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ABUNDANCE, DISTRIBUTION, AND DISSUASION EFFORTS OF CASPIAN TERNS (*Hydroprogne caspia*) and DOUBLE CRESTED CORMORANTS (*Nannopterum auritum*) ON RICE, MILLER SANDS, AND PILLAR ROCK ISLANDS OF THE COLUMBIA RIVER: 2022 SEASON SUMMARY REPORT.

Fisheries Field Unit

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SUMMARY

This report documents compliance with Term and Condition 1.k. of the 11 July 2012 Biological Opinion issued by NMFS for the Columbia River Navigation Channel Operations and Maintenance, Mouth of the Columbia River to Bonneville Dam, Oregon, and Washington. Term and condition 1.k. require the U.S. Army Corps of Engineers to monitor dredge material placement sites during the nesting season and discourage any avian predators that are found attempting to nest on the dredged material placement site consistent with the Migratory Bird Treaty Act. The upland placement sites of concern are located at Rice Island, Miller Sands spit and Pillar Rock Island. During the period of 22 April to 6 June an incipient colony of Caspian Terns (*Hydroprogne caspia*) was detected and successfully dissuaded from nesting on Rice Island. No known Caspian Terns or Double-crested Cormorants (*Nannopterum auritum*) successfully nested within these upland placement sites in 2022.

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BACKGROUND

Long-term evaluation of Caspian Terns (CATE; *Hydroprogne caspia*, formerly *Sterna caspia*) and Double-crested Cormorants (DCCO; *Nannopterum auritum,* formerly *Phalacrocorax auritus*) in the Columbia River estuary has revealed that aggregations of these birds can impact some salmonid stocks (Evans et al., 2012, Adkins et al., 2014). In response to the increased presence and abundance of these bird species in the Columbia estuary, NOAA fisheries issued a biological opinion in 1999 requiring the U.S. Army Corps of Engineers (USACE) to dissuade colonial water birds (i.e., CATE and DCCO) from nesting on USACE owned and managed lands in the estuary. The avian directives present in the 1999 Biological Opinion (BiOp) were reissued in subsequent BiOps in 2005 and 2012. This has led to complex management efforts to balance the impacts of avian predators on ESA listed salmonids while preserving the integrity of the avian populations in the Pacific Flyway (NOAA 1999, 2005, 2012).

Formed in 1984, the largest CATE colony had historically been on Rice Island, a state-owned island used by the Corps for placement of dredged material. In 2000 the Rice Island CATE colony was successfully moved to East Sand Island (ESI) in the lower estuary near the mouth of the Columbia River. The dissuasion and hazing methods developed to move the colony from Rice Island to ESI have since been employed to continually deter re-colonization of Rice Island and the nearby deposition sites of Pillar Rock and Miller Sands Islands (NOAA 2005, Figure 1). Continued monitoring and dissuasion is required to ensure that CATE and DCCO do not attempt to recolonize these dredge material placement sites.

Specifically, term and condition 1.k. of the 11 July 2012 Biological Opinion issued by NMFS for the Columbia River Navigation Channel Operations and Maintenance, Mouth of the Columbia River to Bonneville Dam, Oregon and Washington requires the Corps to monitor upland dredged material placement sites during the nesting season and discourage any avian predators that are found nesting at an upland dredged material placement site, consistent with the Migratory Bird Treaty Act. To comply with this condition in 2022, the USACE Fisheries Field Unit (FFU) operationalized a monitoring and dissuasion effort on Rice, Miller, and Pillar Islands, funded by the Columbia and Lower Willamette Rivers federal navigation channel project. The objective of the effort was to deter CATE and DCCO

interest in these sites and ensure no CATE or DCCO successfully reproduced on these islands. Using the methods developed by Real Time Research™ and with personal communications and support from independent contractors, the OSU-USGS avian research cooperative unit, and various USACE personnel, the FFU deployed dissuasion materials on Rice Island and recorded CATE and DCCO abundance and breeding activity on Rice, Miller, and Pillar Island. This report details the actions taken by the USACE to ensure the USACE meets the conditions of the 2012 Biological Opinion, beginning on 5 April 2022, and concluding on 8 September 2022.

METHODS

Surveys - The 2022 avian occupancy and abundance monitoring of upland dredge material placement sites in the Lower Columbia River began 5 April, following USACE protocols that were adapted from Real Time Research and altered to provide the required data. Abundance and occupancy surveys progressed upriver, beginning with Rice Island, followed by Miller Sands and Pillar Rock Island. Boat crews followed a standard route to ensure consistent and replicable data for inter- and intra-season comparisons. All avian abundance data were collected by boat- or land-based observers equipped with 8x42 binoculars. Field data was recorded on mobile devices utilizing the ArcGIS Survey123 Application®, which permits unified data capture in a customized format. GIS mapping was accomplished in the field using mobile devices equipped with the ArcGIS Field Maps Application® which permits USACE biologists to geospatially record polygons and GPS points while in the field.

