6 Managing heat detection

Objective:

- To ensure the best possible expression and observation of oestrus.

Challenge:

- Critically assess your current heat detection performance and practice
- Identify key areas for attention and implement a practical improvement programme to address them.

Target

Achieve a Heat Detection Rate of 70% with a Calving to First Service Interval of 60 days.

Targeting service

Failure to meet first service targets has been established as one of the major reasons for long Calving Intervals and high Culling Rates. Submitting cows for service at the right stage in their oestrus cycle is known to be the single most important determinant of service success.

So it isn't surprising that the top priority in any fertility management programme is heat detection – which, in turn, depends on a combination of good expression of oestrus by cows and accurate observation of it by herdsmen.

Achieving the 60-day Calving to First Service Interval target means a 70% Heat Detection Rate with 70% of cows submitted for service in the first three weeks after a Voluntary Waiting Period of 45 days.

What's in this section?

- **Establishing the importance of first service policy**
- **Understanding the hormonal control of oestrus (heat)**
- **Optimising and observing oestrus behaviour**
- **Improving heat detection practice.**

Contents

While precisely the same heat detection principles apply, block-calving herds have rather different requirements to those units with a less clear seasonality of calving (Section 9).

A summary of the section

- In herds without a distinct calving pattern, cows should be served at the first observed heat following a Voluntary Waiting Period of 45 days after calving
- The extent to which normal oestrus cycling resumes after calving and is evident in signs of heat is crucially important if service targets are to be met
- Standing oestrus, during which a cow will stand to be mounted by herd mates or a bull, is the most reliable indicator of oestrus
- Poor heat expression can be as much of a problem as poor heat detection
- Achieving a Heat Detection Rate of 70% requires frequent dedicated observations throughout the day during the breeding season
- The importance of a well managed Heat Detection Rate, whereby the animals on heat are recorded, may have a greater positive financial impact than an improvement in Submission Rate
- Herd nutrition and health are key elements in optimising oestrus expression
- Heat detection aids can help to improve fertility performance but should never be seen as a replacement for good husbandry practice.

See also...

Section 2:	Defining your terms
Section 3:	Identifying critical records
Section 4:	Planning your approach
Section 5:	Establishing your starting point
Section 7:	Optimising herd nutrition
Section 8:	Addressing herd management
Section 9:	Managing block-calving herds
Section 11:	Hormonal control of oestrus

Action plan

To achieve a Heat Detection Rate of 70% with a Calving to First Service Interval of 60 days.

1. Review your First Service policy

Assess the benefit of reducing your Calving to First Service Interval by adjusting your Voluntary Waiting Period (**Page 6:4**).

2. Understand Oestrus Resumption

Appreciate the critical importance of a prompt resumption of normal oestrus cycling after each calving and the factors affecting it (**Page 6:6**).

3. Plan Your Oestrus Observation

Ensure those responsible for heat detection in your herd fully understand oestrus behaviour and work to a clear observation plan (**Page 6:9**).

4. Encourage Oestrus Expression

Control body condition, manage cow health and minimise both lameness and stress in your stock to maximise oestrus expression (**Page 6:11**).

5. Improve your Heat Detection success

Boost heat detection success in your herd by planning observations, pinpointing problems, understanding failures, and improving techniques (**Page 6:15**).

6. Evaluate Heat Detection aids

Assess the various heat detection aids available and use the most appropriate to support your day-to-day fertility management (**Page 6:19**).

First service policy

First service policy is closely linked with heat detection in maximising fertility performance.

Improving the Heat Detection Rate by 10% from the national average of 50% can reduce Calving to Conception Interval by four days and Culling Rate by 6%, improving profitability by 0.97p/litre (Table 6.1).

Table 6.1: The value of improving Heat Detection

Heat Detection Rate (%)	Pregnancy Rate (%)	Calving to First Service Interval (days)	Calving to Conception Interval (days)	Failure to Conceive Culling Rate (%)	Financial improvement from 50% Heat Detection Rate	
					£/cow	p/litre*
50	40	80	125	21		
60	40	80	121	15	230	0.97

** 7000 litre/cow average*
Source: Esslemont (personal communication, 2010).

Reducing the Calving to First Service Interval by 10 days can reduce the Calving to Conception Interval by 10 days and Culling Rate by 2%, giving a profitability improvement of over 0.6p/litre (Table 6.2).

Table 6.2: The extra value of improving Calving to First Service Interval

Heat Detection Rate (%)	**Pregnancy Rate** (%)	**Calving to First Service Interval** (days)	**Calving to Conception Interval** (days)	**Failure to Conceive Culling Rate** (%)	**Financial improvement from 70 Day Calving to First Service Interval**	
					£/cow	p/litre*
50	40	80	125	21		
50	40	70	115	19	39	0.65

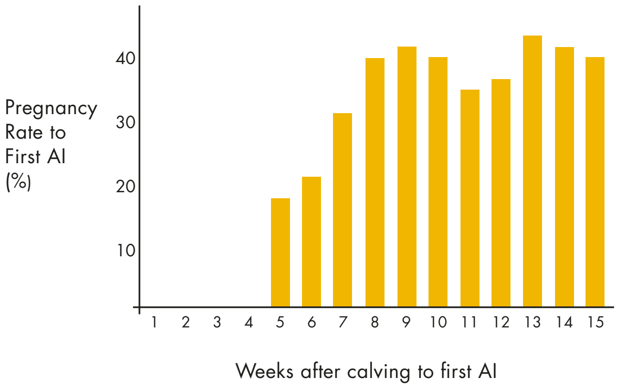
** 7000 litre/cow average*
Source: Esslemont (personal communication, 2010).

