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Subject: [EXTERNAL] Boca Chica nest fates
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Hello,

As you know, we have been continuing to monitor nesting shorebirds at Boca Chica. Attached is a report based on before/after monitoring of last week's rocket launch. All nests were either partially or completely destroyed. We have not cleaned off the faces of the game cameras, if there is any interest in analyzing/testing that. Please pass along to any others as you see fit. Let me know if you have any questions.

Thanks

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Shorebird nest fates at Boca Chica after rocket test launch

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Coastal Bend Bays & Estuaries Program
June 6, 2024



Background

Coastal Bend Bays & Estuaries Program (CBBEP) staff perform weekly nesting shorebird surveys across different subsites at Boca Chica during the shorebird breeding season, approximately March through August. Focal nesting species for these surveys include Snowy Plover (*Anarhynchus.nivosus*; SNPL), Wilson's Plover (*Anarhynchus.wilsonia*; WIPL), and Least Tern (*Sternula.antillarum*; LETE).

Potential nesting habitat in the Boca Chica area is quite extensive so our monitoring efforts focus on several "subsites" within the area. The South Launch subsite is located entirely within Boca Chica State Park (Fig. 1). Nesting activity at this subsite has been monitored since the 2021 nesting season. Monitoring of the 2024 nesting season began on February

23. The site is a large open sandflat directly south of a rocket launchpad. Sediments in the area consist almost entirely of fine silt, clay and sand particles, with scattered biogenic (molluscan shell) fragments but no native component of lithic materials. Previous rocket test activity has spread debris (gravel, concrete, metal, plastic, rubber, and others) of varying sizes across a large swath of habitat in surrounding conservation lands, including a test in 2023 which disintegrated the launchpad spreading concrete debris across the area. While large pieces of concrete debris have since been removed, smaller rubble remains widespread.

Ongoing and annual monitoring of the Boca Chica area has documented shifts, and overall reductions, in shorebird nesting activity in recent years since rocket testing and launch activity began.

To document the immediate impact of an individual launch attempt, we conducted monitoring as close as possible prior to, and following, a launch event. This report summarizes findings of one such launch event at the South Launch subsite.

Methods

During regular monitoring, when new nests of SNPL and WIPL are encountered, eggs are carefully “floated” in a small container of water to observe orientation and buoyancy of each egg, allowing for accurate estimation of the age of each egg and therefore an expected hatch date. WIPL and SNPL nests are typically monitored until hatching or failure. Upon failure, the nest is approached and the area searched to determine cause of failure.

The rocket operator announced a test launch planned for the morning of June 6, 2024. On June 5, CBBEP staff conducted a monitoring visit to the South Launch subsite and recorded GPS locations and nest status of a total of five Snowy Plover nests, one Wilson’s Plover nest, and a dispersed colony of 11 Least Tern nests within the South Launch subsite (Figure 1). Monitored nests ranged from approximately 250 meters up to 430 meters away (~0.16 – 0.26 miles) from the most proximate edge of the launchpad. Total numbers of Least Tern adults, nests, and chicks are recorded during surveys but individual locations are not. Observations of these intact nests last occurred on June 5th between 3:00 and 4:00 p.m. local time (Central Daylight Time; all subsequent times are reported in CDT).

Following the launch, the six plover nests and three randomly selected LETS nests approached to determine nest status. We recorded the number of eggs in each of the nine monitored nests, and examined them for damage.

Additionally, two Bushnell E3 game cameras were set up near two nests at 4pm on June 5th to document any disturbance during the rocket launch attempt planned for the next day, June 6th. One camera was set ~1 m behind a Snowy Plover nest (SNPL 2) facing north and the other was set ~1 m feet behind a Wilson’s Plover nest (WIPL 1) facing north. Cameras were set to a high-sensor “motion trigger” mode, with 3 images per sensor trigger.



Figure 1. Map of the South Launch subsite at Boca Chica showing the locations of active plover nests and a dispersed Least Tern colony on June 5, 2024 in relation to the rocket launchpad.