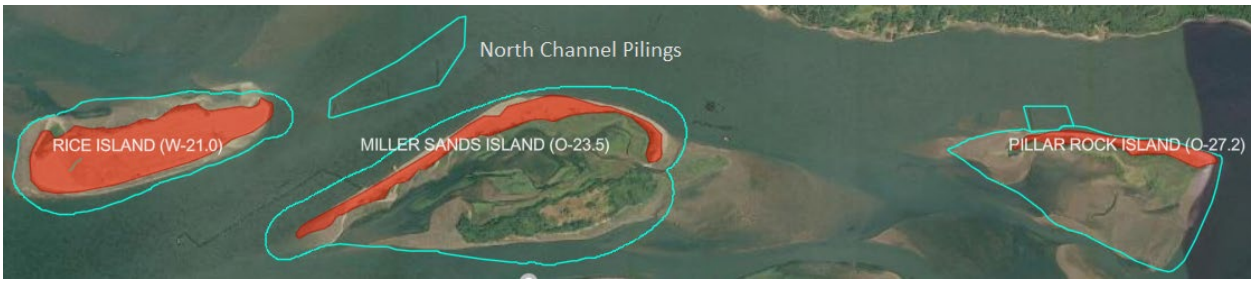

Figure 1. Map of dredge material placement sites (red polygons) and areas surveyed for Caspian Terns and Double-crested Cormorant abundance (teal polygons) on the Lower Columbia River.

Estimating the abundance of DCCO and CATE on Rice Island necessitates the use of both offshore and land-based observations to ensure complete coverage of the survey area. From offshore research vessels, USACE biologists enumerate CATE and DCCO from the western tip of Rice Island to the North Channel pilings. Ensuing land-based counts necessary for complete coverage of Rice Island were made either on foot or via an All-Terrain Vehicle (ATV) and consisted of surveys of the historical nest and roost sites located on the northwestern tip, as well as the "bowl" at the western end of the island (see Laser Area of Observation, Figure 2). These surveys were supplemented with monthly circumferential trips around Rice Island via ATV to ensure that any satellite colonies or incipient roost spots were located. Rice Island was surveyed twice per week, weather permitting.

Full surveys of Rice, Miller Sands, and Pillar Rock Island were conducted every two weeks. USACE biologists landed on Miller Sands or Pillar Rock Island only if CATE or DCCO were sighted in upland areas which suggested active nesting in those areas. Birds spotted upriver of the North Channel pilings, or on inter-channel roost sites were included in survey numbers with the adjacent islands, whether Miller Sands or Pillar Rock Island. The frequency of full avian surveys of Rice, Miller Sands, and Pillar Rock Island was influenced by CATE and DCCO activity, weather and operational constraints, and increased abundance of both species further down river.

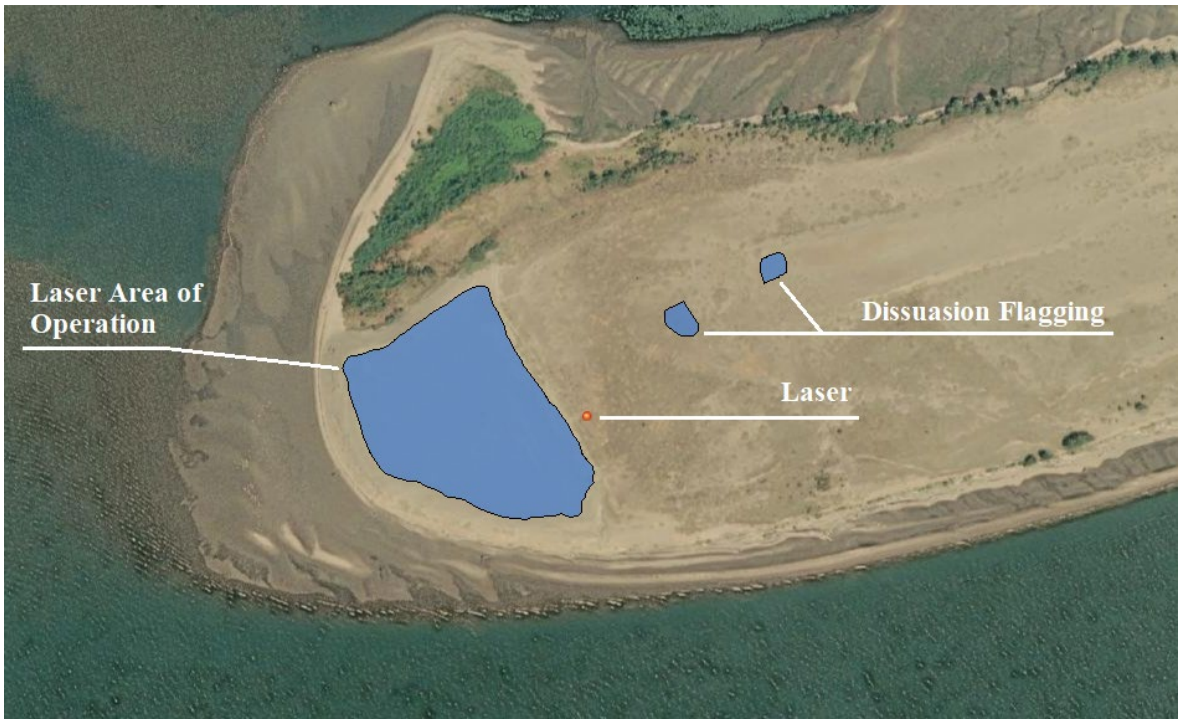

Figure 2. The "bowl" area of Rice Island detailing the lasers area of operation and locations of dissuasion flagging.