Providing the Heat Detection Rate is high and Calving to First Service Interval low, fertility performance can be very acceptable even at low Pregnancy Rates **(Section 5; Table 5.9)**.

Research indicates that very early service – at six-seven weeks (42-49 days) post-calving – may be associated with lower Pregnancy Rates.

However, it clearly shows that extending the Calving to First Service Interval beyond eight-nine weeks (56-63 days) gives little benefit in Pregnancy Rates **(Figure 6.1)**.

Figure 6.1: First Service Pregnancy Rate and weeks after calving



Source: Recent Research in Dairying (2002). Agricultural Research Institute of Northern Ireland.

A Voluntary Waiting Period of 45 days and Calving to First Service Interval of 60 days will give the best fertility performance when linked to a Heat Detection Rate of 70%.

Calving to First service Interval is also one of a number of management factors that affect Pregnancy Rates **(Section 8)**.

The oestrus cycle

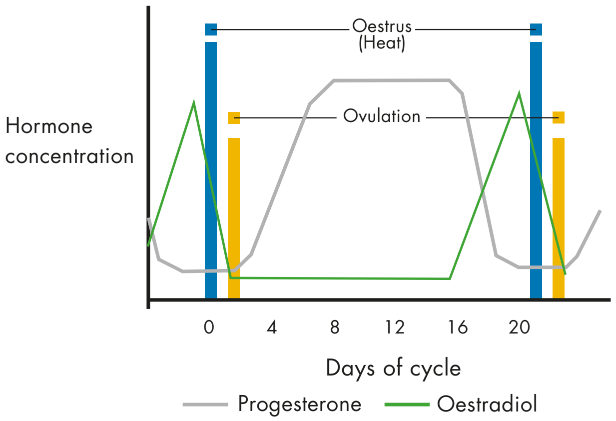
All of the events of the three-week oestrus cycle and the maintenance (or otherwise) of pregnancy are controlled by hormones produced by the ovaries, pituitary gland and uterus.

Chief amongst these are:

- Progesterone
- Oestrogen (oestradiol)
- Follicle-stimulating hormone (FSH)
- Luteinizing hormone (LH)
- Prostaglandin.

Cycling itself is primarily governed by the balance between oestrogen, which prepares the animal for mating and progesterone, which prepares the uterus to accept and nurture the embryo (**Figure 6.2**).

Figure 6.2: Change in blood hormone levels during the oestrus cycle



Source: Peters and Ball (1994) in Reproduction in Cattle.

During the whole of the cow's reproductive cycle, eggs continue to be produced from follicles in the ovaries in a continual series of waves.

Under normal conditions, one follicle – the dominant follicle – grows more rapidly than the rest to a size of 15-20mm in each cycle, then ovulates to release its egg to travel down the fallopian tube into the uterus.

This follicle is then transformed into a corpus luteum which secretes progesterone.

Cows commonly show standing heat 18-30 hours before ovulation so the egg and sperm arrive together in the uterus in prime condition.

If fertilisation is successful, the egg develops and becomes implanted in the uterine wall where the foetus develops. The corpus luteum is maintained and hormonal feedback inhibits further oestrus cycling during the pregnancy.

If fertilisation is unsuccessful, the egg is shed and cycling continues, with the corpus luteum decaying until a sudden drop in its progesterone production allows the next developing dominant follicle to ovulate.

Cycling also recommences once the hormonal feedback of pregnancy is removed following early foetal loss, abortion or birth.

Factsheet 4 gives information on the role of hormones in controlling oestrus.

Understanding oestrus resumption

The extent to which normal oestrus cycling resumes after calving and is evident in signs of heat is crucially important if service targets are to be met.

Recent on-farm studies in Northern Ireland revealed a steady increase in the proportion of cows resuming oestrus activity in the 50 days after calving (**Table 6.3**).

Table 6.3: Resumption of oestrus post-calving

Post-calving (days)	**Cows resuming oestrus** (%)
20	36
40	80
50	88

Source: Mayne and Others (2003) Farmers Booklet, Agricultural Research Institute of Northern Ireland.

While further studies at the Scottish Agricultural College show around 90% of cows completing their first new oestrus cycle by 60 days after calving, they indicate a markedly lower early detection rate (**Table 6.4**).

Table 6.4: Resumption and detection of oestrus post-calving

Post-calving (days)	**Cows completing one ovarian cycle** (%)	**Cows detected in oestrus** (%)
40	77	35
50	84-89	48-53
60	87-93	60-67

Source: Ball (1982) British Veterinary Journal.

The Northern Ireland study also revealed 40% of cows with one or more non-typical progesterone profiles in the early post-calving period, suggesting considerable potential for problems.

This finding is confirmed by University of Nottingham work comparing populations of cows in 1975-82 and 1995-98, showing the incidence of unusual post-calving hormone patterns increasing from 32% to 44%.

Implying a longer average period between calving and first heat and service, this change has an obvious impact on fertility performance and is most likely to be related to nutrition and body condition (**Section 7**).

