York City Audubon (NYCA) and NSMM governs when to initiate the shutdown procedures: when numbers of birds circling in the beams exceed 1,000 individuals, based on visual observations, NYCA requests that lights be extinguished for ≈20 min. These requests originate from observers on site that are directly monitoring birds and their behaviors in the beams.

We examined September 11th nights from 2008 to 2016. High-resolution radar imagery did not exist before 2008, which limited our temporal scope. We excluded 2009 and 2011 because of the presence of precipitation, which interferes with analysis of radar data containing bird migration information. Of the remaining 7 y, migration conditions varied from marginal to favorable, assessed based on prevailing atmospheric conditions. Of these 7 y, the lights were shut down at least once during 5 of them; as a result, many of our analyses are restricted to these 5 y (2010, 2012, 2013, 2015, and 2016). Of the remaining 2 y, the first (2008) occurred before stakeholders could reach a consensus on a protocol for shutting down the light installation when birds were present and in danger. Organizers did not shut down the installation in 2014 because few birds were present in the lights.

Local Weather Conditions. We downloaded hourly local climatic data (LCD) for September 11 and 12, 2008–2016 (excluding 2009 and 2011 as described above) from the closest official National Weather Service station to the installation between evening and morning civil twilight (sun angle 6° below the horizon): WBAN 94728, Central Park, New York, NY at 40.789°, −73.967°; and meteorological terminal aviation routine weather reports (METARs) from Newark Liberty International Airport, the closest such station at 40.690°, −74.174°. Based on a review and summary of these data, we classified all nights during our study as clear (*SI Appendix*, Tables S3 and S4).

Weather Surveillance Radar Data. We gathered radar data from the Brookhaven, NY WSR-88D radar (KOKX; 40.866°, −72.864°) to quantify migrants' flight behaviors and extracted georeferenced measures of reflectivity (η; cm^2 km^{-3}) and radial velocity (ms^{-1}) from the ≈0.5° and ≈1.5° elevation scales (12, 13, 70, 75, 76). We measured between civil twilight periods within a 20-km radius surrounding the installation (98.5 km from the radar, azimuth 260°) and consolidated analyses into 500-m height annuli bins. We dealiased velocities when necessary following refs. 76 and 77. We restricted our analyses to data points within 90 min of a shutdown period except when described.

We studied the effect of light stimuli on migratory birds using several metrics. First, we used the radar sweep with the lowest elevation angle (≈0.5°) to estimate the number of birds present in a cylinder centered on the installation with a radius along the ground of 500 m and a height of 1.7 km, the approximate width of the radar beam above the site (78). We calculated total effective scattering area per unit volume (cm^2 km^{-3}) of birds in this cylinder using bird density measures from the 0–500-m bin. Then, we converted to numbers of birds using an estimated value of one bird = 8.1 cm^2, which is the measured cross-sectional area on S-band radar of a small passerine songbird (common chiffchaff, *Phylloscopus collybita*) (79). We chose a relatively small cross-section value because visual observations indicated that birds in the lights were predominantly small songbirds. The radar beam set to the 0.5° elevation angle passes above the installation at an altitude of ≈1.5 km (50% power range, 0.7–2.4 km), which is higher than the altitudes at which the greatest migratory activity during this season in this region generally occurs (80). Therefore, we used an analysis of the entire radar scan to estimate the proportion of migration occurring beneath (or above) the radar beam at the installation, out of sight of the radar. We then adjusted our estimates to account for these undetected birds by multiplying by the necessary correction factor (*SI Appendix*, Fig. S10). This approach assumes that the light beams did not greatly alter the altitudinal distribution of birds near the installation. The validity of this assumption is supported by direct visual observations at the site, where observers noted descent only by the lowest-flying individuals, which would not be detected by radar. Furthermore, any unaccounted-for descent at higher altitudes would render our estimates conservative, because a greater proportion of birds flying below the radar beam than expected would yield a lower estimate of total bird numbers.