On five days during the 2022 season, the USACE coordinated with the Civilian Air Patrol (CAP) to photograph upland dredge material placement sites in the Lower Columbia River (LCR). The CAP flights took place between 6 June and 7 August. During CAP flights, photographs were taken of Rice Island, Miller Sands and Pillar Rock Island, from low altitude while circling to ensure complete coverage of each island. Photos were later analyzed to ensure that incipient DCCO and CATE colonies were identified and responded to (i.e., other dissuasion; see below) in timely fashion.

Use of Autonomic Laser - On 13 April preparation for hazing began with the deployment of the AVIX Autonomic Laser (Figure 2-3). The AVIX Autonomic Laser (Mark II AVIX laser®, Bird Control Group, Wilsonville, OR. 97070; hereafter, laser), laser was installed on Rice Island at an elevated position overlooking the westerly bowl region of the island (Figure 3), historically used by CATE as nesting

habitat (Figure 2). The solar powered laser is a green laser of intermediate power, rated class 3B that operates in the 495mW- 499mW range. The device was programed so that the laser beam moved across the targeted area of operation (AO) following a preprogramed path, and operating on a 15-minute interval, from 20:30 – 06:15. When armed during low light conditions the laser would flush birds near the beams point of contact. This provided the USACE with effective dissuasion limited to the bowl region of Rice Island, without necessitating the presence of USACE personnel. The laser was permitted by proposal to the USFWS on 18 May 2021. After field testing during the 2021 season by the USACE, the laser was deployed in 2022. The laser is automated and the operation time, intervals of operation, and the area to be covered by the laser can be programmed. The AO was 15.4 acres in size.

Use of the laser reduced field time and use of field materials and reduced potential impacts on other species. For example, the use of dissuasion posts and flagging requires a substantial amount of material, some of which becomes degraded through time and must be replaced. In addition, use of the laser thereby minimizing waste generated via the deployment of dissuasionary posts and flagging, and any subsequent impact that hazing actions by USACE personnel might have on the state and federally listed Streaked Horned Lark (SHLA; *Eremophila alpestris strigata*). To minimize impact to SHLA, trained USACE biologists visited the island and documented SHLA activity and territory locations to ensure that the laser did not adversely affect SHLA. The laser AO was situated in a region of the island that has not been used by SHLA since 2019.

Precautions were taken to protect the visiting public and passing vessels in the navigation channel from exposure to the laser beam. Warning signs were installed on the island to warn potential visitors of the laser's operation. The laser's path was programmed with a 6m buffer formed by the berm of the Bowl around the AO, thereby protecting marine traffic from a direct or reflected beam. The laser path was reprogrammed in mid-season to account for erosion and ensure continuing safe operations. Prior to unmonitored operation of the laser on 28 April, testing was conducted by USACE personnel on 26-27 April for a series of two-hour monitored intervals during low light conditions to ensure safe and consistent operation. Unmonitored operation of the laser was initiated as needed after 27 April.

Other dissuasion activities - Installation of additional dissuasion materials was required on 12-19 May and resulted in the deployment of an array of ropes and flagging in an area of 0.60 acres (Figures 2, 4, and 5). Materials and methods of flagging and passive dissuasion are adapted from the same system previously employed by contractors on the island (Harper & Collis, 2018). This system is comprised of metal T-posts supporting twisted polypropylene rope that had 1m long strips of yellow "Caution" tape woven through it at one-meter intervals to create a visual distraction and harassment array.