The first follicle to develop after calving may:

- Ovulate and form a corpus luteum in the normal way
- Degenerate to allow another follicle to develop from a second growth wave after two-three days
- Continue to grow, become cystic and prevent ovulation.

Cows experiencing excessive weight loss or in a prolonged negative energy balance after calving have been shown to have a smaller dominant follicle and lower oestradiol levels than normal.

Comparisons between US Holsteins with Pregnancy Rates around half those of New Zealand Friesians reveal the Holsteins to have more persistent first dominant follicles, a slower emergence of second wave follicles, a faster turnover of follicles and lower progesterone concentrations.

The incidence of non-cycling cows has a major impact on fertility performance.

So-called anoestrus is generally classified as:

- Anovulatory anoestrus – a failure of the dominant follicle to ovulate
- Silent ovulation (heat) – where a corpus luteum is present but oestrus is absent
- Management-induced anoestrus – a failure to detect the heat
- Clinical cases – resulting from uterine infections, follicular cysts or a prolonged corpus luteum in the absence of an embryo.

Oestrus behaviour

The average oestrus cycle varies in duration from 18 to 24 days, although there are examples of 16 and 28-day cycles.

The period of oestrus – when the cow is fertile – ranges from one to 30 hours, with a typical duration of 8 to 12 hours.

Recognising oestrus

The signs of oestrus in cattle are many and varied **(Figure 6.3)**.

Standing oestrus, during which a cow will stand to be mounted by herd mates or a bull, is recognised as the most reliable indicator of true oestrus because it is rarely seen at other times.

Standing cows are normally mounted over the rump, although they can be mounted over the head or forequarters in a few cases.

More mounted cows are in oestrus than those performing the mounting.

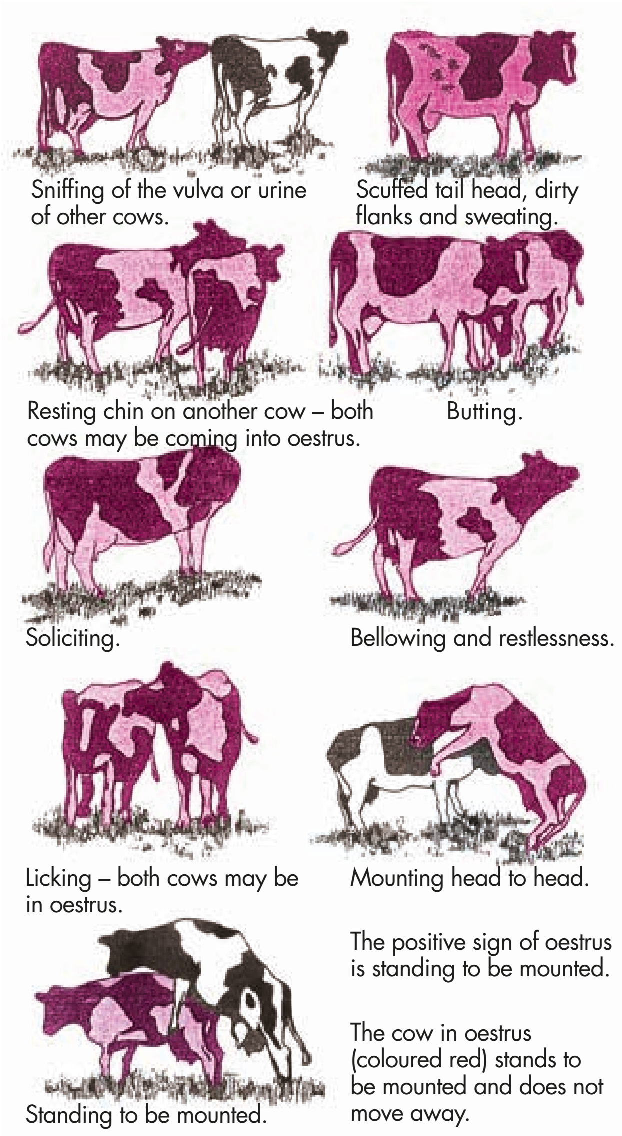
More than 88% of front-mounting cows are in oestrus themselves.

The period of standing heat lasts for a maximum of 8 to 10 hours and may be considerably less.

The animal will typically be mounted around four or five times an hour but the intensity of mountings can vary enormously, from zero to 60-80 times.

There is evidence that the period of standing heat is getting shorter and its intensity less in modern herds.

Figure 6.3: A guide to the typical displays of heat



The other most common behavioural signs of oestrus are:

- Sniffing the vulva or urine of other cows
- Rubbing or licking other cows
- Chin resting on other cows
- Standing behind other cows without mounting
- Bellowing, butting and restlessness
- Scuffed tail heads, dirty flanks and sweating.

A Dutch scoring system has been developed to establish the significance of the key physical and behavioural signs of heat **(Table 6.5)**.

This system has been found to be useful in valuing other signs of oestrus when standing heat is not always apparent in observation programmes, giving a Heat Detection Rate of 74% with no false positives.

Table 6.5: Oestrus detection scoring

Sign	Points Score
Clear vulval slime	3
Bellowing, butting and restlessness	5
Sniffing or licking vulva	10
Being mounted and walking off	10
Chin resting on another cow	15
Mounting (or attempting to mount) other cows	35
Head mounting another cow	45
Standing heat	100

The system is designed to be used cumulatively during a 24-hour period, points for observed activities being added-up for each cow.

