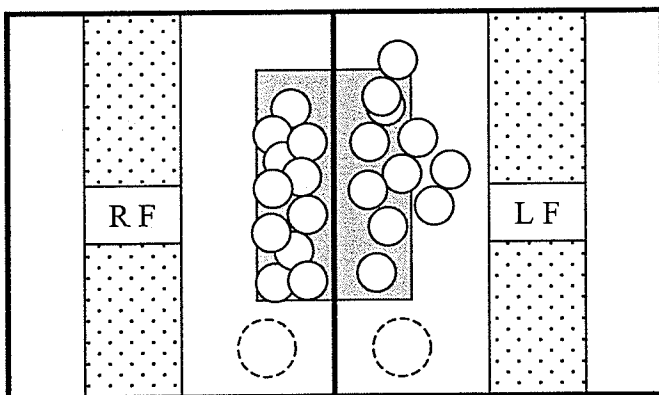
Crate: 25 Crate: 26

Time: 9:00 Time: 9:00



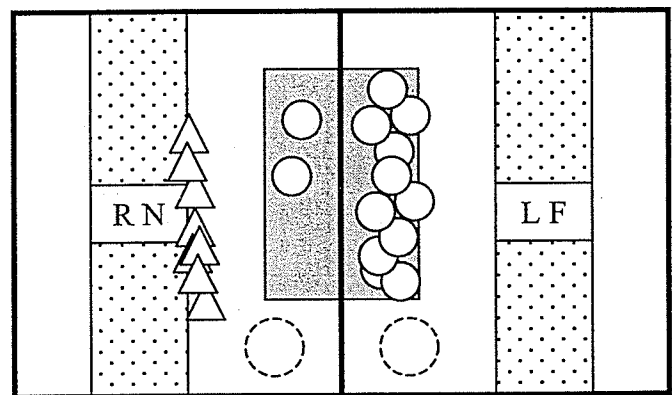
Crate: 25 Crate: 26

Time: 9:30 Time: 9:30



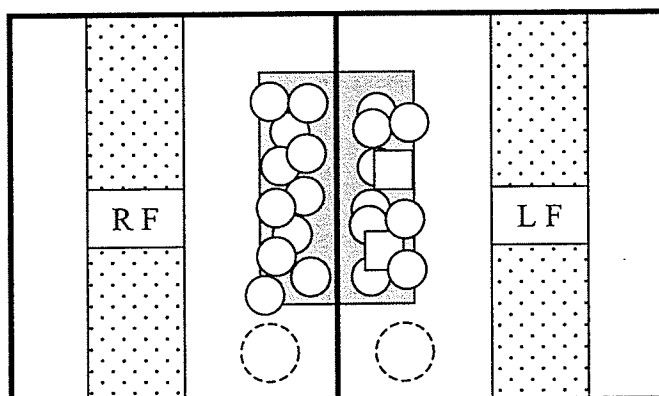
Crate: 25 Crate: 26

Time: 10:00 Time: 10:00



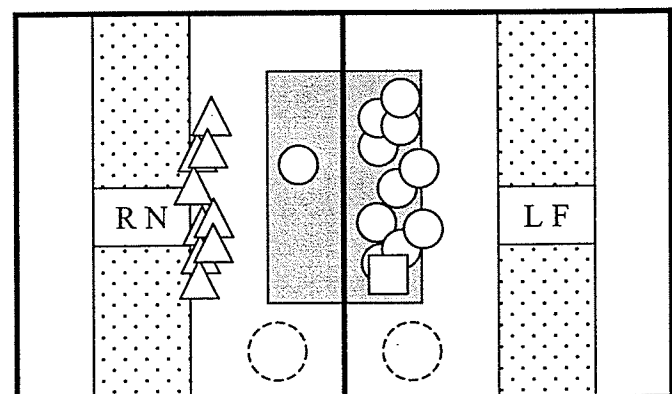
Crate: 25 Crate: 26

Time: 10:30 Time: 10:30



Crate: 25 Crate: 26

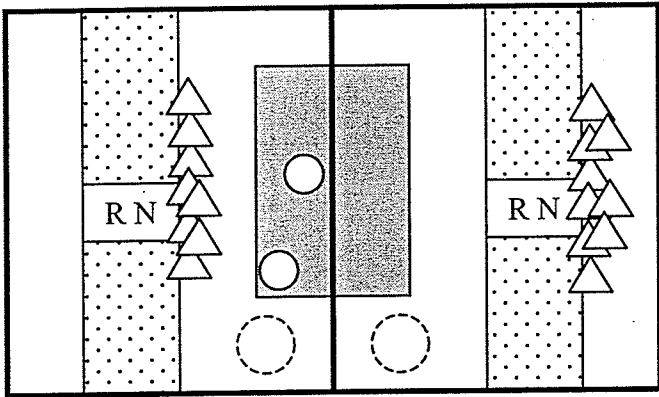
Time: 11:00 Time: 11:00



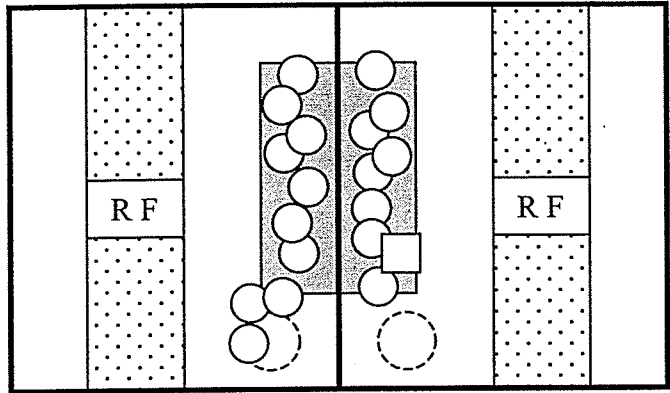
Crate: 25 Crate: 26

Time: 11:30 Time: 11:30

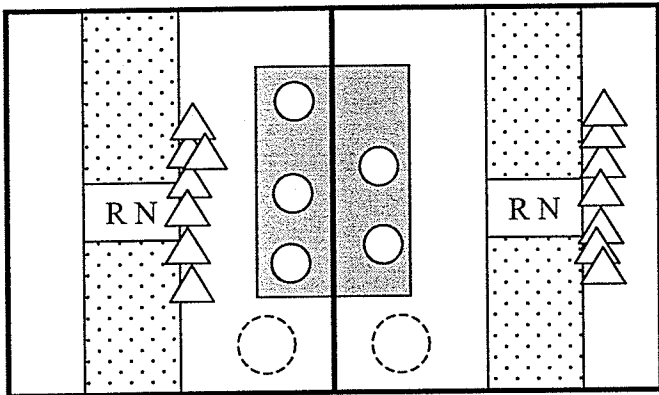
Behaviour Tests - Spring Farrowing 2002
 Day 3 - Section D (Heat Lamps Off)
 February 15-16, 2002