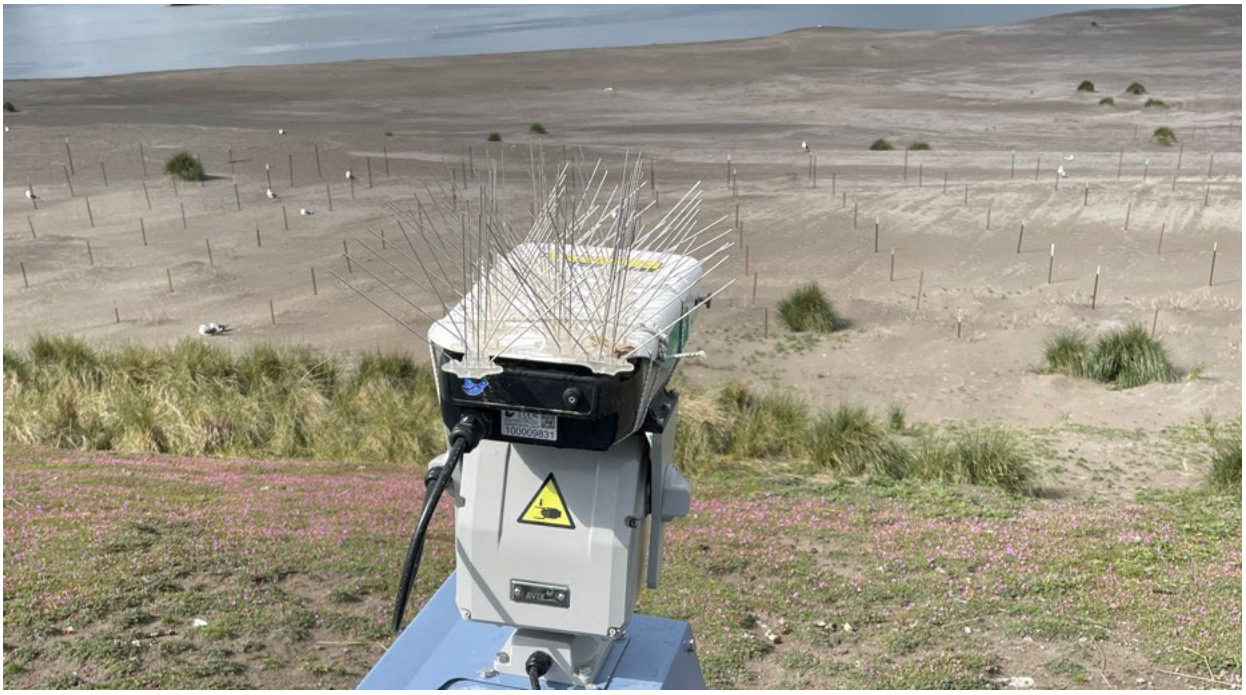

Figure 3. The laser deployed overlooking the western bowl of Rice Island.

Nest activity by CATE and DCCO was monitored by walking nest detection transects in suitable habitat, throughout areas where CATE have historically nested, or in areas where CATE had been identified prospecting for nest sites. When a CATE scrape was identified, it was assessed for the presence of an egg. If no egg was present, the scrape was recorded and filled in with sand to dissuade future nesting

attempts and to enable accurate scrape enumeration. If an egg was observed, USACE biologists made record of the nest and attempted to dissuade the attending adult from the area. If the adult would not leave the area with harassment, visual dissuasion of ropes and flags were deployed near the nest. If after dissuasion the egg remained, the egg and nest were destroyed and filled in with sand per depredation permits held by USACE biologists. Performing non-lethal dissuasion near the area of interest has proven to be an effective deterrent to other prospecting adults that would likely establish near the identified nest and minimizes the amount of egg take required. In doing so, adults are dissuaded from the area and predatory gulls and scavengers are encouraged to forage at the site further dissuading the CATE interest in nest formation and establishing long term benefits relative to destroying just one or two nests. Scrape enumeration was performed in a uni-directional pattern, to minimize double counting of scrapes and eggs. Scrape locations were documented using the Survey123 app and the Field Maps application in real time.

RESULTS

Rice Island Intensive Dissuasionary Period to Prevent an Incipient CATE Colony– Monitoring for colonial waterbirds in the LCR was conducted between 5 April and 31 August. USACE biologists first identified heightened CATE interest in Rice Island on 22 April when 1000 CATE were enumerated in the bowl and as many as 1000 more CATE flushed from the bowl by USACE biologists. On 4 May, USACE biologists detected 29 scrapes in the bowl region of the island and 60 scrapes in the mossy turf 175 m east northeast of the laser's location (Figure 2). Due to severe weather and technical limitations, the next site visit did not occur until 10 May when USACE biologists located 110 scrapes east northeast of the laser's location. By 12 May, 500 CATE were enumerated loafing in two locations east northeast of the laser's location. USACE biologists responded on 12 May by deploying dissuasion flagging on 0.35 acres (Figure 4). The following day, 63 scrapes were recorded in the immediate vicinity of the dissuasion flagging, and another 3 scrapes were recorded to the west in the bowl region of the island. On 19 May, USACE biologists installed additional dissuasion flagging to a 0.25-acre area 315 m east northeast of the laser's location at a secondary site CATE were attempting to utilize (Figure 5). Hazing CATE on foot and via

ATV was supplemented with two American Bald Eagle (*Haliaeetus leucocephalus*) decoys, one of which was deployed in the bowl region of the island, and the other at the easternmost site utilized by CATE.

Figure 4. Dissuasion posts and flagging installed at the primary satellite colony location.