When cows are observed three times a day for 30-minute periods a threshold of 50 points indicates heat.

Source: Eerdenburg and Others (1996) The Veterinary Quarterly.

Other signs of oestrus which can be valuable in aiding heat detection include:

- More physical activity and movement – up to double or quadruple on the day of oestrus
- A swollen vagina and vulva with changes in the electrical resistance of mucus and fluids
- Presence of Bulling String as distinct from small amounts of clear vulval discharge (which is unreliable as an indicator)
- Unique odours from body fluids – including an attractant oestrus pheromone that is readily detected by bulls and released 2-3 days before standing oestrus
- A low vaginal temperature just before oestrus, suddenly increasing by around 0.6-0.9°C for six-seven hours on the day of oestrus – accompanied by a similar short rise in milk temperature
- A notable slowing of the heart rate, pulse rate and blood flow rate on the day of oestrus, peaking three days later
- Loss of interest in food accompanied by a slight reduction in milk yield from the day before oestrus until two days afterwards.

Planning oestrus observation

Experience shows the best times to observe oestrus activity are:

- At dawn and dusk when cows are at grass
- At night and mid-afternoon when cows are housed
- When cows are not being milked or fed
- When cows are stirred-up – especially on the way to the milking parlour or pasture
- After feeding when non-oestrus cows lie down and those on heat are able to find each other and, therefore, become more obvious.

A number of factors influence the extent to which cows display standing heat and can be used to improve the chances of observing oestrus.

The most important factors determining oestrus activity levels are:

- The number of sexually active cows in the group – activity peaking with three-five in oestrus together **(Table 6.6)**
- The space and opportunity for sexually-active animals to interact
- The ambient temperature – very cold and very hot conditions reduce oestrus behaviour
- Floor and foot conditions – slippery floors reduce oestrus behaviour

- Day length and light intensity – greater levels of activity are recorded where there are more hours of daylight and where the period of light has been extended artificially
- Nutrition – cows in negative energy balance may stop showing signs of heat.

Table 6.6: Number of cows in oestrus and Standing Heat Activity

Cows in oestrus simultaneously	**Duration of Standing Heat** (hours)	**Number of mounts per animal**
1	8	13
2	12	17
3	14	31
4	15	29
5	15	38

Source: Diskin and Others, in Recent Research in Dairying (2002), Agricultural Research Institute of Northern Ireland.

The chances of observing oestrus can also be improved by planning observation with an appreciation of the conditions under which oestrus detection is likely to be difficult.

Oestrus detection difficulties are most likely to arise when:

- Dairy staff are under stress – with insufficient time to look after large numbers of cows
- Only one cow is on heat **(Table 6.6)**
- Cows are lame
- A cow is mounted fewer than 20 to 30 times during heat
- The introduction of a stock bull depresses cow-on-cow mounting activity
- High-yielding, early lactation animals are in particular negative energy balance; especially if they are not carrying sufficient condition at calving
- Oestrus starts late in the evening or at night
- Twins or dead calves are born, afterbirths have been retained or vulval discharges continue after calving
- Cows are kept in crowded conditions or tied by the neck
- Management activities such as feeding and scraping interfere with cow behaviour
- Stress and extremes of temperature inhibit natural cow behaviour.

Oestrus expression

The increasing incidence of abnormal hormonal patterns and delayed interval to first heat highlights the fact that poor heat expression can be as significant a problem as poor heat detection.

Even though heat detection standards vary from farm to farm, it is widely recognised that in some cases there may be insufficient oestrus activity to register (silent heat) or animals may not actually ovulate at all (anoestrus).

There is conclusive evidence of such problems which are significantly higher in:

- High-yielding cows
- Cows that are too fat at calving
- Cows in prolonged negative energy balance
- Cows subjected to severe grazing restrictions at pasture.

Although such animals appear to resume normal oestrus cycling seven-14 days after calving, some seem incapable of ovulating, entering a period of negative hormonal feedback which can become a prolonged period of anoestrus.

Controlling body condition

Most cows milk off their backs in early lactation, drawing on fat reserves to fill the gap between the amount of energy they can consume and their production needs.

The more pronounced this negative energy balance and the longer it continues, the greater its effect on ovulation and oestrus expression.

Cows with a Body Condition Score (Section 7) of under 2.5 at calving have insufficient fat reserves to draw on in early lactation

Equally, those with a Body Condition Score of over 3.5 have too much fat, resulting in less efficient mobilisation of reserves.

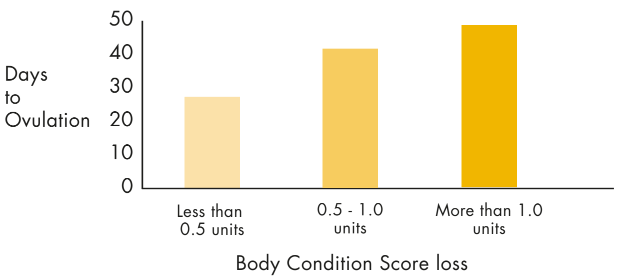
These cows both exhibit higher levels of uterine discharge and a longer interval to first oestrus than animals with a score of between 2.5 and 3.5.