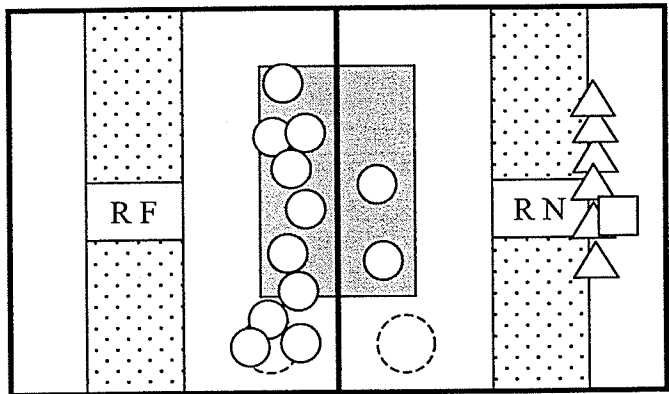
Crate: 33 Crate: 34
 Time: 9:30 Time: 9:30



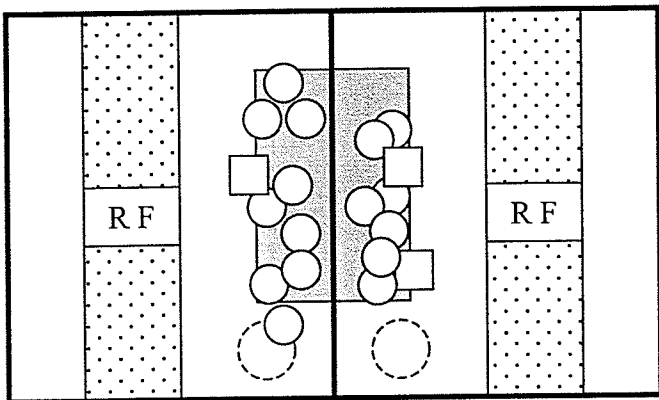
Crate: 33 Crate: 34
 Time: 10:00 Time: 10:00



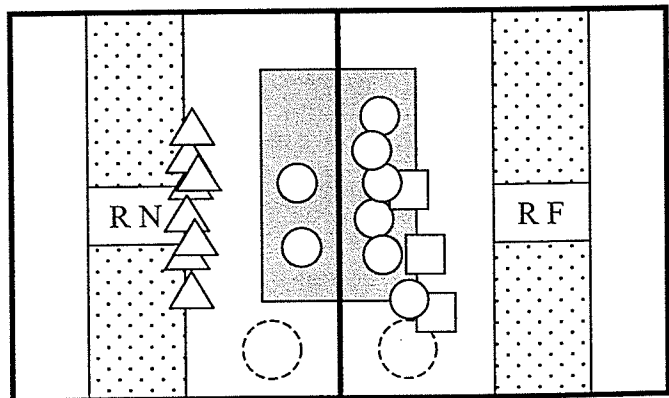
Crate: 33 Crate: 34
 Time: 10:30 Time: 10:30



Crate: 33 Crate: 34
 Time: 11:00 Time: 11:00



Crate: 33 Crate: 34
 Time: 11:30 Time: 11:30

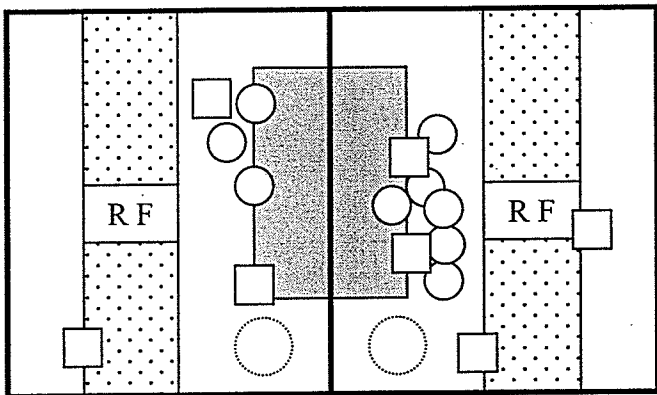


Crate: 33 Crate: 34
 Time: 12:00 Time: 12:00

Behaviour Tests - Spring Farrowing 2002

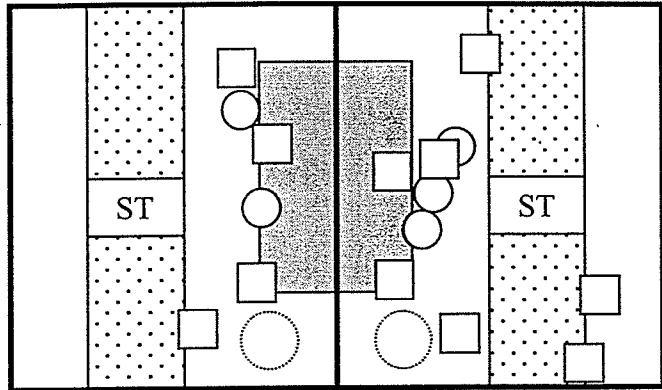
Day 7 - Section A (Heat Lamps Off)