Results

The rocket launch occurred on June 6, 2024 at approximately 7:50 a.m. and access was subsequently reopened to the public at approximately 8:35 a.m. CBBEP staff were on-site by 9:50 a.m. and began general reconnaissance noting some minor metal sheet and insulation debris on the intertidal flat along the north side of Highway 4 - most within 100 meters of the road. There was evidence of water deluge spilling/projecting out onto the sand flat within the rocket operator's property south of the launchpad, but it was unclear if the deluge directly washed over onto the adjacent Boca Chica State Park land. The soil in much of the South Launch sandflat appeared a darker color than the day before and also appeared slightly bumpy and crunchy, indicating that water, vapor and/or sand and mud may have been projected out over the landscape and begun to dry already in the hot sun. Burned remnants of a small wildfire about 400 sq. ft. in size was observed in the grass southwest of the rocket launchpad within Boca Chica State Park, but no affected wildlife was observed.

Nest checks in the South Launch subsite began at approximately 12:15pm on June 6.

All 9 shorebird nests monitored following the rocket launch on June 6 were either missing eggs, had damaged eggs, or both (Table 1; see photograph log at end of report). Following the plover nest checks, three additional still-active LETE nests in this area were checked and also found to each have at least 1 damaged egg within them. Out of 22 eggs within the 9 nests that were checked (assuming the LETE nests were at full clutch/2 eggs on June 5), only 5 total eggs within 4 individual nests were found intact and still viable following the launch – all other eggs were missing or were deemed too damaged to be viable.

Cracks/holes in eggs ranged from relatively small cracks/notches up to fully penetrated pea-sized holes. Bloody egg contents were found on several egg exteriors near holes within them.

Table 1. Nest statuses observed by CBBEP staff the day before the rocket test launch (June 5) and within hours after the launch (June 6). Note that three random LETE nests that were observed being incubated on June 6 after the launch were also checked for egg damage after CBBEP staff noted damage/missing eggs for all plover nests in the South Launch subsite.

Nest ID	# eggs on June 5	Est. hatch date	# eggs on June 6	Status of remaining eggs on June 6
SNPL1	3	June 16, 2024	0	no eggs present
SNPL2	3	June 17, 2024	1	1 egg w/ hole/crack
SNPL3	3	June 26, 2024	2	2 eggs apparently intact
SNPL4	3	June 25, 2024	0	no eggs present, dried egg contents in nest cup and drip line away from nest
SNPL5	1	June 30, 2024	1	1 egg w/ hole/crack
WIPL1	3	June 16, 2024	1	1 egg apparently intact
LETE1	unknown	unknown	2	2 eggs w/ hole/crack
LETE2	unknown	unknown	2	1 egg intact, 1 w/ hole/crack
LETE3	unknown	unknown	2	1 egg intact but scratched, 1 w/ hole/crack

In the post-launch monitoring, both CBBEP game cameras that were placed near nests were found to be heavily coated in clumped sand/mud on their launchpad-facing sides (the camera face). Additionally, the lens on the camera set up at WIPL 1 had been shattered by a pea-sized piece of concrete debris that was found wedged between the game camera and its protective metal housing. Game camera photographs explained below.

- WIPL 1 camera: camera images clearly show all 3 eggs as well as one or both WIPLs incubating the nest through the rest of June 5 and the proceeding night. Flames are seen from under the rocket at 7:50am on June 6 and at that point the adults are no

longer in sight but 3 eggs clearly remain. Subsequent images show the thick cloud of dust and small debris approach the camera at a very high rate of speed (estimated minimum 100 ft/sec based on location of leading edge of cloud between photos less than 1 second apart). Within 18 seconds of the engines firing the dust began to clear and all subsequent images appear in a pinkish hue, possibly due to wet sand/mud coating the camera and sensors. It also became apparent that the concrete pebble had broken camera lens and lodged in front of the lens, blocking any view of the nest towards the bottom of the images. The next images taken were 2.5 hours after launch, at which point the WIPLs can be seen switching places incubating the nest, though the nest contents still cannot be seen in the photos. The nest was found at 12:42pm by CBBEP staff with only one egg remaining in it and no signs of predators or egg pieces around.