The change in Body Condition Score during the first 30 days of lactation is also recognised as having a major influence on the resumption of oestrus activity.

Cows losing less than half a score in early lactation appear to show signs of ovulation two weeks earlier than those losing over one score (Figure 6.4).

D.

Figure 6.4: Body Condition Score loss in the first 30 days of lactation and Interval to First Ovulation



Source: Butler (2001) BSAS Occasional Publication 26.

Ensuring cows calve at the optimum Body Condition Score and do not lose excessive condition in early lactation will make a major contribution to their resumption of oestrus activity and oestrus expression.

It is important to:

- Calve cows at a maximum Body Condition Score of 2.5-3
- Manage cows to lose a maximum score of 0.5-1.0 and as near to 0.5 as possible in the first 30 days of lactation
- Condition score at calving and condition loss in early lactation also has a major influence on Pregnancy Rates **(Section 7)**
- Data capture forms for Body Condition Scoring can be downloaded from DairyCo's website.

Managing animal health

A number of clinical conditions are known to delay the return to normal oestrus activity, including:

- Retained placenta (cleansing) – resulting from infectious abortions, premature calvings (including those induced by drugs), prolonged calvings caused by twins or dystocia and infection during calving and milk fever

  A 3% incidence of retained placenta may be normal. A level approaching 5% suggests a problem and may require investigation
- Endometritis – caused by an infection acquired at the time of calving and producing either a brown discharge or more commonly, a continual flow of white pus (whites)
- Cystic ovaries – including the more common follicular cysts where there is a failure to ovulate and the cyst secretes oestrogen.

Veterinary attention needs to be sought at an early stage if any of these conditions are recognised or suspected, to avoid serious fertility problems.

Controlling lameness

Besides being an important economic and welfare problem in its own right, lameness can also seriously impair oestrus expression and other aspects of fertility (Table 6.7).

In particular, lameness can have a serious impact on Pregnancy Rates **(Section 8)**.

Table 6.7: The Impact of lameness on reproductive performance

	Lame cows	Non-lame cows	Difference
Calving to First Service Interval (days)	72	68	+ 4
Calving to Conception Interval (days)	100	86	+ 14
Pregnancy Rate to First Service (%)	45.9	56.3	- 10.4
Number of Services per Pregnancy	2.14	1.72	+ 0.42

The annual incidence of lameness in UK dairy herds recorded in surveys has increased significantly over the past 40 years – from 4% in the late 1950s to 25% in the early 1980s and up to 35% more recently.

The degree to which lameness affects dairy fertility depends on its severity, duration and the stage of lactation when it occurs.

Lesions involving ulceration of the sole are considered to have most effect on oestrus expression, with lame cows less inclined towards oestrus activity because of the pain experienced.

Awareness of lameness on UK dairy farms has been found to be worryingly low, herd managers estimating its prevalence at an average 5% when the measured figure averaged 22%.

An American study has further revealed that 75% of cows culled for infertility were suffering foot infections.

A number of practical things can be done to reduce lameness and the oestrus expression problems it causes. These include:

- Improving cow comfort
- Performing regular Mobility Scoring and establish a lameness health plan, recording lameness incidence and analysing records to pinpoint problems
- Examining feet and trimming them two or three times a year, ideally at drying-off or at six weeks post-calving to address any problems that have arisen at calving
- Attending to poor floor surfaces
- Reviewing the diet; particularly starch and degradable protein levels
- Scraping cubicle passageways twice daily
- Preventing and controlling digital dermatitis through frequent foot-bathing – several times per week or daily
- Improving heifer rearing **(Section 10)**
- Attending to tracks.

Because lame cows go off their feed, rumen fill scoring can be a useful tool to pinpoint lameness as well as other impediments to intake.

Stress factors in dairy cattle

Stress is often mentioned as a contributor to poor and declining fertility performance.

Typical stress-inducing factors which may reduce the willingness of animals to show oestrus include:

- Limited space and over-crowding
- Slippery and uncomfortable floors
- Cows standing for too long in the collecting yard
- Cubicles too small for the size of stock
- Changes to cow groups
- Heat stress.

The effect of stress on fertility and other aspects of herd performance is best illustrated by studies of social behaviour.

Cows moved five places or more down the hierarchy within the herd:

- Took an extra 46 days to get in calf
- Required an extra 0.6 inseminations per conception
- Produced 1.6 litres less milk per day
- Showed a 389,000 cells/ml cell count increase.

To minimise levels of stress in the herd:

- Reduce movement of cows between groups, wherever possible
- Don't skimp on space for feeding, lying and loafing
- Make any changes in housing and feeding gradual.

Heat detection practice

A variety of fertility performance studies show that UK Heat Detection Rates:

- Have remained virtually unchanged over the years at 48%
- Are rarely higher than 59%
- Tend to be higher in herds of over 100 cows (55-59%) than in smaller herds (44-46%)
- Do not tend to be lower in higher yielding herds
- Vary widely (from 35% to 80%) between farms for first services
- Vary much less widely (70%-90%) between farms for repeat services.

Research and practical experience from a number of sources indicate that Heat Detection Rates of only 40% are achievable in the course of routine work.

Achieving higher Heat Detection Rates is recognised as requiring frequent, dedicated observations throughout the day during the breeding season (Table 6.8).

