Several new traits will be introduced by Lactanet with the December 2020 release of genetic evaluations. For all breeds, genetic evaluations for the linear type traits Udder Floor, Fronts Legs View and Locomotion will be added to the current list of conformation descriptive traits. For the Holstein, Jersey and Ayrshire breeds Lactanet is expanding the number of health trait evaluations available to include resistance to three fertility disorders, namely Retained Placenta, Metritis and Cystic Ovaries. Lactanet is continually working to expand the tools available for genetic selection of dairy cattle in Canada. Genetic evaluations for these traits are made possible by the participation of dairy producers in the national classification program and their recording of herd health events.

New Linear Type Traits

Three new linear type traits will have official genetic evaluations for all breeds starting December 2020. These traits are Udder Floor, Front Legs View and Locomotion. In general, once a trait is added to the classification program by Holstein Canada it takes a few years of collection to have a sufficient number of records to perform accurate genetic evaluations. Udder Floor was added to the Canadian classification program in June 2017 as a trait contributing to Mammary System, replacing at that time the defective characteristics "Tilt" and "Reverse Tilt". For over a decade Locomotion has been scored as a research trait and this has also been the case for Front Legs View since June 2018. In 2021 Holstein Canada will transition these two traits to be official traits and having genetic evaluations will now enable genetic selection and improvement.

Expression of Genetic Evaluations for New Type Traits

Type trait genetic evaluations are expressed relative to the genetic base with an average of zero and a standard deviation of 5 points, meaning they have a typical range of -15 to +15. Proofs for both Udder Floor and Front Legs View will be published using letter codes since they have intermediate optimums. The letters "T"=Tilt and "R"=Reverse Tilt will be used for Udder Floor evaluations and for Front Legs View, the letter codes of "K"=Knock Kneed and "B"=Bow Legged will be used. While type traits are generally more heritable compared to other trait groups such as health and fertility, there is wide variation in the level of heritability among type traits. The estimated heritabilities for these new type traits are moderate to low. For the Holstein breed, the heritability of Udder Floor, Front Legs View and Locomotion is 21%, 11% and 5%, respectively.

Interpretation of Sire Proofs for New Type Traits

The interpretation of genetic evaluations for conformation traits in terms of how they relate to expected daughter performance in the Canadian classification program is not always intuitive. This information can be important to understand for descriptive type traits in order to properly consider them in sire selection decisions, especially with mid-scoring traits with intermediate ideals. For the three new type traits, Table 1 outlines the average linear score in first lactation that is expected for daughters of sires with an average proof (i.e.: EBV) of zero in the Holstein,

Jersey and Ayrshire breeds. This average represents what would be anticipated in an average herd and with an average dam and, therefore, will likely not be what would be actually observed in the majority of herds as there are many variables impacting daughter performance. The presented average does give an indication of how daughters of these bulls with a proof of zero are scoring across the Canadian breed population. Table 1 also provides the equivalent change expected in daughter linear score expected with each 5-point change in sire proof. Since the relationship is linear between daughter performance and sire proof for these traits, this value is valid for any 5-point difference in proof (i.e.: comparing a +9 to a +4 bull or a +2 to a -3 bull) or can be extrapolated to fit any other degree of difference in proof. This difference value is relevant for all herds since it reflects the expected genetic level of daughters regardless of the management level of the herd for the specific trait.

Table 1: Bull proof interpretation table including the expected average first lactation linear score for daughters of breed average sires (proof=0) and the expected increase in the average daughter performance with each 5-point increase in sire proof.

	Holstein		Jersey		Ayrshire	
	Average for proof=0	Per 5-point proof increase	Average for proof=0	Per 5-point proof increase	Average for proof=0	Per 5-point proof increase
Udder Floor[1]	5.70	0.15	5.43	0.15	5.32	0.15
Front Legs View[1]	5.18	0.15	5.27	0.20	5.26	0.15
Locomotion	5.45	0.20	5.98	0.15	5.32	0.35

[1]*Trait is considered to have an intermediate optimum and for interpretation purposes a positive proof change represents a tendency towards more "Reverse Tilt" for Udder Floor and towards and "Bow Legged" for Front Legs View.*

Evaluations for Resistance to Fertility Disorders

Also coming with the December 2020 release are the first genetic evaluations for Retained Placenta, Metritis and Cystic Ovaries, which will join Lactanet's current portfolio of health-related traits for the Holstein, Jersey and Ayrshire breeds. The collection of health events for these three fertility disorders began with the Canadian National Health Project, a nationwide effort to collect health and disease data, launched in 2007. The growing database of health events recorded by producers using on-farm management software or record books or by veterinarians offering herd health services through the Dossier Santé Animale/Animal Health Record Program in the province of Quebec has already been used to produce genetic evaluations for Clinical Mastitis and traits contributing the Metabolic Disease Resistance index in Canada.