To complement estimates of the total number of birds in proximity to the installation, we also calculated the extent to which birds were concentrated at high densities in the airspace near the installation, relative to the baseline value in the surrounding airspace. To produce this baseline, we calculated the mean and SD of density values between 2 and 20 km from the installation. We then found the peak bird density value within 500 m of the installation, and we subtracted the baseline mean density from this peak density and divided the difference by the baseline SD (again, 2–20 km from the installation). The resulting value, referred to as "standardized peak density," represents the number of SDs the peak density falls above the baseline density.

Acoustic Data. We collected continuous acoustic data at 32-kHz sampling rates and 16-bit sample sizes during each year's event with a pressure zone microphone (Old Bird 21c; Old Bird, Inc.) specifically designed for monitoring avian flight calls, connected to (*i*) a Nagra ARES-BB+ (2010 and 2013) or (*ii*) a custom-built passive acoustic recording system (2015 and 2016), comprising a Raspberry Pi 2 Model B (Raspberry Pi Foundation) with a Cirrus Logic Raspberry Pi audio card (Cirrus Logic). We focused analysis on the 6- to 9-kHz frequency band to minimize interference from anthropogenic, geophonic, and nonavian biophonic noise and because many of the migrating birds in the New York City area emit flight calls in this frequency band (81). The microphone sensitivity in the relevant frequency band for this study (6–9 kHz) was −33 dB re 1 V Pa^{-1} (±2 dB).

Visual Observations. We complemented remote sensing data that characterized behaviors of nocturnally migrating birds above the installation with visual observations. Numerous observers, including one of us (A.F.) and volunteers from NYCA and the local birdwatching community, made visual counts of nocturnally migrating birds at the installation during the period between civil twilight dusk and dawn. All visual counts are archived in the eBird reference database (ref. 82; ebird.org/ebird/hotspot/L1744278).

Statistics. We used generalized additive models (R package mgcv) (83) to quantify the effects of TiL illumination on birds' behaviors (*SI Appendix*). We tested the categorical factors of light (on/off) and year on four metrics: standardized peak density, the total number of birds present within 500 m of the installation, the radial velocities of birds above the installation, and the number of flight calls recorded beneath the site. For models of time series, we also included smooth terms that accounted for overall variation in densities and behavior through the night. We confirmed that there was negligible temporal autocorrelation of residuals using the acf function in R for all analyses involving time series (*SI Appendix*). We log-transformed response variables when necessary to reduce residual skewness; for models with log-transformed response variables, we express effect size as a multiplicative factor, found by exponentiating the coefficient. Finally, to determine whether the light effects we present in the study are representative of those observed across years, we compared standardized peak densities across the lighted periods of all 7 y, including the 2 during which no light shutdowns occurred.

Simulations. To understand the dynamic patterns of bird density at the installation, we formulated a spatiotemporal flow model to simulate behavioral changes resulting from exposure to light. In our simulation, birds could transition between two behavioral states: an undisturbed migratory state and a disoriented state induced by ALAN. Detailed methodology of our simulations is in *SI Appendix*.

ACKNOWLEDGMENTS. We thank Eli Bridge, Wesley Hochachka, Steve Kelling, Jeff Kelly, Frank La Sorte, Felix Liechti, Michael Patten, and Brian Sullivan for review of manuscript drafts; anonymous reviewers provided invaluable comment and criticism. Matt Robbins, Raymond Mack, Christopher Tessaglia-Hymes, and Bioacoustics Research Program staff assisted with development, deployment, and operation of autonomous acoustic recording units. Graham Taylor provided information about flight energetics. John Rowden and Debra Kriensky coordinated volunteers for New York City Audubon. Special thanks to Michael Ahern, Jared Abramson, Jennifer Hellman, Massimo Moratti, Dorian Cynajko, and Olivia Egger for TiL logistical support. Support was provided by National Science Foundation Grant IIS-1125098 (to A.F. and B.M.V.D.), National Science Foundation Grant EF-1340921 (to K.G.H.), the Leon Levy Foundation (A.F. and S.B.E.), the Marshall Aid Commemoration Commission (B.M.V.D.), and a Cornell Lab of Ornithology Edward W. Rose Postdoctoral Fellowship and NASA Grant NNX14AC41G (to A.M.D.).

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