By 23 May, USACE biologists identified a growing number of CATE that warranted enhanced dissuasion tactics to dissuade the forming incipient colony. Prior to deploying the more advanced dissuasion tactics described below, USACE personnel consulted with USFW biologists and policy teams to ensure best management practices were employed to minimize potential impacts to SHLA. Permissions were granted and close communication between USACE and USFW staff were maintained while dissuasion occurred. During the intensive dissuasion period, the USACE deployed the Avix Handheld 500 HSS Laser Repeller, as well as powerful battery powered LED flashers to dissuade CATE from roosting on the island. The handheld 500 HSS Laser Repeller permitted targeted application of laser dissuasion to roosting CATE outside the bounds of the bowl region of Rice Island, which was effectively covered by the AVIX Autonomic Laser. CATE roosting on beaches or at inland sites were immediately

targeted with the AVIX Handheld Laser or approached and pursued by USACE biologists on ATV's. Periodic trips around the circumference of Rice Island were made by USACE biologists to assess other possible roost sites on the island. Flocks of 3 – 8 CATE were intermittently spotted using the foreshore at the northeastern end of the island, but no signs of scrapes or persistent use of this habitat was detected.

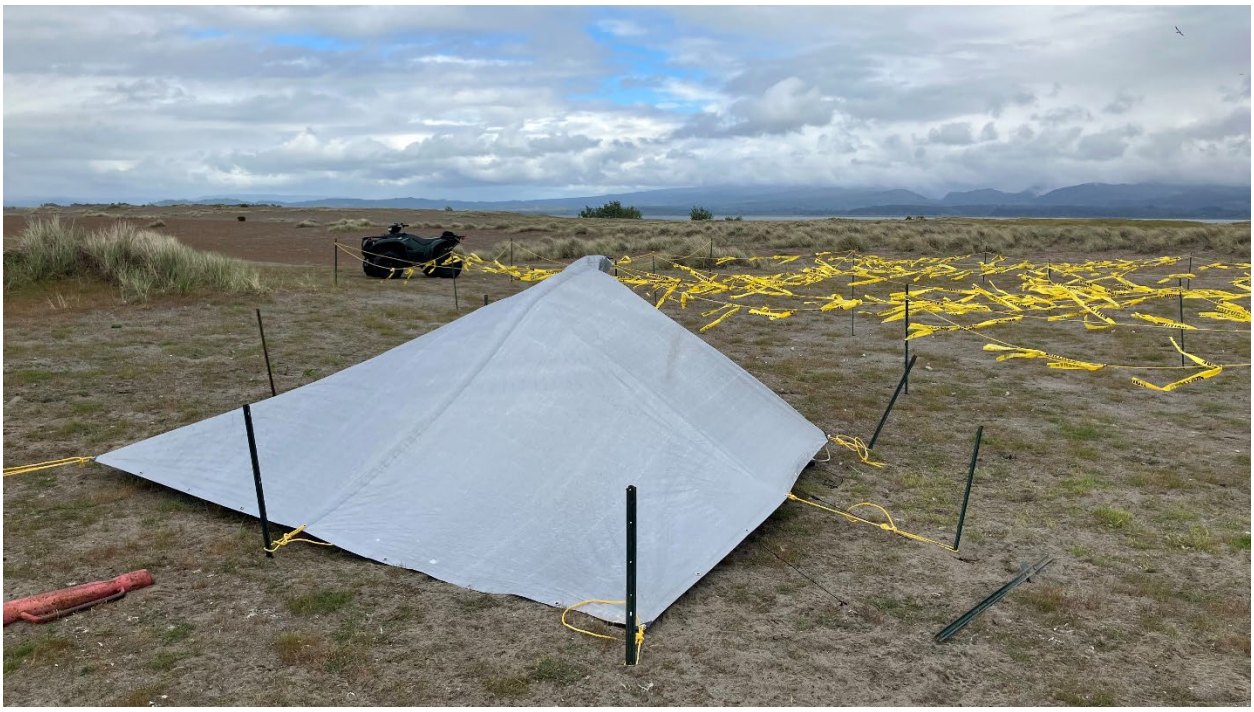

Figure 5. Tent located at eastern terminus of dissuasion flagging

During this interval, USACE biologists spent three nights on Rice Island, actively dissuading CATE from 0630 to 2200 hrs. Two biologists operating ATV's actively dissuaded CATE from roosting on the island by direct approach with ATV's. One biologist with an ATV operated on the beaches, repeatedly patrolling the west and northwest tip of the island. The second biologist patrolled a path on ATV that circumnavigated the elevated bowl region of the island and periodically drove along a preset path running east to west between the two satellite colony locations. Utilization of a preset path

minimized potential impacts to SHLA territories located in this region of the island per USFW guidance. A third USACE biologist operated on the island, responding as needed during the duration of this three-day period of intensive dissuasion.