Genomic evaluations for resistance to these fertility disorders are calculated using "Single-Step" methodology, which calculates genomic evaluations by simultaneously using all pedigree, performance and genotype information. This same methodology is already used by Lactanet for Hoof Health evaluations in the Holstein breed. Consistent with all other functional traits, fertility disorder evaluations will be expressed as Relative Breeding Values (RBV) with a breed average of 100 and a standard deviation of 5, where higher values indicate a better resistance to the fertility disorder (i.e.: lower frequency of disease). One evaluation will be published for each of the three fertility disorders, which is a combination of first and later lactation values. A sire is considered to have an official evaluation for all of three fertility disorders when they have health events available for daughters in at least 5 different herds and a minimum Reliability of 70% for Holstein (50% for Ayrshire and Jersey) for at least one of the three traits.

The heritability of Cystic Ovaries and Metritis is 4% while it is 5% for Retained Placenta. Although these levels are relatively low, like other health traits, there is genetic variation observed among sires that can be exploited and used for genetic improvement. The incidence of these fertility disorders is regarded to be largely management related by many producers, but a genetic component is present and if a problem is present in the herd, genetics can provide a more permanent, additive solution over and above herd management considerations.

Interpretation of Sire Proofs for Resistance to Fertility Disorders

Even with the relatively low heritability of these fertility disorders, there is an evident relationship between the observed percentage of healthy daughters and the RBV of their sire. Table 2 provides the expected average percent healthy daughters for a sire with a breed average RBV of 100 and the increase in percent healthy daughters expected with each 5-point increase in RBV. The values given are based on combined records in first and later lactation daughters. As discussed with the interpretation of linear type traits, the actual average percent healthy daughters will be different for each herd depending on management factors.

Table 2: Bull proof interpretation table including the expected percent healthy daughters for breed average sires (RBV=100) and the expected increase in percentage of healthy daughters with each 5-point increase in sire RBV for fertility disorders.

	Holstein		Jersey		Ayrshire	
	Average for RBV=100	Per 5-point RBV increase	Average for RBV=100	Per 5-point RBV increase	Average for RBV=100	Per 5-point RBV increase
Retained Placenta	94.7%	1.83%	97.6%	1.01%	91.4%	3.39%
Metritis	93.8%	1.80%	94.1%	1.67%	94.8%	1.83%
Cystic Ovaries	90.4%	1.96%	87.7%	3.77%	92.4%	2.70%

### Correlations Between Resistance to Fertility Disorder Proofs

While Retained Placenta, Metritis and Cystic Ovaries can all be defined as fertility disorders, there are major differences between them even in terms of genetics. In the Holstein breed, there is a moderately strong relationship between sire proofs for Retained Placenta and Metritis (73%), but the proof correlation of these two traits with Cystic Ovaries is much lower at 24% with Metritis and 11% with Retained Placenta. This suggests that Cystic Ovaries is a genetically different trait compared to the other two fertility disorders and may require specific attention for genetic selection and improvement.

Correlations with Other Traits

The three fertility disorders will not be combined into a specific index nor included in the LPI formula. It is therefore important to be conscious of how selection for other traits may indirectly affect genetic progress for these fertility disorders. Figure 1 displays proof correlations for Holstein sires between the fertility disorders and other key traits commonly considered in selection decisions. All three fertility disorders are favourably correlated with Herd Life and Daughter Fertility. Metritis also has a favourable relationship with Metabolic Disease Resistance, confirming a link between these diseases important during the transition period. Most notable though is the negative correlations observed between Cystic Ovaries and many other traits of

interest, including LPI and Pro$. Therefore, while many selection practices will already be indirectly reducing the frequency of Retained Placenta and Metritis Resistance, the same selection could have an unfavourable indirect effect on the incidence of Cystic Ovaries.