February 18, 2002



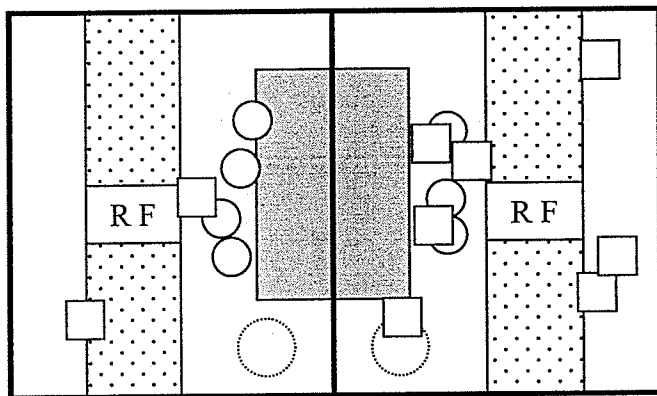
Crate: 3 Crate: 2

Time: 1:00 Time: 1:00



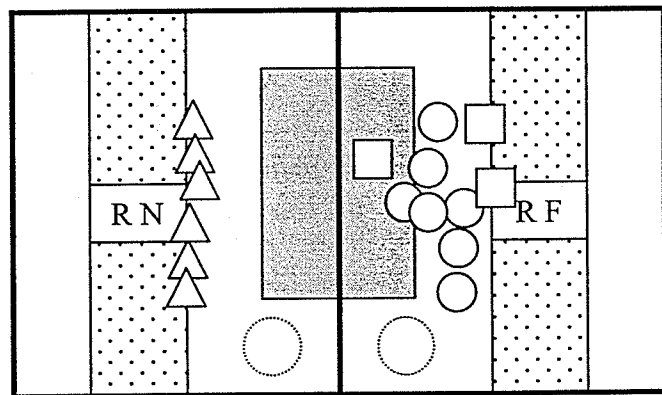
Crate: 3 Crate: 2

Time: 1:30 Time: 1:30



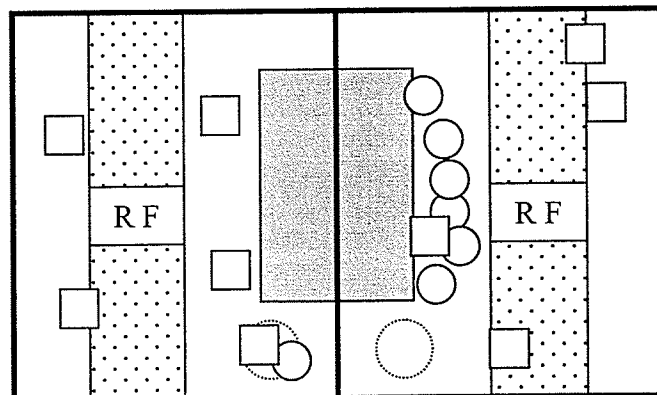
Crate: 3 Crate: 2

Time: 2:00 Time: 2:00



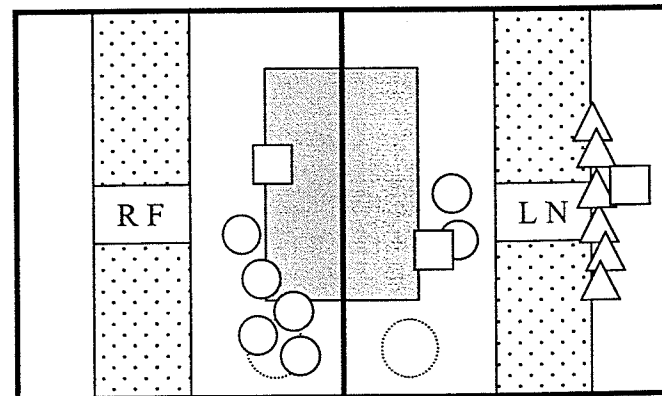
Crate: 3 Crate: 2

Time: 2:30 Time: 2:30



Crate: 3 Crate: 2

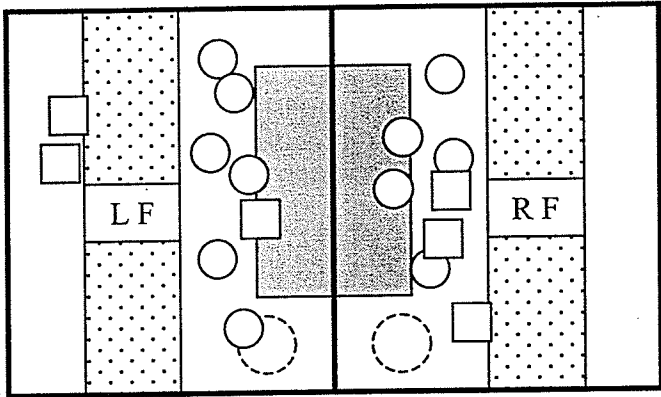
Time: 3:00 Time: 3:00



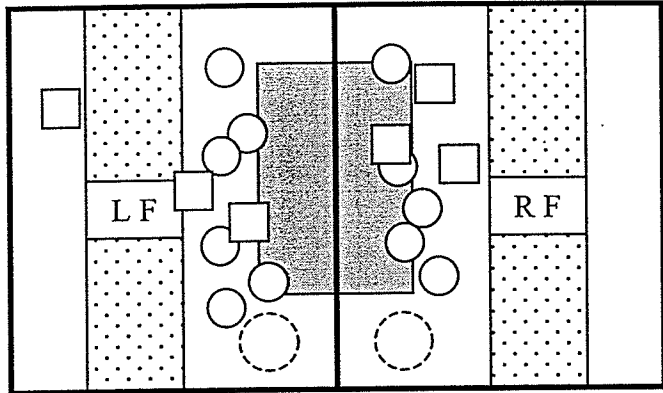
Crate: 3 Crate: 2

Time: 3:30 Time: 3:30

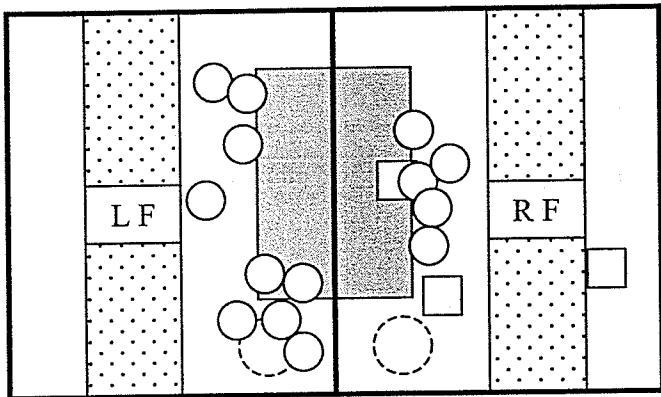
Behaviour Tests - Spring Farrowing 2002
 Day 7 - Section B (Heat Lamps Off)
 February 22-23, 2002



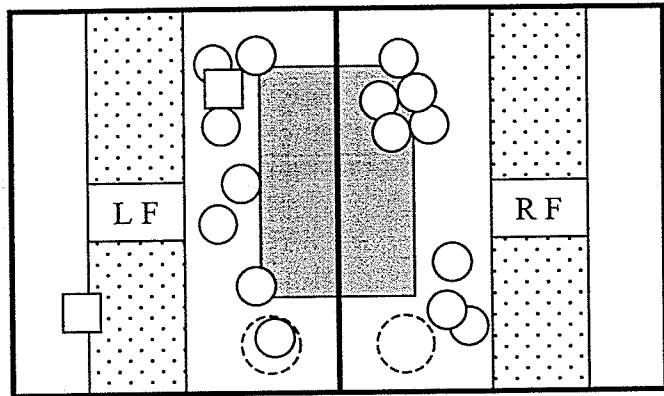
Crate: 11 Crate: 12
 Time: 1:00 Time: 1:00



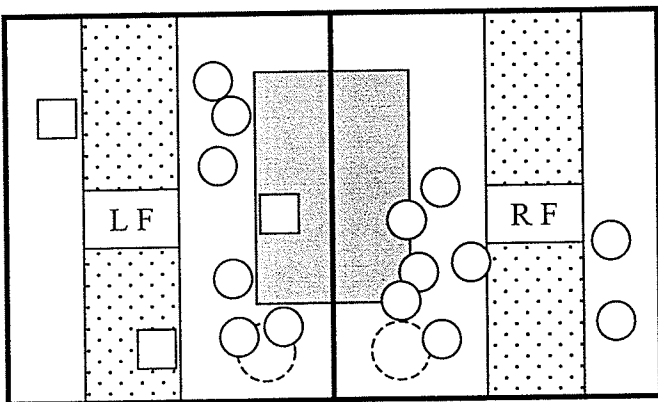
Crate: 11 Crate: 12
 Time: 1:30 Time: 1:30



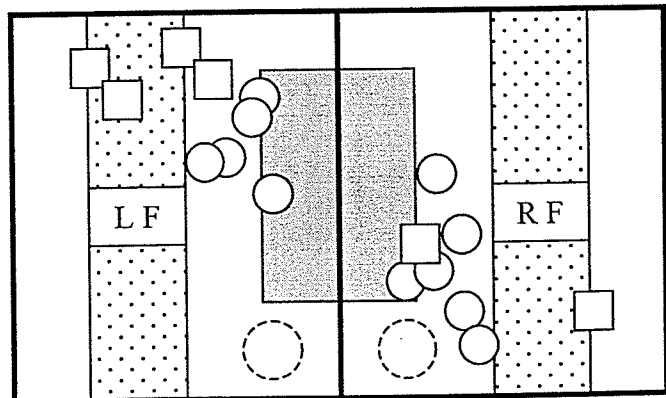
Crate: 11 Crate: 12
 Time: 2:00 Time: 2:00