- SNPL 2 camera: camera angle did not allow for clear viewing of nest contents, but the SNPL pair did return to incubate the 3-egg nest after camera installation for a few photos. No other photographs were taken until 7:50am on June 6, just after the rocket launch when the dust cloud and debris can again be seen rapidly moving towards the camera. Nest contents are not perfectly clear in the images but the edge of at least two eggs appear to be visible in the nest cup. The images turn a yellowish hue after the dust settles and no more photographs were taken until CBBEP staff checked the nest at 12:28pm. The nest was then observed with just a single egg in it that was cracked and no longer viable, though the attending SNPLs were still incubating the nest.

Discussion

Out of the 9 nests directly observed by CBBEP staff after the rocket launch, 5 nests were found with damaged eggs consistent with being hit with small objects such as the pea-sized concrete/rock debris associated with this launch. This damage is not consistent with any predator interactions in our experience. Additionally, the strong speed/force of projected debris and wet sand/mud was apparent both in the game camera photographs as well as on the face of the camera bodies themselves – one of which had its lens shattered by a concrete pebble. Additionally, 5 of the 9 nests were observed with missing eggs. Shorebirds, along with most other birds, are known to instinctively remove damaged/non-viable eggs from their nests when found by the attending adults to reduce the chance of attracting predators. All of the plover nests in the South Launch subsite were at least 10 days away from their estimated hatch date as determined by egg floating within the prior week, so none of the egg losses could be attributed to chicks hatching out.

Though shorebird nests are often predated by mammals due to their simple ground nest structure, in our experience it is quite rare for partial nest predation to occur (i.e. that a predator does not consume all eggs in a nest). Additionally, a predator that finds a colony of nests near each other is extremely unlikely to randomly predate only 1 or 2 eggs out of each nest rather than consuming all 3 eggs of all nests present. Game cameras did not detect any predators and though the lens or sensors of both cameras were either damaged

or obscured from the test launch, both were still functional and photographed CBBEP staff when we returned to check the nests on June 6. CBBEP staff did not directly observe any predators or fresh predator tracks in the South Launch subsite on June 6.

The combination of fast flying debris associated with the launch, lack of any predator signs in-person or on-camera, and presence of cracked and/or missing eggs in every nest checked within 5 hours of the rocket test launch indicates that most, and likely all, of the 9 nests were likely damaged directly by debris that had been projected outwards during the test launch. Though only 5 nests had eggs that were obviously damaged, the remaining 4 nests were all missing 1-3 eggs, consistent with the hypothesis that adults found damaged eggs in their nests and instinctively removed them to prevent predators from coming into the area.

Photograph Log



Figure 2. SNPL 1 nest intact and with 3 eggs on June 5, the day before the rocket test launch.



Figure 3. SNPL 1 nest with 0 eggs and no signs of predator tracks despite moist ground that would be highly impressionable by any predators on June 6, 2024.



Figure 4. SNPL 2 nest with only one egg remaining and the rocket launchpad in the background on June 6, 2024.



Figure 5. SNPL 2 close up photograph with arrows showing damage on single egg on June 6, 2024.



Figure 6. WIPL 1 with only a single intact egg remaining on June 6, 2024.



Figure 7. SNPL 3 with only a single egg remaining on June 6, 2024.



Figure 8. Lone egg from SNPL 3 with large cracks in it on June 6, 2024.



Figure 9. LETE 1 showing both eggs with large holes/cracks and dried egg contents emerging on June 6, 2024.



Figure 9. SNPL 4 with dried egg contents spilled in the nest cup and droplets moving away from it in a straight line on June 6, 2024.



Figure 10. Lone egg from SNPL 5 with a small but significant depressed crack on June 6, 2024.



Figure 11. Small but noticeable crack on egg from LETE 2 on June 6, 2024.



Figure 12. Small but noticeable depressed crack on egg from LETE 3 on June 6, 2024.



Figure 13. WIPL 1 as referenced by red arrow with game camera installed nearby facing north pre-launch on June 5, 2024.



Figure 14. Game camera from WIPL 1 showing the launchpad-facing side covered in mud as well as a concrete pebble sitting in front of the camera lens post-launch on June 6, 2024.



Figure 15. Game camera from WIPL 1 showing completely cracked camera lens after pebble was removed post-launch on June 6, 2024.



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Figure 16. WIPL 1 game camera showing adult female WIPL incubating nest at 6:59am on June 6, 2024, 50 minutes before rocket launch.

