The North Carolina Hog Belt Heat Stress Lens

A seasonal regional stress counter whose mechanism is physically intuitive, whose history runs the opposite direction in two of every three summers, and whose honest job is to supply ten percent of a four-member composite rather than call a trade on its own.

David Stendahl · Market Lab Analytics · October 30, 2026

A heat-stress counter with a story worth sitting with

North Carolina is the third-largest hog state in the country, and almost all of its roughly ten million market hogs a year sit in a tight cluster of coastal plain counties — Duplin, Sampson, Wayne, Robeson, Bladen. The Smithfield packing complex at Tar Heel runs about 32,000 head a day, the largest hog kill floor in the world. The region's weather is punishing in July and August: ninety-degree afternoons stacked with coastal humidity that will not clear overnight. Pigs do not sweat. When the Temperature-Humidity Index pushes above ninety, animals cut feed intake, gain slower, and in the worst stretches die at elevated rates. The mechanism is as physically clean as any in the livestock complex.

This signal does one specific thing. It counts the number of severe-heat days in that North Carolina belt over the last thirty days, standardizes the count against the trailing five-year distribution, and squashes the result between minus one and plus one. A deeply positive reading means heat days are stacking up right now. A deeply negative reading means the belt is unusually mild. In theory, a stacked positive reading in summer should flag a tighter US pork supply forming two to four months out — bullish for lean hog futures on the CME.

Here is the part worth sitting with. Looking at the moments when the signal actually transitioned into a Sustained Heat state and sampling the next sixty trading days from each run entry, the average lean hog forward sixty-day simple return is minus 9.34 percent — against an unconditional baseline of plus 1.60 percent over the same 8,988-day sample. That is nearly eleven percentage points of edge, running the wrong direction from the mechanism. Mild Conditions run entries, by contrast, average plus 3.74 percent on the same horizon. The Spearman information coefficient against lean hog forward sixty-day returns computes to minus 0.52 across the full sample. That is not a weak result. It is a strong result in the wrong direction.

So why does the signal still earn a seat inside the LH Supply Census Composite? Because the tails carry information even when the sign disagrees with the mechanism. The two extreme states, Sustained Heat and Mild Conditions, together account for most of the sample, and across run entries they discriminate forward sixty-day returns by roughly thirteen percentage points. That is tradeable magnitude. The composite that uses this signal weights it at ten percent and sizes its contribution carefully.

The composite is where the trade lives. This component is a supplement with directional information that is likely being read in the opposite orientation than its physical story suggests. Today the signal reads minus 0.12, inside the NORMAL band, nine trading days running since October nineteenth. It is October. The physical driver of this signal does not fire outside summer, so flat is correct and expected right now.

What follows is three real run-entry cases from the parquet that frame how to read this signal in practice, the full state-conditional record at run entry, the mechanics of how the inputs compose, how to actually use it today, and the limitations that any serious reader should hold alongside the headline numbers.

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Three cases that frame how to read this signal

The honest way to teach this signal is to walk through three real Sustained Heat run entries from the parquet and watch what the lean hog market did over the sixty trading days that followed. Two of the three show the typical anti-mechanism pattern — heat stacking into a run entry, then lean hogs collapsing twenty percent. One of them, drawn from the COVID-era disruption of 2020, is the rare exception where the mechanism did work. The point of the three cases together is not to cherry-pick. It is to show that the typical outcome runs opposite the physical story, and to show the specific kind of regime in which the mechanism occasionally does what its proponents say it should.

Case 1: May 2018 — the typical pattern

On May 23, 2018 the signal entered its Sustained Heat state at a composite reading of plus 0.283, and that run stayed in Sustained Heat for 109 trading days through the deep summer. The 2018 NC summer heat regime was intense: an early-season spike in late May, then sustained ninety-plus conditions through September. The thirty-day severe-heat count surged well above the trailing five-year baseline. The physical mechanism was engaging exactly the way its proponents describe. Pigs in the Carolina coastal plain were under genuine thermal stress. On the ground, the mechanism said bullish lean hogs in sixty days.

The market did the opposite. Over the next sixty trading days from that May 23 entry, lean hog continuous futures on the CME fell **21.45 percent**. The national supply picture dominated. Coming off the 2016-17 hog expansion, US inventory was elevated, placements were climbing, and whatever regional stress NC was absorbing was swamped by the national cycle. The signal fired, the mechanism was intact, and a trader who had sized long on it would have taken a twenty-percent hit in sixty trading days.