Crate: 11 Crate: 12
 Time: 2:30 Time: 2:30



Crate: 11 Crate: 12
 Time: 3:00 Time: 3:00

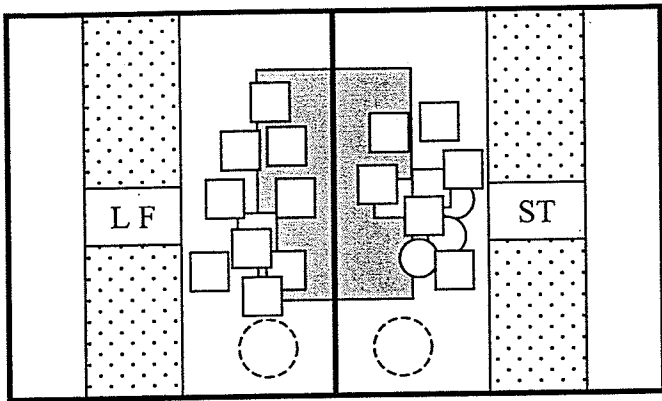


Crate: 11 Crate: 12
 Time: 3:30 Time: 3:30

Behaviour Tests - Spring Farrowing 2002

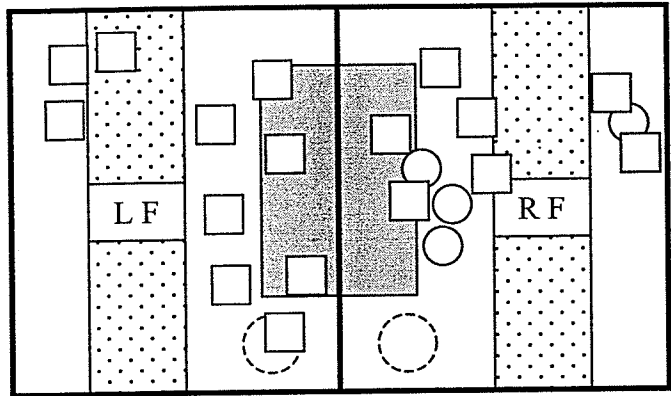
Day 7 - Section C (Heat Lamps Off)

February 27, 2002



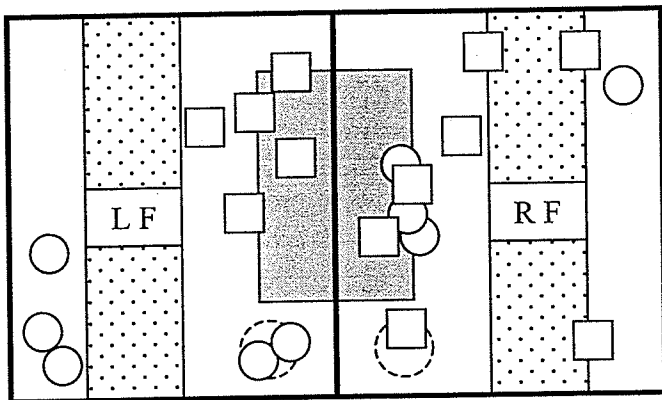
Crate: 25 Crate: 26

Time: 9:30 Time: 9:30



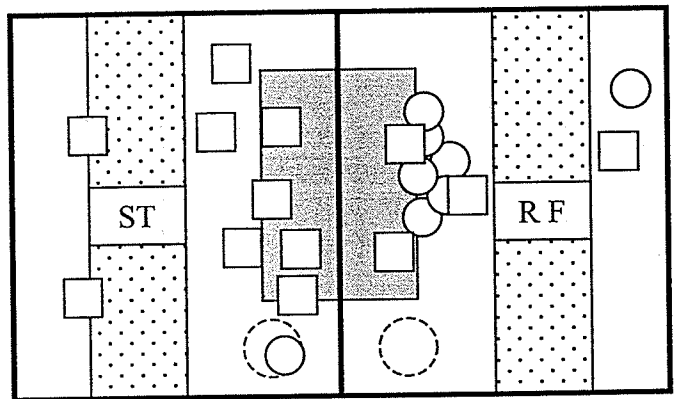
Crate: 25 Crate: 26

Time: 10:00 Time: 10:00



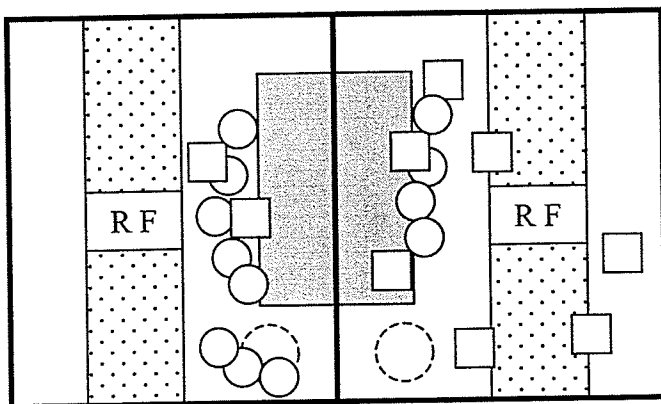
Crate: 25 Crate: 26

Time: 10:30 Time: 10:30



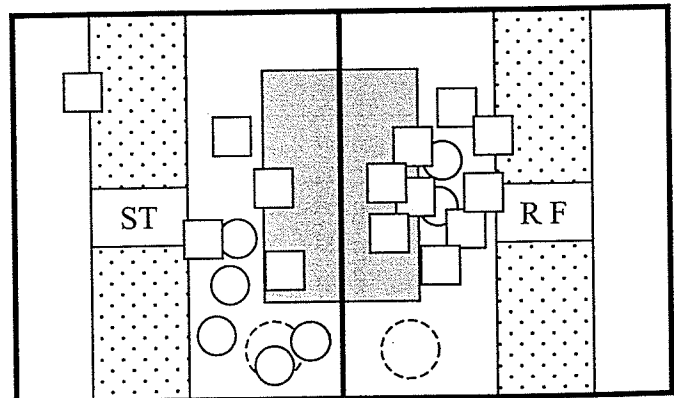
Crate: 25 Crate: 26

Time: 11:00 Time: 11:00



Crate: 25 Crate: 26

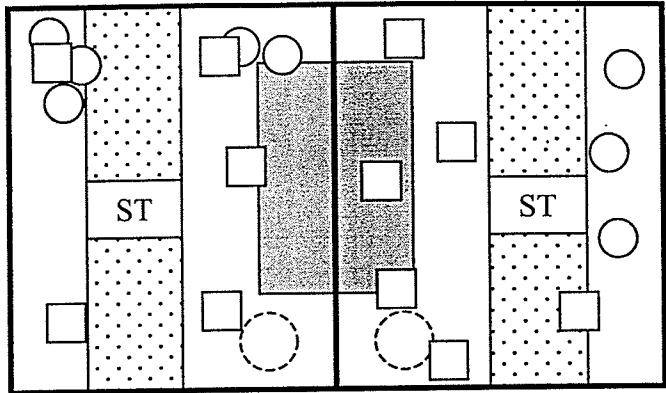
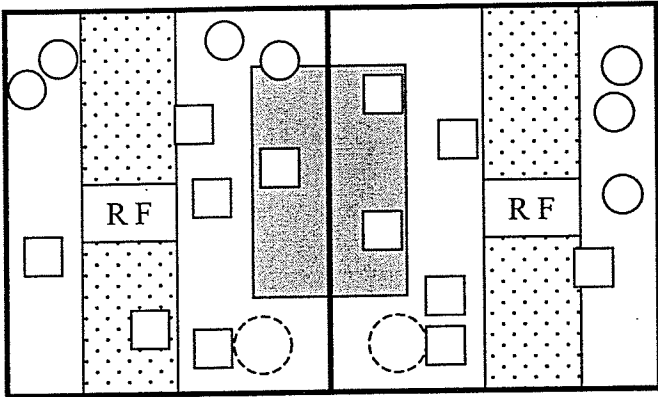
Time: 11:30 Time: 11:30