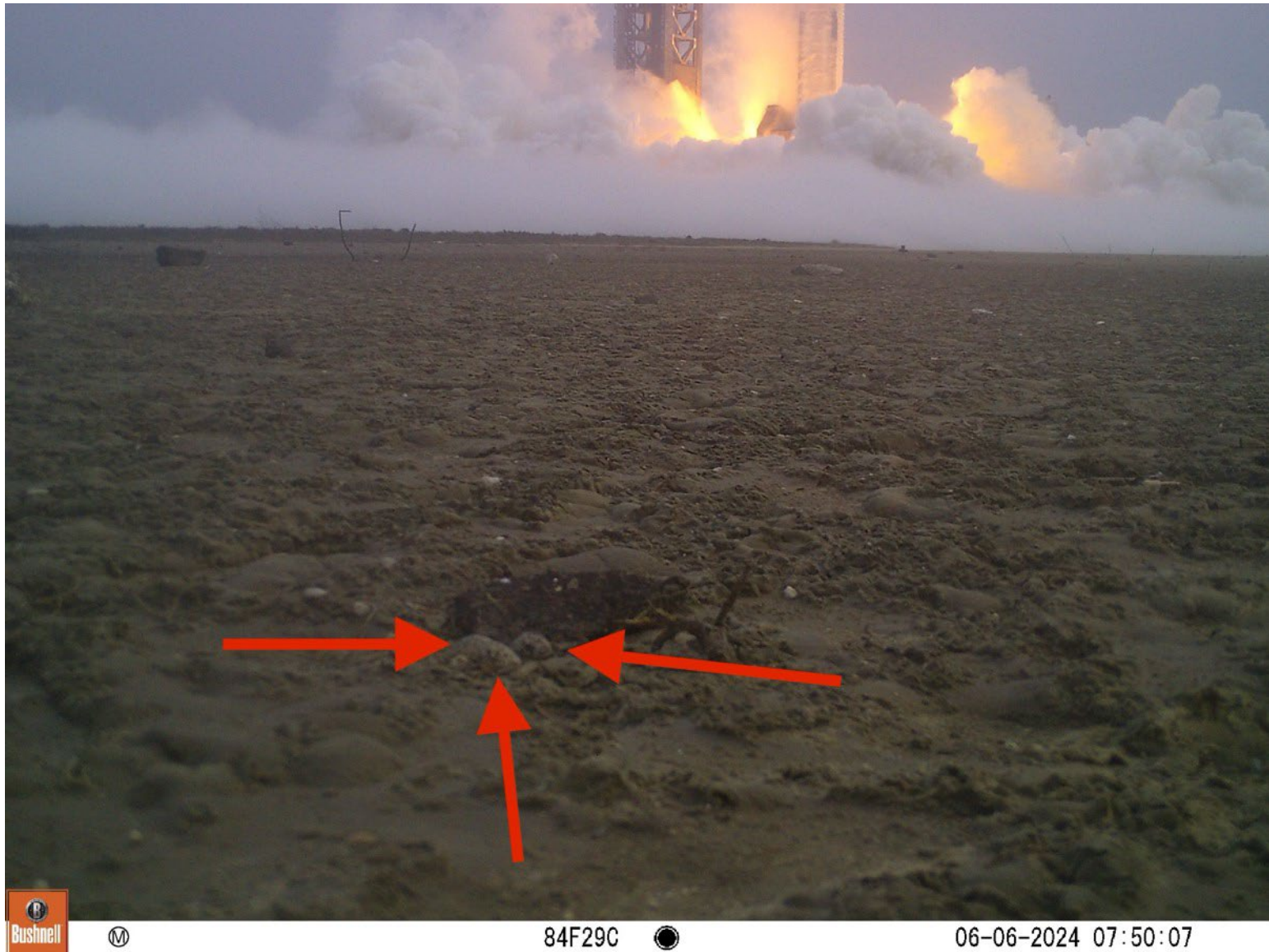


Figure 17. WIPL 1 game camera showing 3 eggs in nest cup with rocket engines firing in the background on June 6, 2024.



Figure 18. WIPL 1 game camera showing dust/smoke and small pale-colored debris moving toward the nest and camera at a high rate of speed during the rocket test flight launch on June 6, 2024.