This is the typical pattern. Not every Sustained Heat run entry ends in a twenty-percent decline, but on average, Sustained Heat run entries precede sharply negative forward sixty-day returns in lean hogs. The 2018 case is a clean illustration of the empirical reality.

Case 2: June 2015 — a second typical anti-mechanism event

On June 1, 2015 the signal entered Sustained Heat at a composite reading of plus 0.261, and the run stayed in that state for 89 trading days. The NC summer that year was a standard heat regime: hot, humid, sustained periods of THI above ninety from mid-June through early September. The signal fired the same way it fired in 2018, and the mechanism predicted the same bullish lean hog outcome.

The market again did the opposite. Over the next sixty trading days from that June 1 entry, lean hog futures fell **20.26 percent**. Two consecutive summers (2015 and 2018), two Sustained Heat run entries, two roughly twenty-percent lean hog drawdowns in the following sixty trading days. Earlier drafts of research on this signal sometimes described 2015 as the summer the mechanism worked. It did not. The parquet record shows 2015 as another anti-mechanism event, not a mechanism success.

The 2015 case is the strongest single piece of evidence against reading this signal in the mechanism-consistent direction on its own. One anti-mechanism event could be bad luck. Two in sequence, from independent heat regimes three years apart, is the empirical pattern asserting itself.

Case 3: June 2020 — the rare mechanism-consistent exception

On June 8, 2020 the signal entered Sustained Heat at a composite reading of plus 0.173, and the run stayed in that state for 82 trading days. The reading at entry was more modest than the 2015 and 2018 cases, but the state transition qualified it as a Sustained Heat run under the same engine rules.

This time the mechanism worked. Over the next sixty trading days, lean hog futures rose **13.28 percent**. In context, 2020 was the COVID-era hog supply dislocation. Packer plants closed on outbreak reports in the spring. Backed-up producer inventory had to be euthanized on farm. By early June, the supply picture had been mechanically re-channeled by COVID packer closures — the normal relationship between regional heat stress and sixty-day forward lean hog prices was running inside a once-in-generation disruption. The 2020 case lines up with the mechanism's prediction, but the clean reading is that the COVID disruption rechanneled the supply picture temporarily, not that the heat mechanism worked in a repeatable way.

The 2020 case is the only clean mechanism-consistent anchor in recent history. It is the exception that proves the rule. In the parquet, it reads as a rare positive sixty-day forward return following a Sustained Heat run entry, specifically against a background of an unprecedented supply shock that any practitioner should mentally subtract before generalizing.

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What the state-conditional firings have actually done

Any signal is ultimately about what the market has done after it fired. Here is the full record, computed off the engine's parquet aligned to CME lean hog continuous closes from November 1990 through October 2026, with forward returns computed as simple percent changes over the following sixty trading days.

The reference baseline matters because every state-conditional number should be read as an edge relative to the unconditional lean hog forward sixty-day return. Over 8,988 aligned trading days, the lean hog forward sixty-day simple return has a mean of **plus 1.60 percent** and a median of **plus 0.23 percent**. Lean hogs on this horizon are a very slightly positive-drift series on this sample, close to zero at the median, with a mean lifted a little above the median by the right tail of recovery rallies. The mean and the median sitting on the same side of zero and close together tells us the baseline is a real small-positive drift, not a one-time crash or a one-time rally yanking the average.

> **Reference baseline (8,988 LH-aligned trading days, November 1990 through October 2026)**

> Lean hog forward 60-day simple return baseline (unconditional): mean plus 1.60 percent, median plus 0.23 percent. Source: this signal's engine parquet joined with CME lean hog continuous closes.

Against that baseline, here is what the states have done when sampled at run entry — the moment the signal actually transitioned into each regime, which is the relevant sampling convention for a trader asking "what happened the sixty days after this signal fired."

The **Sustained Heat** state at run entry delivered a mean forward sixty-day return in lean hogs of **minus 9.34 percent**, an edge of minus 10.94 percentage points below the unconditional baseline. Nearly eleven percentage points of negative edge, every time the signal transitioned into "heat is stacking." That is the single most important number in this brief, and it is the strongest piece of evidence that the signal's directional reading is backwards from its mechanism.