Crate: 25 Crate: 26

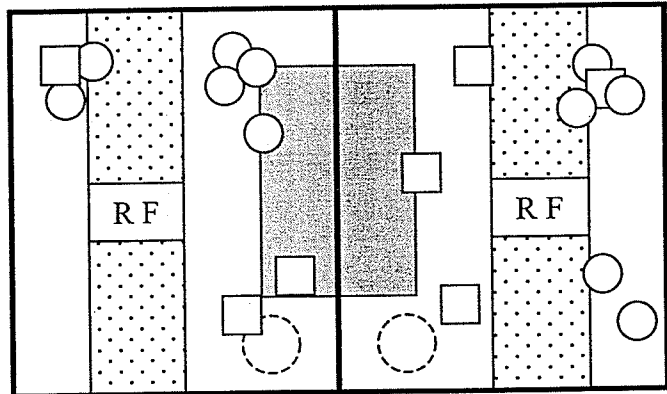
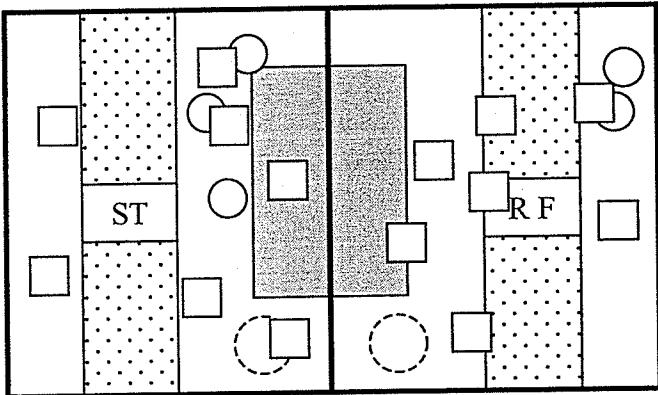
Time: 12:00 Time: 12:00

Behaviour Tests - Spring Farrowing 2002
 Day 7 - Section D (Heat Lamps Off)
 February 20-21, 2002



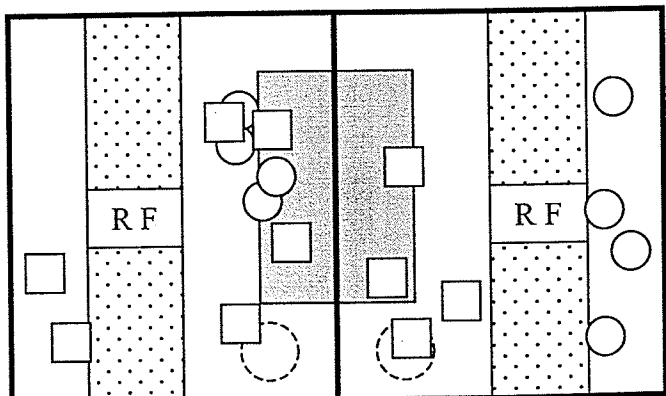
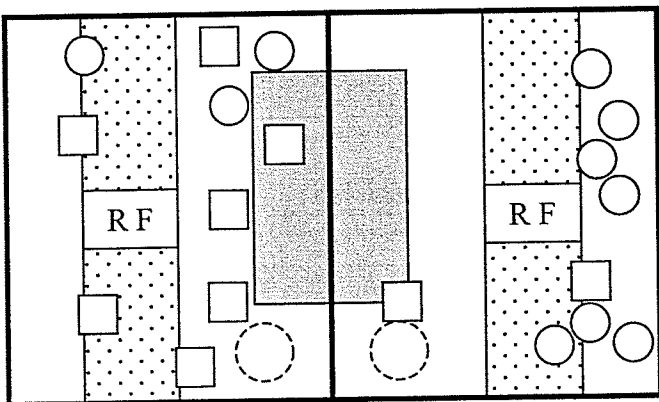
Crate: 33 Crate: 34
 Time: 1:00 Time: 1:00

Crate: 33 Crate: 34
 Time: 1:30 Time: 1:30



Crate: 33 Crate: 34
 Time: 2:00 Time: 2:00

Crate: 33 Crate: 34
 Time: 2:30 Time: 2:30



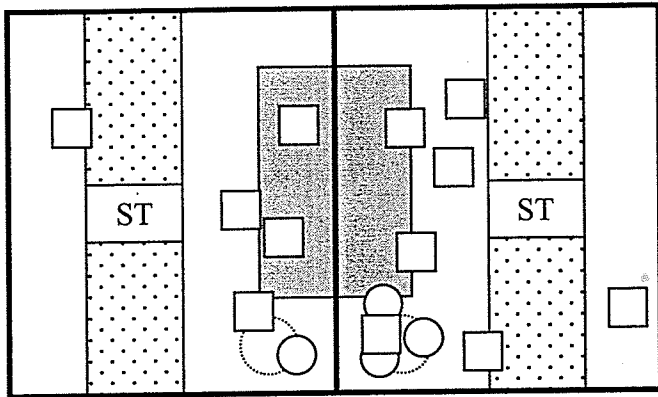
Crate: 33 Crate: 34
 Time: 3:00 Time: 3:00

Crate: 33 Crate: 34
 Time: 3:30 Time: 3:30

Behaviour Tests - Spring Farrowing 2002

Day 16 - Section A (Heat Lamps Off)