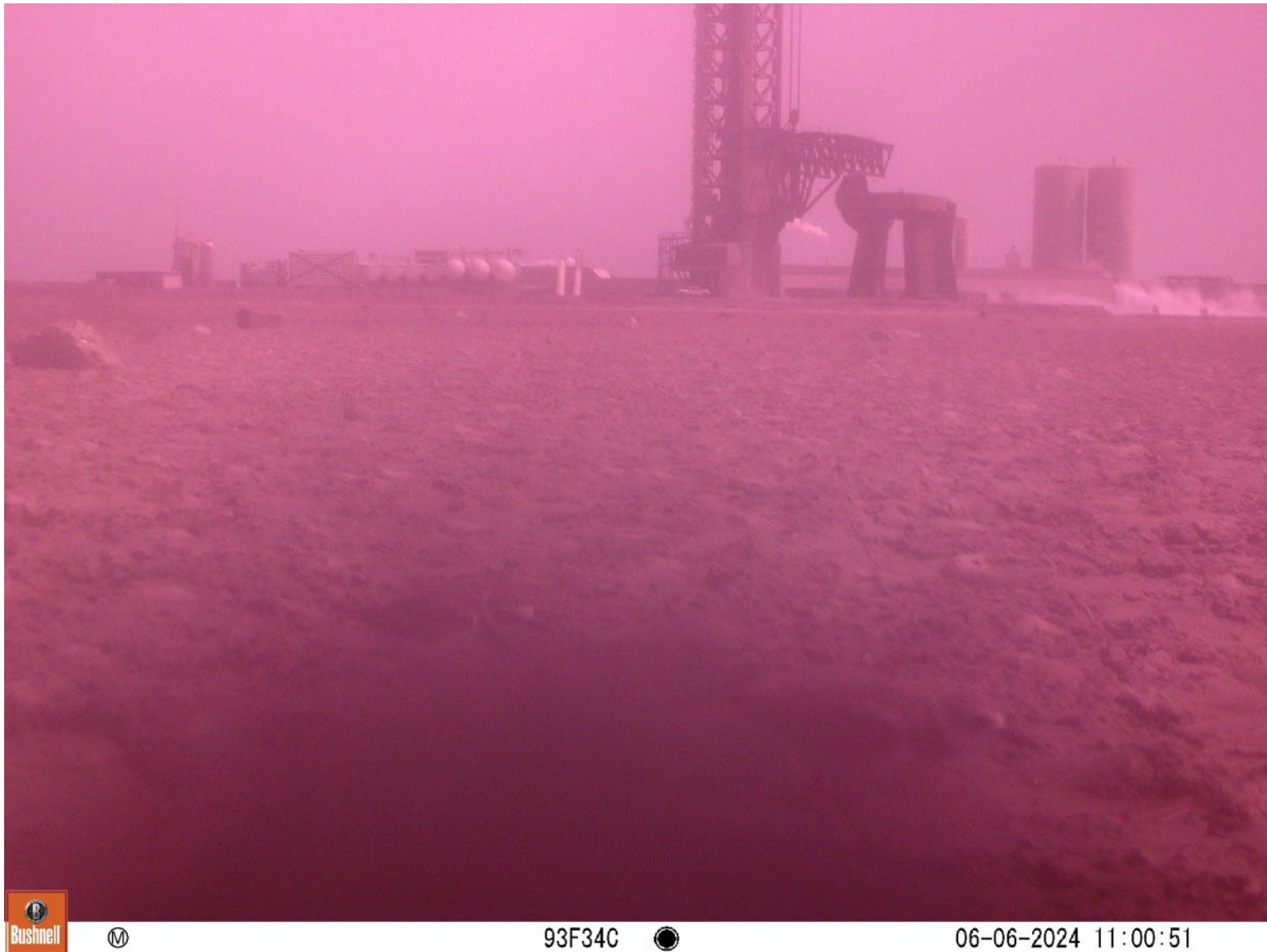


Figure 19. WIPL 1 game camera showing both WIPL adults in attendance but nest cup not quite visible due to pebble lodged in camera lens and overall pinkish hue post-launch on June 6, 2024.



Figure 20. Game camera from SNPL 2 showing the launchpad-facing side completely covered in mud as compared to a clean side post-launch on June 6, 2024.