The **Normal** state at run entry delivered a mean forward sixty-day return of **minus 2.28 percent**, an edge of minus 3.88 percentage points below baseline. A mildly negative edge, consistent with transitions into Normal that are either stepping down from a heat regime (and inheriting some of that drag) or stepping up from a mild regime.

The **Mild Conditions** state at run entry delivered a mean forward sixty-day return of **plus 3.74 percent**, an edge of plus 2.14 percentage points above baseline. The symmetric opposite side of the Sustained Heat result: when the belt is cool and the mechanism says no supply stress is forming, the market has rallied lean hogs by nearly four percent on average in the sixty trading days that followed, a couple of points above the unconditional drift.

The spread between the Sustained Heat and Mild Conditions run-entry outcomes is roughly thirteen percentage points of forward sixty-day return, running in the opposite direction from what the physical mechanism predicts. The Spearman information coefficient computes to minus 0.52 across the full day-by-day sample with a p-value indistinguishable from zero. That is a highly significant result in the direction opposite the stated sign. The all-day Sustained Heat-minus-Mild Conditions spread is larger than the thirteen-percentage-point run-entry spread because the all-day sample folds in the full length of each run; the run-entry number is the methodologically honest one for a reader deciding whether to act on a fresh signal transition, and it still shows a strong anti-mechanism signal.

A note on what this signal's declared polarity is doing. The engine's AS_IS orientation treats positive composite readings as bullish lean hogs — the mechanism-consistent orientation. The LH Supply Census Composite then uses this signal with a positive polarity sign at ten percent weight. Taken literally, that configuration is wiring this signal in the wrong direction. In practice, the composite's weighting discipline — ten percent is the smallest of the four member weights — caps the damage from any sign disagreement. But the honest read is that this component may need its sign flipped at the composite layer, or it may need to be treated as informational-not-directional, with its contribution scaled by magnitude rather than by signed direction. That is a composite-design conversation, not a trading conversation. The composite is where the trade lives, not here.

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How the inputs compose

The signal pulls daily temperature and humidity observations from NOAA weather stations in the North Carolina hog belt — the Carolina coastal plain counties where Smithfield and Tyson have concentrated their finishing operations. It computes a daily peak Temperature-Humidity Index from the hottest hour of each day. The THI combines temperature and humidity into a single stress metric that the swine industry has used for decades. Above a THI of ninety, pigs measurably stop performing: feed intake drops, growth rates slow, and in sustained stretches, mortality rises.

Any day with a peak THI above ninety counts as a severe heat event. The engine also folds in days flagged "moderate stress" by the underlying station data, so the daily indicator captures both severe spikes and sustained-elevated conditions rather than only the hottest extremes. The engine then counts those stress days over a trailing thirty-day window. That raw count is z-scored against the trailing five-year distribution of thirty-day stress counts, with a sixty-day minimum sample population before the z-score is reported. The z-score is bounded by a hyperbolic tangent transform so that extreme heat domes do not blow the signal out to open-ended values. The output lives between minus one and plus one.

The engine's underlying method was deliberately tuned to count stress days rather than sum heat-degree-days. Animals recover between heat events, so event frequency carries more biological signal than cumulative heat exposure. One week of ninety-five-degree afternoons followed by a cool front is a different stress profile from four weeks of mid-eighties with no break, even if the heat-degree-day totals look similar.

The regime state machine partitions the composite into five bands at plus-or-minus 0.5 and plus-or-minus 0.2. The distribution is strongly bimodal: Sustained Heat and Mild Conditions together account for more than eighty percent of all trading days. This is a direct consequence of the seasonal signal structure. NC summers reliably stack stress days from June through September. NC winters reliably deliver zero stress days from November through March. The rolling thirty-day count therefore cycles between near-zero in winter and sustained-elevated in summer every single year. The two middle bands, Moderate Heat and Moderate Mild, are the brief transitional windows in spring and fall.

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How to use this signal today

Today the signal reads minus 0.12, in the NORMAL band, nine trading days running since October nineteenth. The NC heat season is physically over. Whatever information this signal is going to produce in 2027 will arrive next June when coastal humidity begins stacking again. Treat the current reading as the signal correctly standing down, not as a view.

The best way to think about this signal in a trading context is as a ten percent weight input into a four-member composite that is itself the actual trade. The composite blends this heat-stress reading with a basis signal, a hog-corn margin signal, and a Canadian feeder pig flow signal. Each input is doing a different job. This one is the smallest weight and the most seasonal of the four. Even at its peak firing in late July, its contribution to the composite's blended score is bounded by that ten percent cap.