February 27, 2002

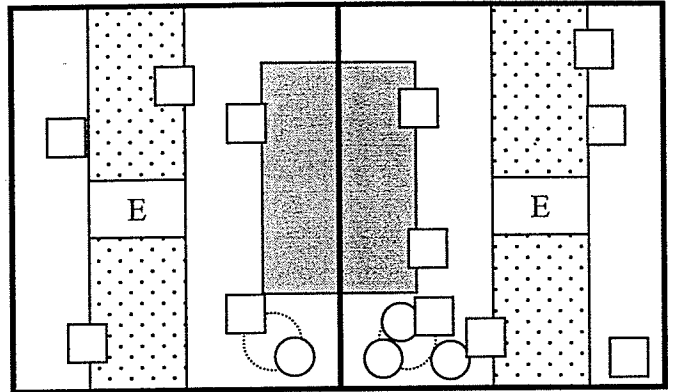


Crate: 3

Crate: 2

Time: 9:00

Time: 9:00

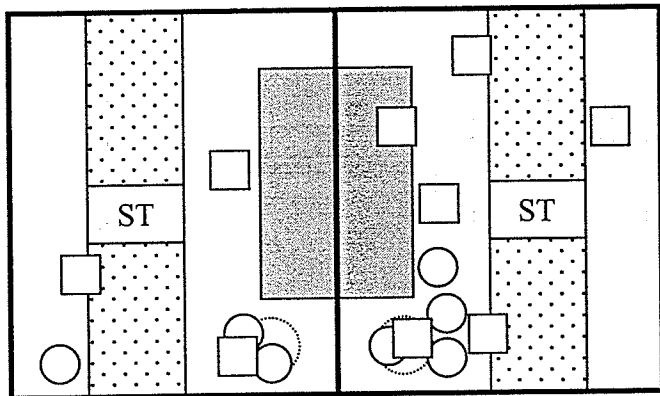


Crate: 3

Crate: 2

Time: 9:30

Time: 9:30

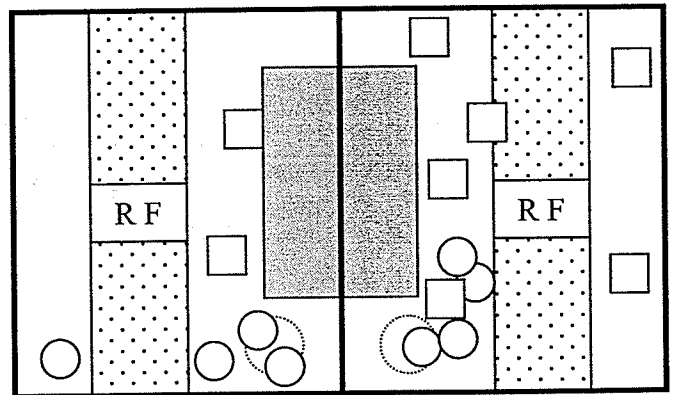


Crate: 3

Crate: 2

Time: 10:00

Time: 10:00

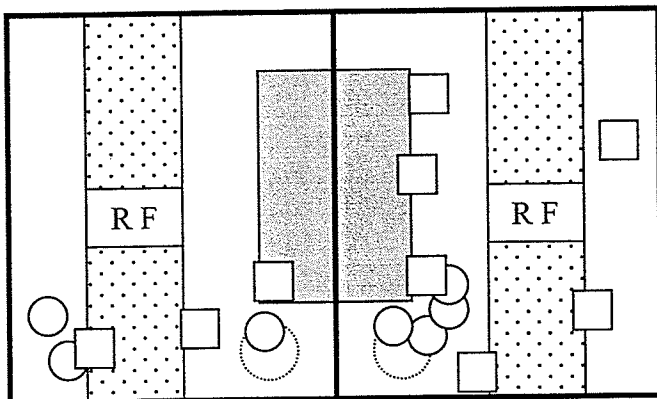


Crate: 3

Crate: 2

Time: 10:30

Time: 10:30

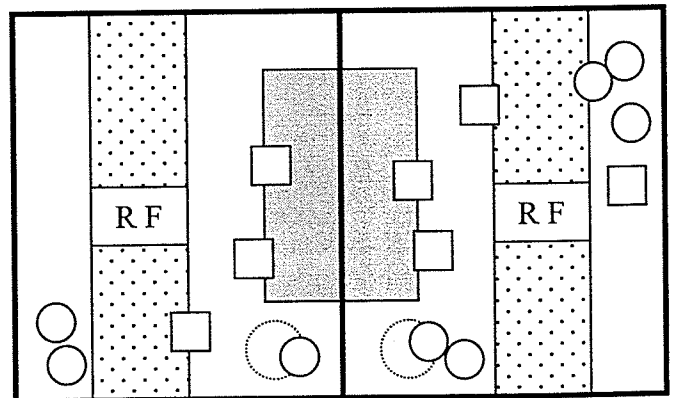


Crate: 3

Crate: 2

Time: 11:00

Time: 11:00



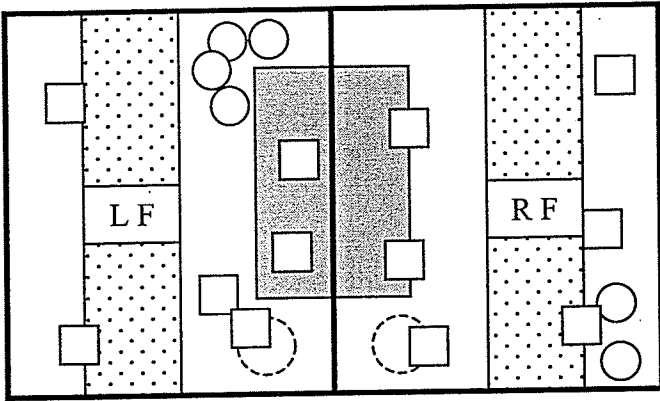
Crate: 3

Crate: 2

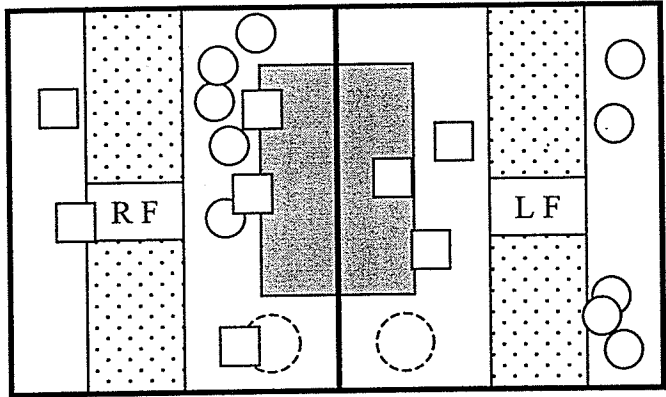
Time: 11:30

Time: 11:30

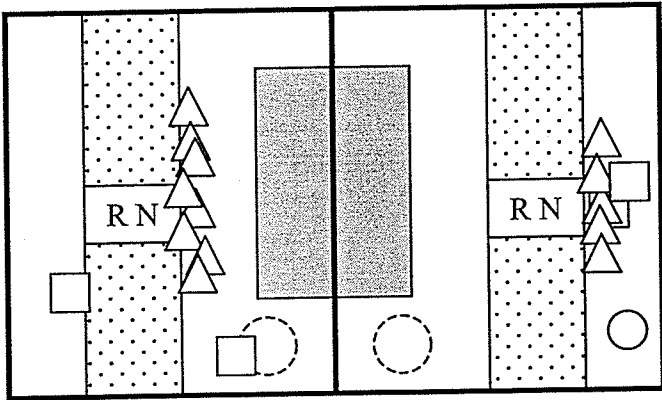
Behaviour Tests - Spring Farrowing 2002
 Day 16 - Section B (Heat Lamps Off)
 March 3-4, 2002



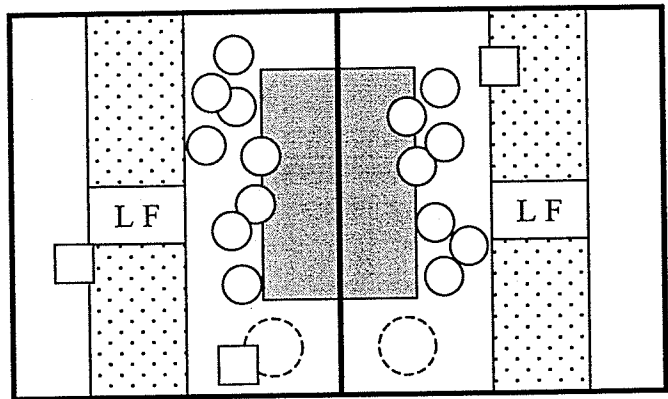
Crate: _____ 11 Crate: _____ 12
 Time: _____ 9:30 Time: _____ 9:30