Figure 21. SNPL pair incubating SNPL 2 shortly after the game camera was set up pre-launch on June 5, 2024.

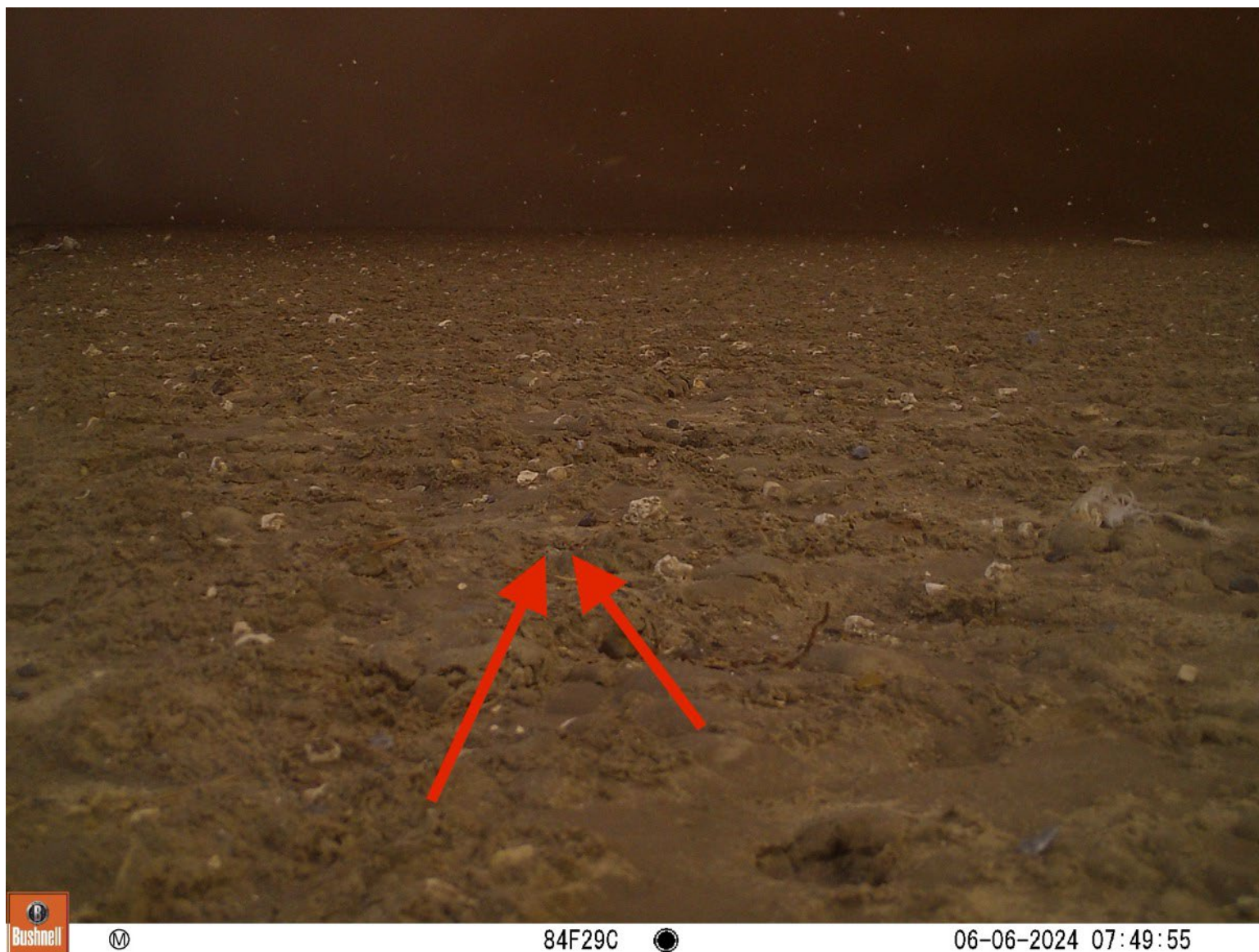


Figure 22. SNPL 2 game camera showing dust cloud and small pale-colored debris moving toward nest and game camera at a high rate of speed, with nest cup and at least two eggs possibly visible as referenced by red arrows on June 6, 2024.