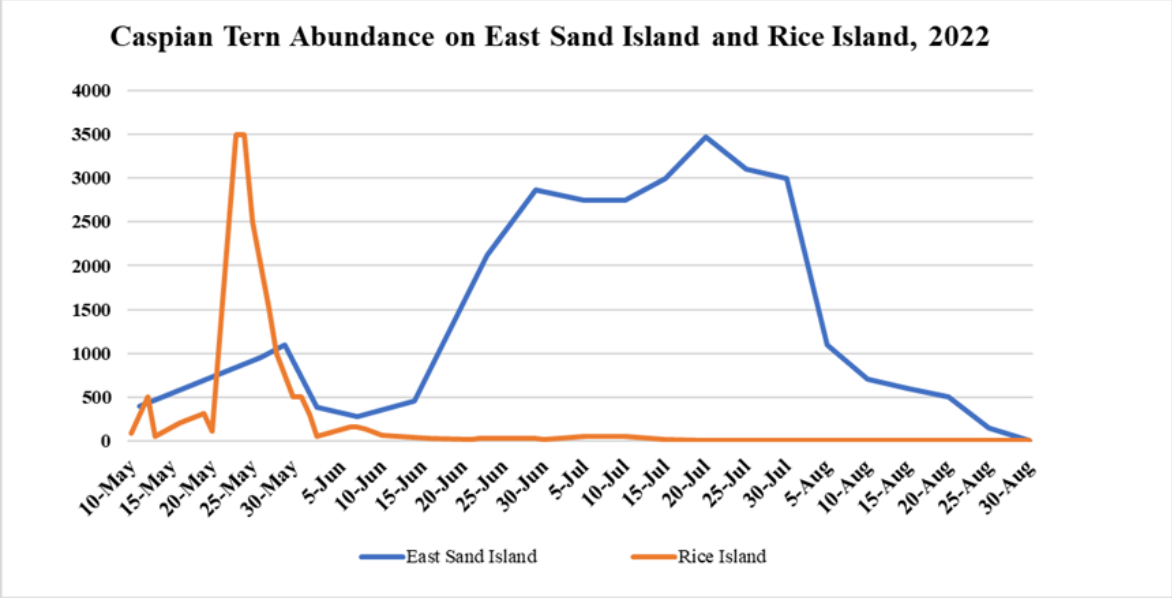

Figure 6. Caspian Terns abundance on Rice Island and East Sand Island displaying the incipient colony on Rice Island in 2022.

On 6 June, 157 CATE were enumerated and dissuaded from attempting to roost in the bowl region at sunset, down from 3500 CATE recorded 13 days prior on 24 May (Figure 6). Intensive monitoring and dissuasion continued until 6 June, during which time visits were made to the island in the evening to ensure that no roost activity was occurring on the island prior to nightfall. By 10 June, CATE numbers on Rice Island had decreased to 65 individuals, and for the remainder of the season never exceeded this number.

To provide metrics tracking the potential impact the incipient CATE colony had on smolt in the LCR, USACE biologists sowed Passive Integrated Transponder (PIT) tags in both regions utilized by

CATE during the incipient colony period. PIT tags were later recovered and analyzed by Real Time Research (RTR) in cooperation with the USACE. These data have been uploaded to PITAGIS and are publicly available.

Abundance and Distribution: CATE- In 2022, USACE biologists visited Rice Island on 53 days, and recorded CATE monitoring data on 44 of those visits. Complete avian surveys of the USACE dredge material deposition islands were conducted between 19 April and 31 August. Miller Sands was surveyed 12 times, and Pillar Rock Island was surveyed 10 times during the season. CAP flights were conducted five times during the season. CATE were observed on Miller Sands Island only once during the season, and three times on Pillar Rock Island (Table 1). All observations on Miller Sands and Pillar Rock Island occurred below the wrack line, with CATE roosting on the foreshore. On 13 April, 35 CATE were first observed on Rice Island and the last observation on Rice Island was on 31 August (Supplementary Table 1). The average abundance estimates for CATE on Rice Island was 446.7 ± SD 862.3 per visit (Table 1).

Between 22 April and 6 June there was an influx of CATE activity on Rice Island. Intensive hazing and dissuasion tactics were deployed throughout, but during this time the single day peak estimate of CATE on Rice Island was 3500 CATE on 23 May (Figure 6). The first record of CATE breeding activity during the 2022 season occurred on Rice Island on 27 April when 130 scrapes were recorded (Table 2). The last CATE breeding activity on Rice Island was recorded on 6 June when 26 scrapes were recorded on the northwest point of the island. The average estimate of CATE scrapes per day during the recorded period of breeding activity was 97.9 ± SD 103.5 scrapes per day. A total of 1,761 scrapes was recorded on Rice Island during the 2022 season, with a single day peak of 310 scrapes recorded on 19 May. Sixty CATE eggs in scrapes on Rice Island were destroyed between the dates of 23 May and 25 May. No further egg take was required during the 2022 season. The remaining CATE eggs were subject to natural predation by Glaucous-winged x Western Gull hybrids present on the island. No CATE eggs were hatched on Rice Island during the season.

Table 1. Abundance monitoring data for Caspian Terns on Rice Island, Miller Sands, and Pillar Rock Island in the Columbia River Estuary between 5 April and 31 August 2022.

		CATE ABUNDANCE, 5 April – 31 August.		
Site	*n* days monitored	$\bar{X}$ ± S.D.	Range	*n* days = 0
Rice	44	446.68 ± 862.27	0-3500	6
Miller Sands	12	1.08 ± 3.75	0-13	11
Pillar Rock	10	2.2 ± 5.94	0-19	7

Table 2. Abundance monitoring data for Caspian Tern nest scrapes on Rice Islands in the Columbia River Estuary between 27 April and 6 June 2022. Note that Miller Sands and Pillar Rock Island are not monitored for scrapes unless Caspian Terns are observed in the upland areas.