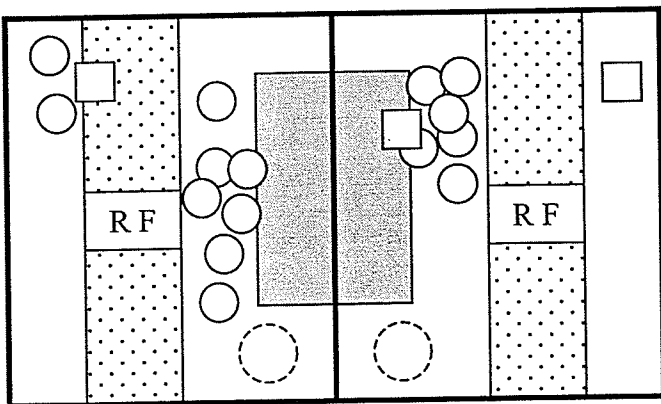
Crate: _____ 11 Crate: _____ 12
 Time: _____ 10:00 Time: _____ 10:00



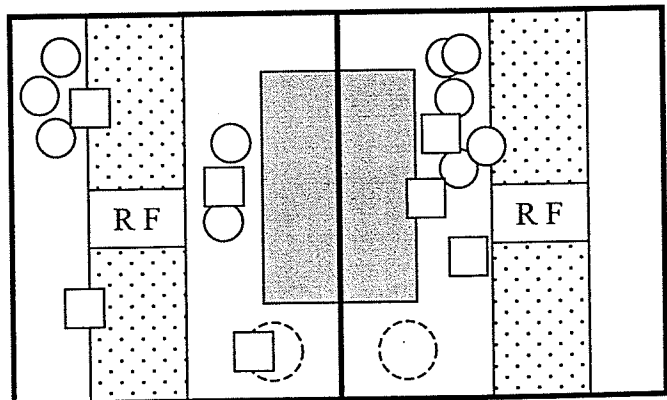
Crate: _____ 11 Crate: _____ 12
 Time: _____ 10:30 Time: _____ 10:30



Crate: _____ 11 Crate: _____ 12
 Time: _____ 11:00 Time: _____ 11:00

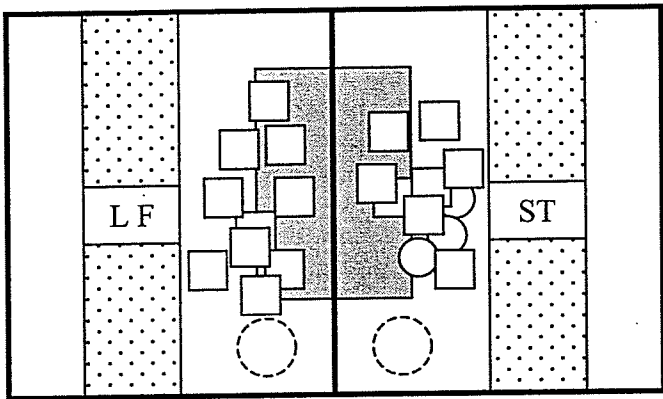


Crate: _____ 11 Crate: _____ 12
 Time: _____ 11:30 Time: _____ 11:30

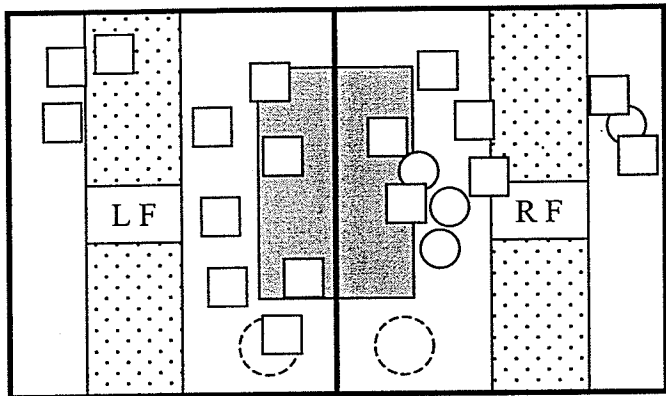


Crate: _____ 11 Crate: _____ 12
 Time: _____ 12:00 Time: _____ 12:00

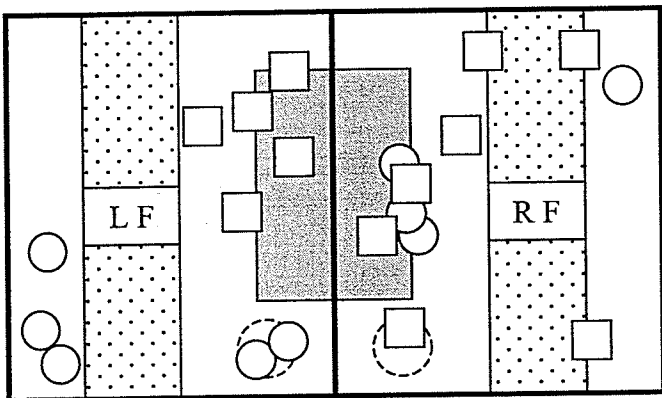
Behaviour Tests - Spring Farrowing 2002
 Day 16 - Section C (Heat Lamps Off)
 March 8, 2002



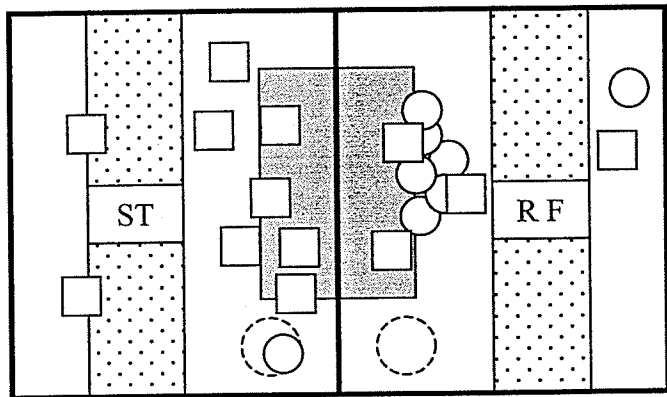
Crate: 25 Crate: 26
 Time: 9:30 Time: 9:30



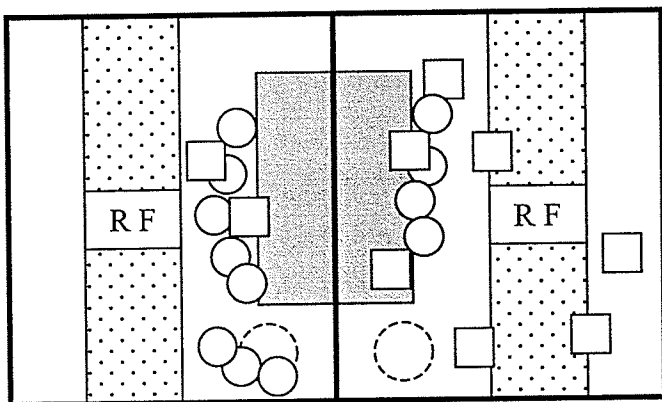
Crate: 25 Crate: 26
 Time: 10:00 Time: 10:00