Table 6.8: The impact of the number of observations on heat detection

Number of observations	Heat detection efficiency (%)
1 or 2	49
3	54
4	61

Source: Datamate, ADAS in DairyCo Report 97/R1/22.

Heat detection efficiency has also been found to be higher where observations take place between 8pm and 10pm (55%) and after 10pm (57%) than where no observations are carried out after 8pm (46%).

Improving heat detection

Over the years a number of practical guidelines to heat detection success have been developed by UK fertility management specialists **(Figure 6.5)**.

Guidelines for Better Heat Detection

1. Set aside time specifically for cow observation and heat detection quite separate from time spent feeding, scraping and milking
2. Combine quiet management activities like cleaning dung from cubicle kerbs, liming cubicles, moving electric fences and grassland recording with heat detection, always creating reasons to get among cows
3. Undertake three 30+ minute observation periods spaced as evenly as possible through the day – 6am, 2pm and 10pm – with particular emphasis on the night-time round for Heat Detection Rate targets of 70% or more
4. Appreciate that the lower the level of bulling activity in a herd the more time will be required to spot cows in heat.

Managing heat detection in expanding herds

Increasing herd size has had a major impact on heat detection in recent years.

More cows per person, fewer management hours per cow and more multi-person units increase the pressure on heat detection and the need for better planning and communication between all those involved in fertility management.

Heat detection needs to be managed particularly carefully in expanding herds.

Key fertility considerations arising include:

- Ensuring new building design and cow flow maximises cow comfort and visibility to observers
- Allowing sufficient time for observing cattle in the new work routines
- Providing improved staff conditions to aid heat detection
- Giving careful attention to cow tracks to avoid increases in lameness resulting from cows having to walk further
- Improving communication where more staff are involved
- Upgrading record-keeping and computer facilities
- Offering refresher fertility training to support and motivate staff.

Expanding the herd may provide the perfect opportunity to put in place a fertility team to maximise management attention and actively involve and motivate all concerned (Section 4)

Larger herds may also consider making use of outsourced fertility management services, where trained technicians assume daily responsibility for heat detection and AI.

Contracted Fertility Management Services

A relatively recent development in British dairy farming is the use of contracted third-party management of heat detection and AI.

A trained, dedicated technician visits the farm on a daily basis at a routine time and becomes responsible for fertility recording, heat detection and insemination. The system relies heavily on the use of tail paints and the observation of cow behaviour.

The service also provides fertility data which may be helpful in herd management, and may also include other cow management services and advice.

Large improvements in Submission Rates, Calving Index and other important fertility measures have been reported by users of this service.

Such a service can provide several additional benefits:

- Reducing workload and associated stress on herdsmen
- Freeing up staff time for other important tasks
- A consistent approach to fertility on farms where large use is made of relief or part-time staff
- The ability to use AI (and therefore access to better genetics as well as provision of more definitive calving dates) rather than relying on natural service for a portion of the herd.

However, there may also be disadvantages:

- A single individual's expertise (or lack thereof) is greatly relied upon in detecting heat in the herd or herd group
- The technician must visit several herds during the day and may therefore be under pressure, particularly if held up on previous farms or en route due to traffic problems
- The requirement for the herd to be housed or penned up at a particular time during the day when the technician is due to visit, which may or may not be convenient for farm staff, or may require changes to be made to farm routines
- The service is quite costly and the investment could be better used in, for example, an automated heat-detection system
- The supplier of the service may insist that only semen sold by them is be used.

It must be recognised that any definite improvements in fertility gained from using a contracted fertility management service will only be measurable into the second year of the programme.

Pinpointing heat detection problems

The incidence of returns to service at the average 18-24 day oestrus cycle length, multiples of it, or intervals at odds with it is one of the best ways of pinpointing problems with heat detection (**Table 6.9**).

Table 6.9: Returns to service interpretation

Days between services	Percentage of Inter-service Intervals (%)			
	Typical spread	Target detection	Poor detection	Wrong detection
1-17	5		5	> 15
18-24	> 50	70	< 45	40-50
25-35	5-10		5-10	> 15
36-48	15	10	15-30	10
More than 48	20		> 15	> 15
More than 78		2	> 15	> 15

ADAS (1984) Dairy herd fertility

If heat detection is working well, a high percentage of returns to service should be at the standard oestrus cycle length. At least 50% and preferably 70% of returns should therefore be in the 18-24 day group.

An 18-24 day returns percentage below 45% suggests a poor Submission Rate or heat detection accuracy.

If the problem is a low Submission Rate, there will be a high proportion of returns – probably as much as 40% – after 36 days.

If the problem is cows not being in oestrus at insemination, a low proportion of returns will be in the 18-24 day category with high proportions in both the one-17 day and 25-35 day categories.

A high proportion of cows presented for pregnancy diagnosis that prove not to be in-calf is also a good indication of poor heat detection.

Understanding heat detection failures

Two types of mistakes can be made in heat detection:

- Missed heats – the most common and easily understood, relating either to insufficient observation or expression
- False positives – most often occurring when there is a lot of oestrus activity, confusion over oestrus recognition, mistakes in identification or an overzealous campaign to serve if in any doubt.

SAC studies indicate the incidence of false positives to be as high as 10%.

American work suggests even higher figures for the average farm, with 15-20% of cows served having high levels of progesterone, indicating they are not in heat.