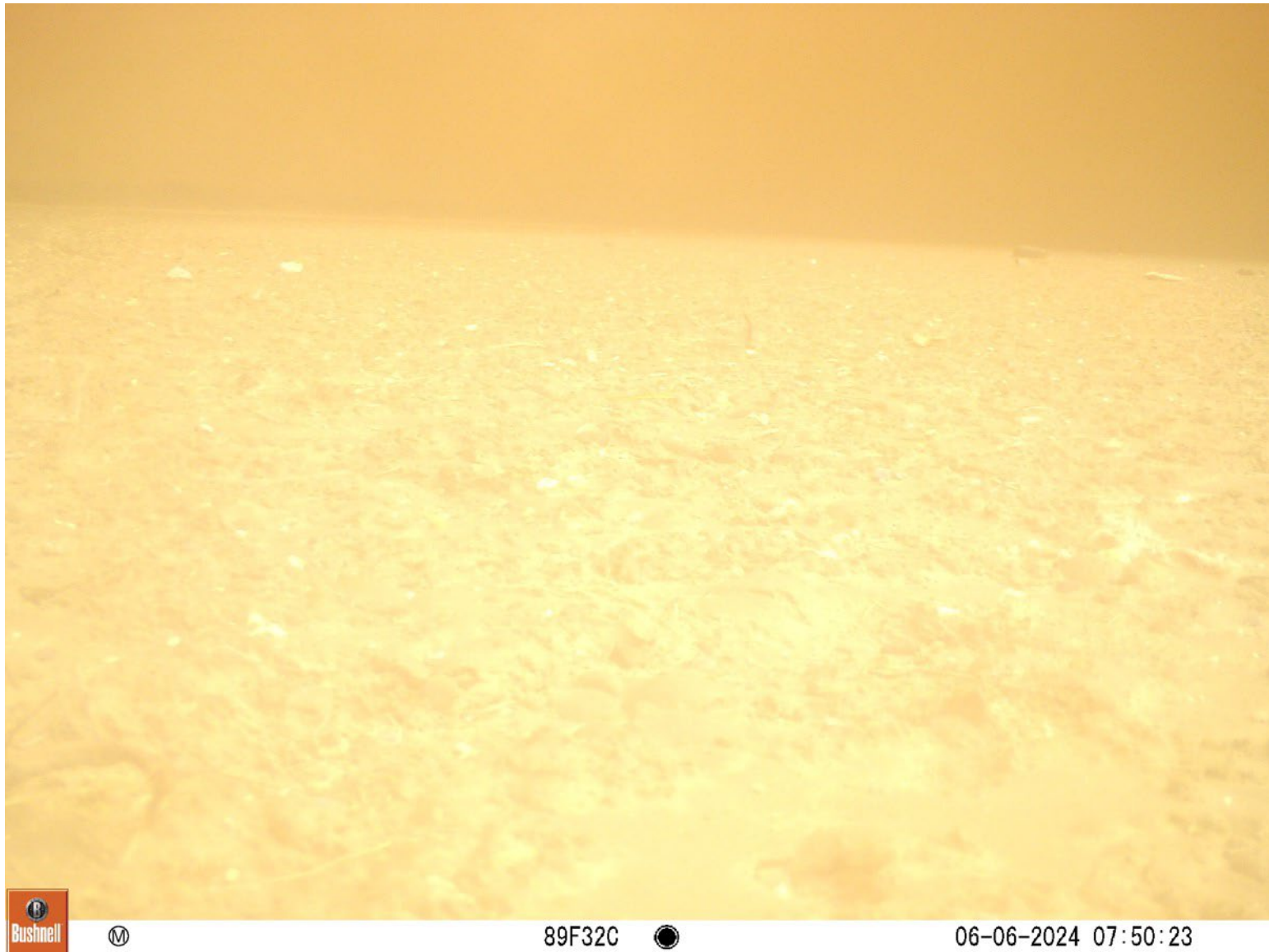


Figure 23. The last SNPL 2 game camera photograph taken post-launch until CBBEP staff checked the nest 4.5 hours later on June 6, 2024.



Figure 24. SNPL 2 game camera with CBBEP staff checking SNPL 2 nest post-launch on June 6, 2024, proving camera is still operational despite limited clarity.