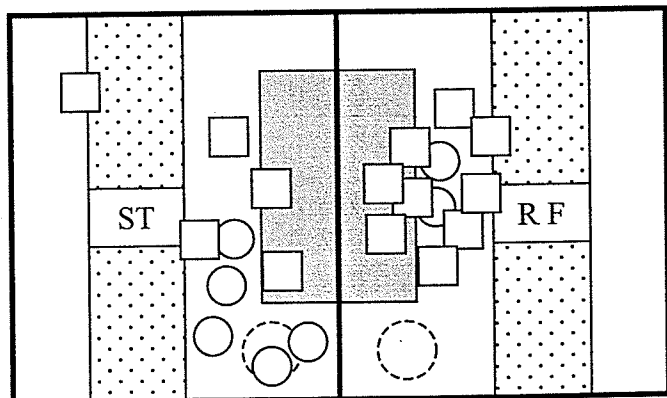
Crate: 25 Crate: 26
 Time: 10:30 Time: 10:30



Crate: 25 Crate: 26
 Time: 11:00 Time: 11:00

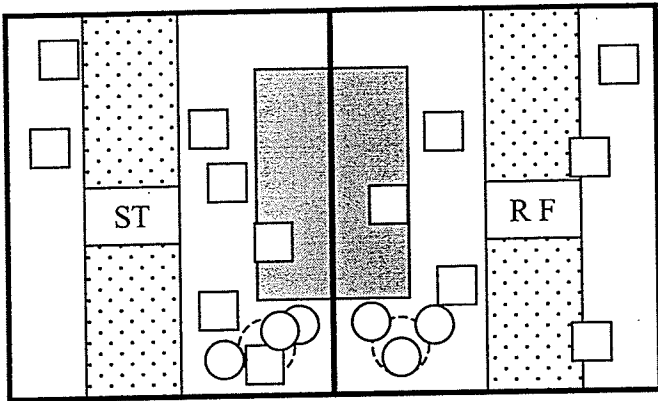


Crate: 25 Crate: 26
 Time: 11:30 Time: 11:30

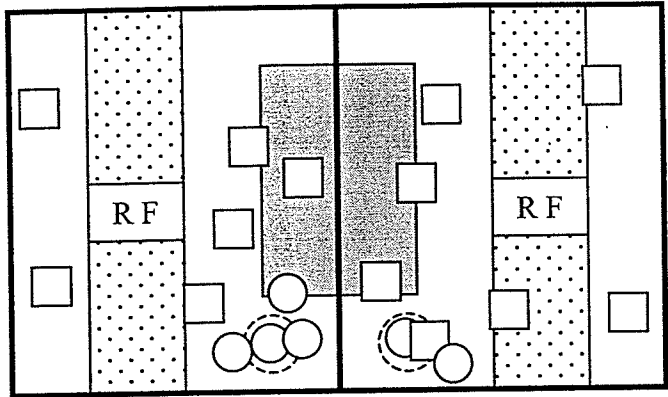


Crate: 25 Crate: 26
 Time: 12:00 Time: 12:00

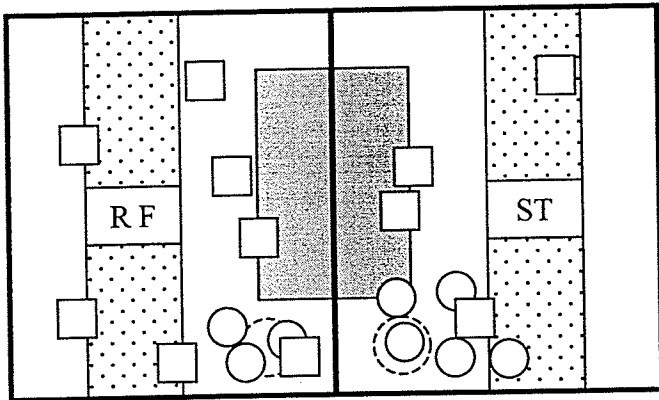
Behaviour Tests - Spring Farrowing 2002
 Day 16 - Section D (Heat Lamps Off)
 March 1-2, 2002



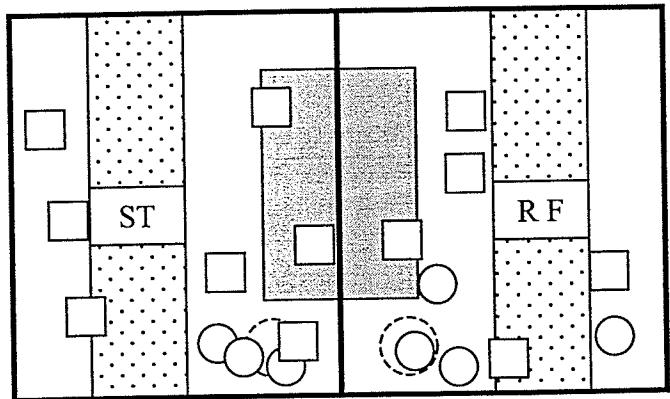
Crate: 33 Crate: 34
 Time: 1:00 Time: 1:00



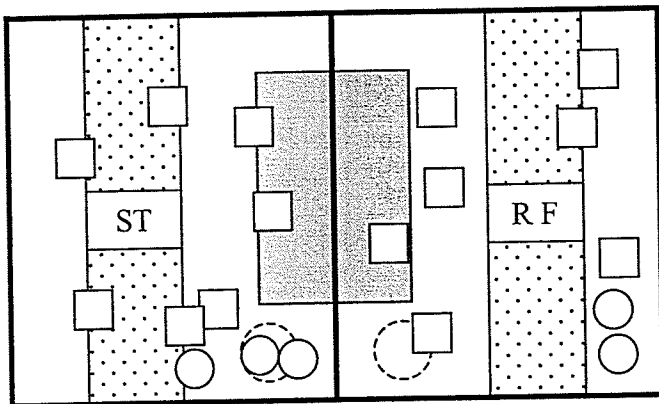
Crate: 33 Crate: 34
 Time: 1:30 Time: 1:30



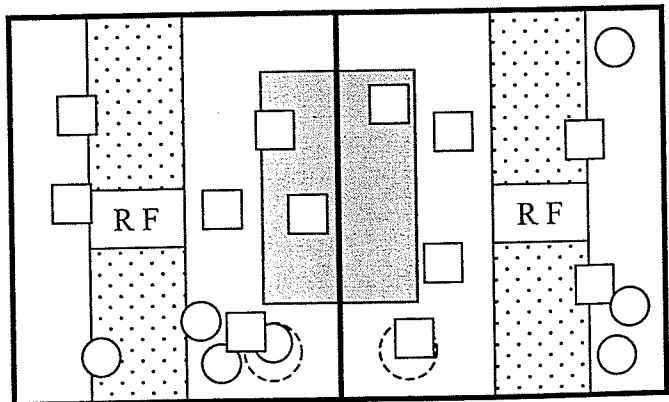
Crate: 33 Crate: 34
 Time: 2:00 Time: 2:00



Crate: 34 Crate: 34
 Time: 2:30 Time: 2:30



Crate: 33 Crate: 34
 Time: 3:00 Time: 3:00



Crate: 33 Crate: 34
 Time: 3:30 Time: 3:30