Improving heat detection technique

As well as ensuring sufficient time is spent observing cows, this time must be effectively used.

Refresher training may be advisable where:

- Additional staff or relief cover are taken-on to support herd expansion
- Replacement staff or relief milkers join the team
- Staff pressures are high
- There appears to be a high incidence of silent heats
- Heat Detection Rates are markedly below target.

Heat detection aids

Heat detection aids are only valuable to support day-to-day management and should never be seen as a replacement for good husbandry practice.

An ideal heat detection aid should be:

- Able to provide continuous cow surveillance
- Accurate – combining low levels of missed heats and false positives
- Simple – so it gives real savings in management time
- Good value for money
- Accepted by staff as an aid rather than a threat
- Practical for the conditions under which it is being used.

Records, diaries and charts

Breeding records, diaries and charts are the most fundamental aid to heat detection, allowing cows likely to be in heat at a particular time to be observed particularly closely.

They also help to ensure correct stock identification.

A range of different formats and systems are available (Section 3). Foremost amongst these are:

- Calendars and diaries – onto which key fertility events and details are recorded
- Action lists – of animals due for service, possible return dates, cows not served 110 days after calving, etc. These may be computer generated, provided as part of milk recording systems or prepared manually
- Three-week breeding diaries – allowing likely next heat and service dates to be predicted from the recording of observed heat activity and providing particular help in reducing false positives
- Rectangular or circular breeding charts – giving a clear visual warning of events and service activities to watch for.

Datamate comparisons reveal Heat Detection Rates of 59% in herds using a three-week breeding diary as against 52% in those not using one – a financial benefit of over 0.5p/litre in an average-performing herd.

Large ear tags, freeze brands and collars

Often not considered a heat detection aid, good highly visible means of identifying animals are essential and can be vital in minimising false positives.

Good identification is especially important in larger herds or where there are several people, such as relief staff, involved in heat detection.

Vasectomised bulls

Vasectomised bulls equipped with halter-mounted, chin-ball marking devices leave paint marks on the back and rump of cows in heat.

They tend to mount non-pregnant animals only.

The presence of a bull improves detection by increasing the vigour of heats and cows on heat mingle actively with the bull.

The level of accuracy has been shown to be equal to reasonable visual detection except in year-round housed animals.

Vasectomised animals may be used from about 350kg liveweight until around 2½ years of age when they tend to be too big for the cubicles.

80-100 cows are an effective working limit for one bull and it is important to top-up the marker every week.

Possible problems include excessive weight gain, loss of interest, the inherent danger of a bull (particularly one frustrated by the continual removal of cows going to AI) and the potential spread of venereal diseases.

Penned bulls

Bulls penned in a suitable location, which cows pass closely and regularly, are valuable in stimulating oestrus behaviour, particularly in otherwise quiet cows.

Probably as a result of pheromones released by pre-oestrus cows, bulls are thought to be able to predict the onset of oestrus two-three days in advance.

A factsheet on Natural Service Management details the management of bulls on farm to achieve optimum fertility

Tail paint

Tail paint has been used with considerable success as a heat detection aid for many years, particularly in New Zealand and the USA.

Paint or paste of the right consistency applied to the tail-head area is rubbed off as mounting occurs.

The technique is usually restricted to groups of cows expected to come into heat or individual problem animals.

Datamate comparisons reveal Heat Detection Rates of 58% in herds using tail paint as against 52% in those not using it – a financial benefit of around 0.5p/litre in an average-performing herd.

False positives can result from paint rubbed-off on cows involved in cow-cow activity but not themselves in heat.

Back brushes may even be to blame for rubbing-off paint in some cases.

This technique demands good records and observation to ensure that cows are inseminated when the paint is first removed, otherwise animals may get served after the optimum time.

Heat mount detectors

Working on the same principle as tail paint, heat mount detectors offer similar heat detection benefits.

They come in several forms, some of which react to the pressure of a mounting cow by releasing coloured dye from a sachet glued on the cow's back.

A different variety of detector is the 'scratch-card' type, where the card's bright backing colour is revealed by the action of the mounting cow removing the card's coating.

Other types rely on the pressure of the mounting cow to release a small spring-loaded flag.

False positives can be a particular problem with heat mount detectors – up to 26% in one study, often caused by back brushes or cows involved in cow-cow activity but not themselves in heat. Another drawback can be the number of lost devices.

Timing of application is important for greatest value; the best times being on completion of the Voluntary Waiting Period and a few days after insemination (reducing the incidence of false positives or lost devices) to detect any returns to service.

Electronic, pressure-sensitive, rump-mounted devices have been developed recently. These are activated by the weight of the mounting animal, they automatically send a signal to the management computer to identify the animal, time and duration of the mounting.

This system is reported to be more accurate than observation but is by no means infallible and research to date has concluded the additional cost is hard to justify.

Motion sensing systems

Systems able to detect and measure cow movement have been developed to give an indication of animals coming into oestrus.

These new technologies, which measure the increased activity during oestrus, can be a very accurate aid to heat detection.

Three distinct concepts are marketed:

- **Pedometers** – strapped to the leg of an animal which measure overall animal movement and detects the increase in movement during oestrus
- **Necometers** – attached to the neck of an animal, which detects oestrus by comparing a previously-measured standard level of individual cow movement to the increased movement a cow exhibits during oestrus
- **Optical sensors** – able to identify increased activity during oestrus by comparing captured images of individual animals with a reference image held on a computer database.

