Vaquita Research Campaign 2025:
Report of the September Vaquita Survey

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Executive Summary

Planning for the 2025 vaquita research was informed by the results obtained in May 2024. Although the weather was better for surveying in 2024 than it had been the year before, only 9 sightings were made compared with 16 in 2023. Of the 9 sightings, 4 were very brief with no photographs obtained, and 3 or 4 of the longer-duration sightings involved the same pair of vaquitas. The final sighting in 2024 was of 4 individuals, one of which had last been seen in 2019. That individual had not been seen and identified in 2021, 2022 or 2023, and this raised the question of whether vaquitas might be "returning" to previously favored habitat. The Zero Tolerance Area (ZTA) and Extension Area (EA) cover 12% of the total area known to have been used by vaquitas in 2015. The ZTA and EA are avoided by fishermen because of the protection afforded by concrete blocks with net-entangling hooks and surveillance. The rest of the Vaquita Refuge remains unprotected from the gillnetting. Immediately after the 2024 survey, the National Commission of Natural Protected Areas (CONANP) and the Sea Shepherd Conservation Society (SSCS) funded acoustic research that was conducted outside the ZTA in August and September 2024. The detection of vaquitas outside the ZTA and EA led to an expansion of research effort in 2025.

Two interconnected but distinct research projects were designed to provide up-to-date information on where vaquitas occur and how often, on how many remain, and generally on whether vaquitas are healthy and continue to produce calves. The first project used acoustic recorders to collect thousands to days of data throughout the area where vaquitas had been observed in 2015, with the objective of determine overall distribution and abundance. The second project, the subject of this report, used both

acoustics and visual survey methods with the following objectives:

Objective 1: To obtain an estimate of the number of vaquitas and the number of calves seen in the survey area using the method of Expert Elicitation (discussed below).

Objective 2: To obtain information on body condition of vaquitas.

The visual survey used Sea Shepherd Conservation Society's (SSCS) 2 vessels to search for vaquitas, with cruise tracks informed by data from the summer acoustic research to map where vaquitas would most likely be seen. The visual and acoustic methods were similar to those employed in 2023 and 2024. A difference was that 2 large ships with onboard overnight accommodations for scientists were used to cover the more distant areas of the Vaquita Refuge. During each sighting, an attempt was made to obtain photographs and drone footage to help determine whether calves were present and whether vaquitas seen outside the ZTA were different from those seen inside the ZTA. All photographs have been compared to the Vaquita Individual Identification Catalog to evaluate whether vaquitas that have not been seen inside the ZTA since 2019 might have moved outside the ZTA.

Reports from scientists, photographs, and drone footage were used to assess whether any of the vaquitas seen were in poor condition. Such evidence can be used to determine if individuals appeared emaciated (e.g., visible ribs) or had skin conditions (e.g., lesions, ulcers).

Since 2018, acoustic data focused areas searched by the visual survey. The acoustic effort of September 2025 increased coverage significantly in time and space when compared to what was applied in the 2023 and 2024 May surveys. Those earlier acoustic efforts consisted of a sampling grid of 35 sites within the ZTA. In 2025, acoustic detectors were deployed at 35 sampling sites within the ZTA, 10 sites in the EA, and 21 sites in nearby waters. Only two acoustic detectors were lost during the study period, which was minimal in comparison to previous years. A total of 93 acoustic encounters of vaquitas were recorded at 24 of the 66 sites from 02 to 28 September 2025. Vaquitas were more active acoustically in the northwest and middle parts of the ZTA, but detections were also recorded in the northwest part of the EA and outside the EA all the way to the border of the Vaquita Refuge (Figure 1). Visual efforts in 2023, 2024 and 2025 surveyed the area covered by acoustic detectors in Figure 1. This area that includes the ZTA and EA and the area to the northwest is referred to as the "study area" in the Expert Elicitation questions for the visual survey.