		CATE SCRAPES, 27 April – 6 June.		
Site	*n* days nesting efforts	$\bar{X}$ ± S.D.	Range	*n* days = 0
Rice	18	97.83 ± 103.45	0-310	5

Abundance and Distribution: DCCO- Data for DCCO abundance and distribution on Rice Island was recorded on 34 days throughout the 2022 season (Supplementary Table 1). Counts of DCCO were made between 22 April and 31 August (Table 3). Average abundance of DCCO was 160.9 ± SD 200.6 per visit. A single day peak estimate of abundance occurred on 26 May when 734 DCCO were enumerated roosting on the island. DCCO were observed on the foreshore (and never above the wrack line), primarily at the northwest and southwestern ends of Rice Island. At no time were DCCO observed above the wrack line on Rice Island. No DCCO nests were encountered and no DCCO were known to have fledged on Rice Island during the 2022 season.

DCCO were recorded on 12 visits to Miller Sands and during one CAP flight (Table 3). The average number of DCCO recorded near but not on Miller Sands was 193 ± 436.53 per day with single day peak estimate recorded on 8 July when 1,594 DCCO were enumerated during CAP photo analysis of Miller Sands and the associated mid-river pilings.

Pillar Rock Island was surveyed 10 times during the season, and an average of 27.6 ± SD 68.7 DCCO recorded per visit. A single day peak estimate was recorded on 27 April when 220 DCCO were enumerated roosting on Pillar Rock Island and the associated mid-river pilings. At no time were DCCO here or at Miller Sands observed roosting above the wrack line.

Table 3. Abundance monitoring data for Double-crested Cormorant on Rice Island, Miller Sands, and Pillar Island in the Columbia River Estuary between 5 April and 31 August 2022.

		DCCO ABUNDANCE, 5 April – 31 August.		
Site	*n* days monitored	$\bar{X}$ ± S.D.	Range	*n* days = 0
Rice	34	160.91 ± 200.60	0-734	9
Miller Sands	13	193 ± 436.53	0-1594	5
Pillar Rock	10	27.6 ± 68.71	0-220	5

DISCUSSION

The USACE successfully achieved compliance with the 2012 Navigation BiOp requirements in the 2022 season by successfully dissuading and deterring CATE and DCCO nesting attempts on dredge material placement sites in the lower Columbia River. CATE were dissuaded from nesting on Miller Sands, Pillar Rock Island, and Rice Island despite their persistent efforts to nest on Rice Island. No DCCO were documented attempting to nest on any of these three islands for the duration of the 2022 season.

USACE biologists successfully deployed the Mark II AVIX autonomic laser® and confirmed the laser provided effective dissuasion of CATE within the AO after nightfall when visitation and

implementation of other methods on the island was impractical. During the laser operational cycle, CATE which were recorded roosting in the AO lifted off as the laser beam approached their position. No CATE were witnessed remaining in the AO while the laser was active. During the intensive dissuasion period, USACE biologists utilizing the handheld laser witnessed similar behavior while dissuading CATE from roosting on foreshore or inland sites. These two tools proved effective at providing dissuasion on Rice Island throughout the 2022 season.

The use of the laser for dissuasion had no known negative impact on other species that occur on Rice Island. In the area where the laser was active, SHLA have not been sighted since 2019. USACE biologists trained in SHLA detection checked the laser weekly as part of routine monitoring for avian activity. During the operational window, on 10 May, at least four SHLA were detected continuously within 75m of the laser's location, primarily to the north and west, but outside of the laser AO. During the 13-day intensive dissuasionary period from 23 May to 6 June, when an incipient CATE satellite colony formed on Rice Island, USACE employees were present on the island. SHLA were noted throughout the habitat to the east of the laser AO, but no SHLA were noted within the laser AO. Diurnal surveys by contractors working for USACE detected 48 SHLA on Rice Island, with two larks detected within the AO while the laser was inactive on the morning of 22 June. Thus, despite the intensive dissuasion of the incipient CATE colony, SHLA abundance on Rice Island maintained typical abundance and distribution. In addition, our implementation strategy and ongoing evaluation was effectively limited to the AO, as we had intended to minimize potential impacts to SHLA.

Caspian terns associated with the incipient colony on Rice Island constructed nest scrapes and roosted in backshore areas not previously identified as potential habitat for nesting. Nesting habitat of CATE is typified by areas of open sand with minimal obstruction to field of view. However, the 2022 incipient colony, at inland area of Rice Island, was dominated by a thick layer of moss. The scrapes we found were intermixed with, and in proximity to, a Ring-bill Gull (*Laurus spp.*) colony. It is possible that nesting CATE benefitted from a facultative commensal relationship with the nearby colony of gulls. Gulls roosting in the area, created an abundance of scrapes that CATE may have utilized. Conversely, the CATE may have been attracted to the density or abundance of gulls and altered their typical scrape behavior and

started establishing nests in dense moss instead of on sand. Regardless, CATE rapidly formed a colony in a region and habitat not previously documented in the LCR which is noteworthy in that such areas will require monitoring in future years. The moss-covered upland habitat available on Rice, Miller, and Pillar Rock islands is abundant and ubiquitous across all three islands and may present a management challenge if CATE elect to use this habitat for colony formation attempts.