That bound is a feature, not a bug. If this signal's sign conflict with its mechanism concerns a reader — and it should — the ten percent weight is the discipline that keeps it from hurting the composite. In seasons where the Sustained Heat anti-mechanism pattern asserts itself, nine other units of weight are coming from inputs with cleaner mechanism-aligned behavior. In the one in four summers where the mechanism does work and lean hogs rally with the heat, this component helps on the margin. The composite's long-run performance is what matters. This piece is a supplement with a wide confidence interval around its contribution.

Three practical uses stand up to scrutiny. First, as a seasonal regional-stress indicator — a reader can glance at this signal in July and know whether the NC belt is in a stressed regime or not. Second, as a magnitude input for the composite rather than a signed direction — the extreme-tail run-entry readings carry about thirteen percentage points of forward return discrimination, and that discrimination is useful even if the signed orientation is suspect. Third, as a sanity flag during known-shock periods — a Sustained Heat state coinciding with elevated national hog inventory, as happened in 2018, is a context where the sixty-day lean hog outlook has historically been meaningfully bearish, and that history is worth knowing.

What this signal will not do is drive a standalone directional lean hog trade. The physical mechanism says one thing, the thirty-six-year empirical record says the opposite, and until that disagreement is resolved — by sign flip, by sample refinement, by better mechanism understanding — the responsible posture is to let the composite do the sizing. Trade the composite, not this component.

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Methodology notes

Data flows from NOAA Global Historical Climatology Network daily station observations in the Carolina coastal plain counties, aggregated to a regional Temperature-Humidity Index and stress-level categorical. The engine's thirty-day rolling stress-day count is z-scored on a trailing 1,260-trading-day (five-year) window with a sixty-day minimum sample. The z-score is tanh-bounded between minus one and plus one. No deseasonalization is applied before z-scoring; the seasonal structure is part of the signal's intended behavior.

The engine's regime state machine partitions the composite according to its internal state-integer logic, with transitions into the Sustained Heat and Mild Conditions states occurring around composite magnitudes near plus-or-minus 0.2 to 0.3 in practice. The chart embedded alongside this brief draws cosmetic reference bands at plus-or-minus 0.5 (extreme) and plus-or-minus 0.2 (moderate); those bands are reader-friendly annotations only. The engine's actual state transitions follow its internal regime indicator, not the chart's visual bands. The two should not be read as identical thresholds.

Sample statistics are computed over 8,988 aligned trading days from November 1990 through October 2026, after a 504-day warmup period is dropped. Forward returns throughout this brief are reported as simple percent changes over the following sixty trading days. The unconditional baseline mean is plus 1.60 percent with a median of plus 0.23 percent. The Spearman information coefficient against lean hog forward sixty-day returns is minus 0.52 with a p-value effectively zero.

State-conditional means at run entry (the convention used for the main numbers in this brief) are: Sustained Heat run entry mean forward sixty-day return minus 9.34 percent, edge minus 10.94

percentage points below baseline; Normal run entry mean minus 2.28 percent, edge minus 3.88 percentage points; Mild Conditions run entry mean plus 3.74 percent, edge plus 2.14 percentage points. The three signature cases are drawn from the parquet at run-entry dates: 2018-05-23 Sustained Heat entry at composite plus 0.283 (109-day run, forward sixty-day return minus 21.45 percent); 2015-06-01 Sustained Heat entry at composite plus 0.261 (89-day run, forward sixty-day return minus 20.26 percent); 2020-06-08 Sustained Heat entry at composite plus 0.173 (82-day run, forward sixty-day return plus 13.28 percent).

The composite's directional polarity is a matter of composite-level design rather than engine configuration. The engine declares the signal AS_IS positive (heat equals bullish, mechanism-consistent). The LH Supply Census Composite applies polarity sign plus one at ten percent weight. Given the empirical record, that composite-level configuration is a candidate for revision — either by flipping the polarity sign at the composite layer, or by treating this signal's contribution as magnitude-only rather than signed-directional. That revision is part of ongoing composite-design work and is not a trading recommendation on its own.

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Why might the mechanism be running backwards?

The signal's mechanism is physically real: heat stress does hurt pig performance, and sustained severe-THI days in the NC belt do reduce the throughput of pigs reaching market weight on schedule. The question is why that physical reality does not show up as higher lean hog prices sixty days later. Four hypotheses are worth stating, with the explicit caveat that each is speculative and the brief is not endorsing any of them as the resolved answer.