Newer systems of movement devices utilise an analytical means to compare increased activity to an earlier base period rather than the absolute level of activity.

On the basis that they are twice as accurate as the normal twice-daily observation routine, as reported, pedometers and similar devices would equate to a 10-12% higher Heat Detection Rate, giving a financial benefit of 0.8-0.9p/litre in an average-performing herd.

The main limitations to the use of pedometers and necometers primarily relate to unfavourable conditions, damage, losses and difficulties in taking readings. A high proportion of lame cows within a herd will also limit the efficacy of the system, as lame cows, even during oestrus, will exhibit reduced mobility.

False positives may also be a problem when using these systems and most are designed primarily for use in continuously-housed herds.

Technological improvements of the most modern systems include data storage; an internal power supply; alert systems and self-contained interrogation devices within the milking parlour relayed to a computer.

As part of combined measurement systems, pedometry and similar systems could offer considerable possibilities in the future for use in larger herds particularly as they can be integrated into automated systems such as automatic drafting gates.

Closed-circuit television or video recording

Systems for observing cows at a distance may be valuable for some herds, utilising several forms of technology:

- They can be wired-in or wireless
- They can use motion sensors which trigger a camera when oestrus behaviour occurs to record images during times when staff members are not monitoring or observing cows
- They can utilise broadband internet connections via webcams
- Remote controls to provide zoom and pan movements can increase the flexibility of these systems.

Closed circuit television systems can be very useful:

- They can improve working conditions for staff by enabling herdsmen to observe cows in the comfort of their homes or farm offices
- They enable and encourage more frequent observation at times when cows may be more active in exhibiting oestrus
- They can increase general farm security.

These systems cannot totally replace close observation of cows:

- They require commitment and close management control; staff must use them effectively
- The costs for these systems are wide-ranging depending on the chosen system and the circumstances in which it is to be used
- They must be installed in such a way that cameras are able to be kept clean but out of the way of potential damage; particularly difficult in typical farm environments.

Other oestrus prediction techniques

Inter-vaginal probes

These detect changes in the conductivity of vaginal mucous to predict the time of ovulation.

There are, however, questions over the reliability of timing and the potential for disease introduction and spread.

Skin temperature measurement

This measures changes in body temperature in order to predict oestrus.

The method has been found to be sensitive enough to pick-up 80% of cows on heat but with a very high false positive rate of 33%.

In its current design, this technique is not considered suitable for routine oestrus detection.

Milk temperature measurement

This measures the rise in milk temperature at the time of oestrus, which has long been considered as a heat detection technique.

However, the accuracy of the relationship is compromised by external temperature fluctuations; the response is not always consistent and, detection on twice-daily measurements has been found to be unreliable.

Combined measurement

Where there are limitations to many of the individual techniques used in isolation, the concept of using combined measurements is attractive.

Systems including milk temperature, activity (as measured by a pedometer), yield and feed intake have demonstrated Heat Detection Rates as high as 87%.

The complexity of such systems and the need to marry-up data from a variety of sources is an obvious drawback, especially where one source may indicate significant changes while another may not.

Milk progesterone assay

Milk progesterone assays have been used over many years to monitor the oestrus cycle, detect pregnancy and identify disorders of the ovary.

Individual milk samples are used to establish that cycling is occurring and identify the sharp drop in progesterone level which precedes ovulation by around 48 hours **(Figure 6.2)**.

The MOIRA (Management of Insemination based on Routine Analysis) technique which involves routine use of progesterone assays has a 98% success rate in predicting ovulation.

Progesterone assay is so accurate that it is used to validate other methods of oestrus detection.

Although considered to be an underestimate of its potential, Datamate comparisons reveal Heat Detection Rates of 62% in herds using progesterone testing as against 52% in those not using it – a financial benefit of around 0.8p/litre in an average-performing herd.

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Despite its proven success, fewer than 1% of herds currently use progesterone assays, presumably due to the extra tasks involved, lack of facilities and, possibly, limited awareness of the technique.

Better automation of the process is considered necessary if the uptake of progesterone assays is to be increased.

DairyCo factsheets on progesterone use as an indicator and veterinary use are included within this folder.

Evaluating heat detection aids

The place for different heat detection aids can best be assessed by rating them against a number of key usability criteria (**Figure 6.5**).

Figure 6.5: Evaluating heat detection aids (the more stars the better)

Aid	Practicality	Sensitivity	Simplicity	False positives	Cost	Recommended use in problem herds
Breeding chart, Three-week diary	*****	****	*****	****	*****	*****
Penned bull	***	****	****	****	***	****
Vasectomised bull	***	****	***	****	***	****
Tail paint Heat mount detector	****	****	***	**	***	****
Pedometer	**	***	**	**	**	***
Pressure sensors	*	****	*	**	*	*
Skin temperature measurement	*	*	*	*	*	*
Milk temperature measurement	*	*	*	*	*	*
Combined measurement	*	***	*	***	*	*
Progesterone assay	**	*****	***	*****	**	*****

The interpretation of data in this table should read the greater the number of stars the more reliable the resource, apart from the false positives column which reads that the greater the star number the less the likelihood of false positives.