Once the incipient colony formed, dissuasion depended heavily on the presence of USACE biologists during the late evening, to target CATE as they attempted to roost. Roosting CATE, once dissuaded either by direct approach with an ATV or after having been targeted with the Handheld 500 Green Laser, would take flight, and circle for several minutes before landing in another region. This pattern persisted throughout the daylight hours; however, as evening progressed, CATE numbers would gradually decrease, until 2200 hours when the last observations were recorded. CATE followed a pattern of gradual return to the island over the following day, typically roosting in regions of the foreshore at the north and west regions of the island and moving up into the bowl and attempting to roost in the mossy interior regions of the island in the vicinity of their incipient colony towards nightfall. By deploying USACE biologists on the island overnight, the USACE was able to effectively provide round-the-clock pressure on the incipient colony, ensuring that overnight use of the inland portion of the island, not covered by the laser AO, was impractical.

The persistency of nesting efforts by CATE utilizing the LCR is consistent with recent years data collected by the USACE. In 2019, 808 scrapes were recorded on Rice Island. In 2020, only 622 scrapes were recorded and the following year, 2021, 1,280 scrapes were recorded on Rice Island (Tidwell 2019; Tidwell 2020; Brandtner and Tidwell 2021). This persistence of recent occurrence and the historical CATE presence on Rice Island in the 1990's, suggests that CATE will continue to attempt to nest on Rice Island. The Mark II AVIX autonomic laser® was essential in preventing CATE colony formation in the historical nesting site located within the bowl of Rice Island. Laser operation during low light and nighttime periods provided active and intensive dissuasion without requiring USACE personnel to remain on the island. The USACE will pursue USFWS permits for laser operation in 2023 to further enhance hazing and dissuasion of avian piscivores on upland dredge deposition regions of Rice Island.

Pursuant to the USACE responsibility to prevent DCCO from nesting on the dredge material placement sites on Rice Island, Miller Sands, and Pillar Rocks Island, the USACE met all management objectives. No known DCCO nests were observed on these islands during the 2022 season. CAP flight data proved invaluable in locating and facilitating enumeration of the single day peak observation of DCCO on Miller Sands. In previous seasons, USACE biologists observed DCCO utilizing mid-river pilings; however, in 2022 such use was not evident. These data, in addition to data from the CAP flights from 2022 will be used to inform the operation of the USACE program for dissuasion and monitoring of DCCO in the LCR in 2023.

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This work would not have been possible without the support of the Civilian Air Patrol crew (Jonathan Ritchie) and the efforts of the Real Time Research crew (Ken Collis, Allen Evans, Nate Banet). We also thank Servando Sanchez and Bird Control Group for assisting us with ongoing technical support with the Mark II AVIX autonomic laser®. Field operations, data collection and monitoring were achieved through the combined efforts of USACE staff. Thanks to Christine Brandtner, Mark Braun, Sean Carrol, Karrie Gibbons, Steven Sachs, Bjorn van der Leeuw, and Robert Wertheimer. Thank you all for your hard work at making this season possible.

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Supplemental Table 1. Raw data for Rice Island Caspian Tern and Double Crested Cormorant monitoring during the 2022 season. Dates not presented were not sampled.

Date	*n* CATE	*n* DCCO	*n* CATE Eggs	*n* CATE Scrapes
22-04-05	0	0		
22-04-13	35			
22-04-19	0	0		
22-04-22	1000*	5		
22-04-27	5	0		130
22-04-28	30			
22-05-03	200			
22-05-04	250	350		89
22-05-10	90			110
22-05-12	500			
22-05-13	50			66
22-05-16	200			
22-05-19	310	0		310
22-05-20	114	300		115
22-05-23	3500		4	250
22-05-24	3500	0	25	220
22-05-25	2500	0	35	262
22-05-26	2000	734		150
22-05-27	1500	20	0	30
22-05-28	1000			3
22-05-29	750			0
22-05-30	500	0		0
22-05-31	500	0		0
22-06-01	300	40	0	0
22-06-02	50	0		0
22-06-06	162	216		26
22-06-07	157	8		
22-06-08	130			
22-06-10	65	330		
22-06-16	23	90		
22-06-21	20	20		0

22-06-22	29	180		
22-06-24	23	40		0
22-06-29	23	50		0
22-06-30	15	445		
22-07-07	51	160		0
22-07-12	54	280		0
22-07-14	10	93		0
22-07-18	0	45		0
22-07-22	7	520		
22-07-25	0	200		
22-07-27	0	260		
22-08-11	0	35		
22-08-22		600		
22-08-31	1	450		

* As many as 1000 additional CATE were observed flying above Rice Island on this date. Birds in flight are not included in the datum presented here.