The first hypothesis is marketings-forward behavior. When producers see a heat wave coming or in progress, they may pull marketings forward — sending hogs to the packer earlier and lighter than planned to beat further weight loss. The near-term consequence is more supply hitting the packing plants in the sixty-day window immediately following the heat event, not less. This would invert the expected supply response and produce the empirical pattern we see.

The second hypothesis is that the summer hog cycle is already priced. Lean hog futures contain seasonal expectations that are visible months in advance. By the time a given summer's heat events are observed, the market may have already set its summer supply curve, and the actual stress realization adds no new information. In that regime, the sixty-day return is being driven by other factors (demand, cold storage, Canadian flows) rather than by the heat realization.

The third hypothesis is co-timing with national herd expansion. Heat events do not happen in a vacuum. They coincide with whatever phase of the national hog cycle is currently running. If the thirty-six-year sample happens to contain more Sustained Heat events during expansion phases of the cycle than during contraction phases, the state-conditional average would pick up the expansion-phase bearish drift rather than the heat-stress bullish signal. This is a sample-composition hypothesis and could in principle be tested with careful cycle-stage conditioning.

The fourth hypothesis is public-information decay. Weather is observed by every participant. A heat event in the NC hog belt is on the news, in forecasts, and in private weather feeds the day it happens. By the time this signal's thirty-day rolling counter has accumulated enough days to flag Sustained Heat,

the market has had weeks to price the information. The surprise content in the signal firing may be very low, and the subsequent sixty-day return may be dominated by whatever information arrived after the signal's visible firing moment.

None of these hypotheses is settled. All of them are plausible. The empirical pattern is what it is, and the honest posture is to trade the composite and leave the mechanism question open.

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What this signal does not cover

Five honest caveats close the brief.

First, the sign disagreement between mechanism and empirical record is unresolved. The brief has walked through four plausible explanations but has not identified a resolved reason. Any reader using this signal — directly or through the composite — should hold the sign uncertainty in mind. The composite's ten percent weight cap is the practical mitigation, not an answer.

Second, the signal is seasonal by physical design. Most of its real information is produced between June and September. In the current month (late October) and through winter, the reading will drift near zero and should not be read as a view. A reader waiting for this signal to produce a strong directional reading between November and April is waiting for a condition the physical mechanism cannot provide.

Third, the signal captures only a regional slice. North Carolina is about ten percent of US hog production. Iowa and Minnesota — the two largest hog states — are not covered by this signal. Stress in NC may be fully offset by mild conditions elsewhere in the national hog belt. The signal is explicitly a regional supplement to broader supply inputs, not a national read.

Fourth, three identifiable structural breaks sit inside the thirty-six-year sample and the signal has no mechanism to detect them. The 2013-14 Porcine Epidemic Diarrhea virus (PEDv) epidemic distorted US hog supply curves for roughly eighteen months, with piglet mortality episodically removing supply in a way that had nothing to do with regional heat. The 2020 COVID packer closures mechanically re-channeled supply and demand in a few weeks' time; the 2020 mechanism-consistent case in this brief should be read against that disruption as context, not as a repeatable pattern. The 2012 Midwest drought drove corn and feed costs sharply higher, and some of the 2012 heat-stress episodes probably aligned with LH weakness through a confounded feed-margin channel — producers at punishing feed costs liquidating sows and front-loading marketings — rather than through the heat mechanism itself. These structural breaks are not isolated and controlled for in the state-conditional record; a reader should mentally bracket them.

Fifth, more generally, an ASF outbreak, a PRRS wave, a packing-plant disruption, or a producer-level depopulation event can scramble the pork supply chain in ways that make the recent historical distribution a poor baseline for several months at a time. The signal has no mechanism to detect these breaks. In those periods, the composite's other members and discretionary overlay carry more of the load.

The full page for this signal is at marketlabanalytics.com/signals/z4775-lh-nc-heat-stress/.

Not investment advice. The analysis in this brief is informational and educational. Signal readings and historical statistics are derived from publicly available data (CME lean hog settlement prices for 1990 through 2026; NOAA GHCN daily temperature and humidity observations aggregated to the North Carolina hog belt region) and are provided without warranty. Hypothetical performance results have inherent limitations. Readers should consult their own financial advisor before making any investment decision. (c) 2026 David Stendahl.