Figure 1: Holstein proof correlations for Metritis, Retained Placenta and Cystic Ovaries with selected other traits.
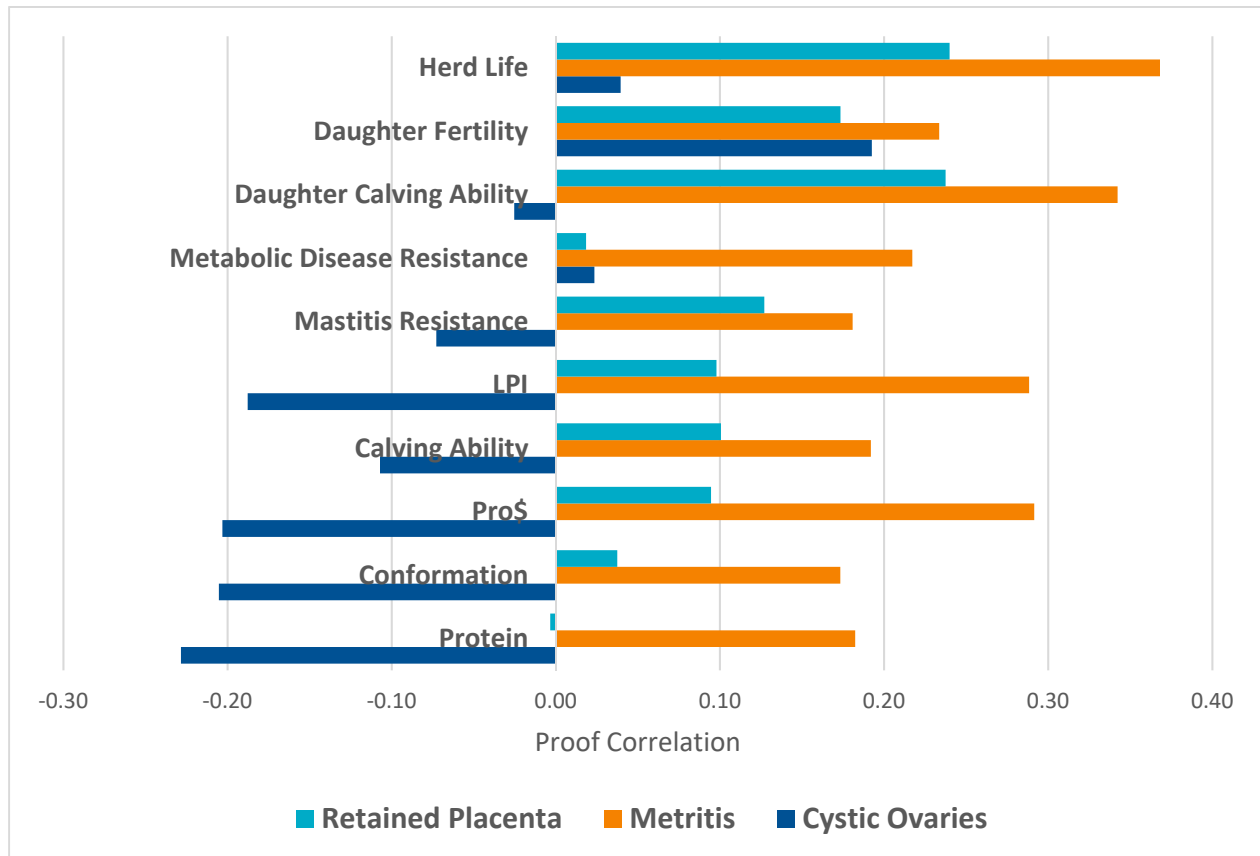
Summary

Starting December 2020, routine evaluations will be available from Lactanet for three new type traits in all breeds, namely Udder Floor, Front Legs View and Locomotion, as well as for three fertility disorders, namely Retained Placenta, Metritis and Cystic Ovaries, in the Holstein, Jersey and Ayrshire breeds. Look for these new type evaluations on each animal's Genetic Evaluation Summary page on the Lactanet Genetics web site. For the three fertility disorders, evaluations for all sires will be accessible on their Health details page.

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