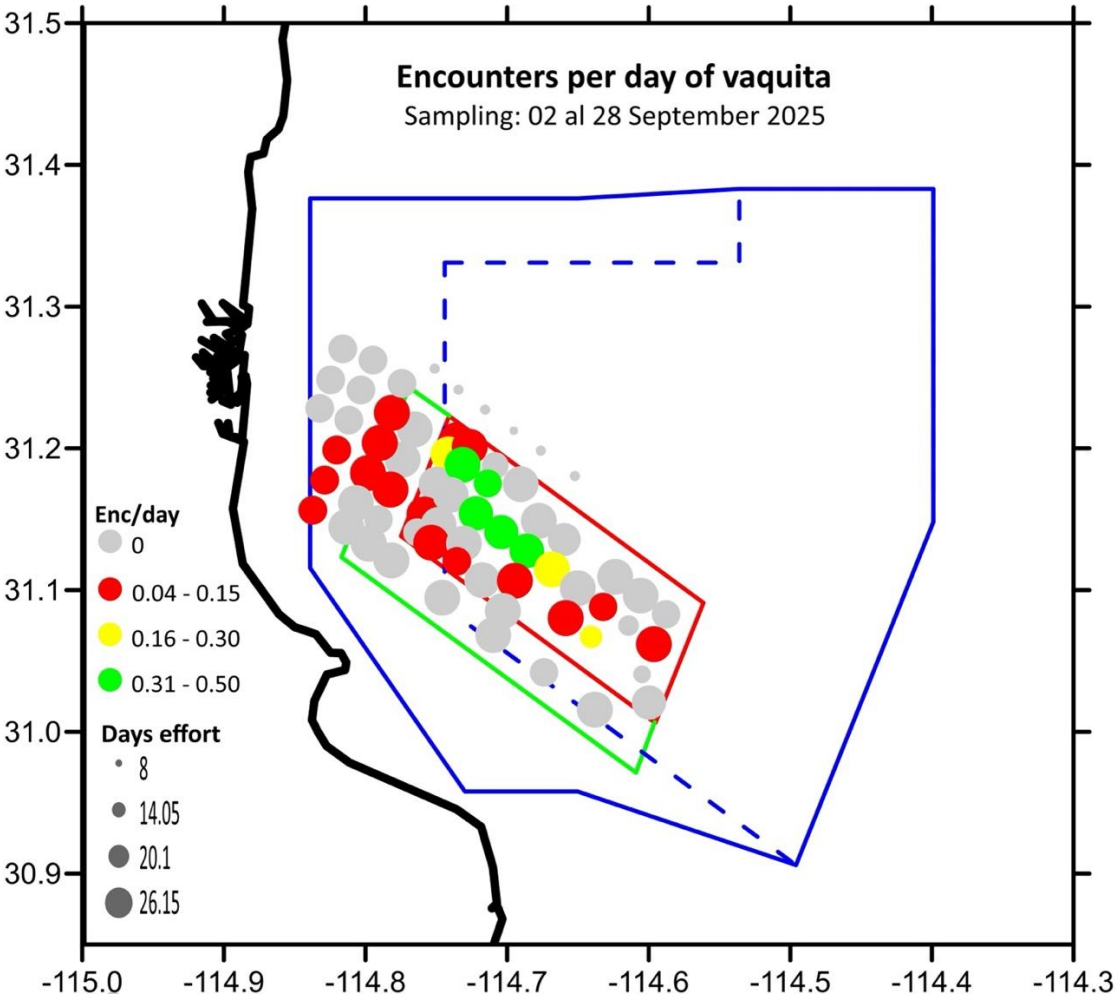

Figure 1. Map showing the acoustic encounter rate of vaquitas per day from 02 to 28 September 2025. The ZTA is the red polygon, the green polygon is the EA, the blue polygon is the Vaquita Refuge. The size of the circles indicates the days of effort per sampling site, and the colors show the acoustic encounters per day. Acoustic detectors were spaced from 1.2 to 4.5 km apart (see Appendix 2 for locations). The area with acoustic detectors covers the area referred to as the 'study area' in visual survey Expert Elicitation questions.

Two SSCS vessels (*Seahorse* and *Bob Barker*), staffed with scientists, surveyed the northern Gulf of California hoping to find and track vaquitas, the rarest and most endangered marine mammal on earth. Each ship was equipped with 3 pairs of 25x binoculars (called bigeyes). The search for these small elusive porpoises was aided by the efforts of Mexican experts on acoustics supported by a group of local fishermen to collect the acoustic data for determining where vaquitas were spending time. This acoustic guidance has been a successful method since 2018 within the ZTA. In 2025, the acoustic effort provided information several times a week in a concentrated area within the ZTA, EA and selected nearby areas (Figure 1). Outside that concentrated area, acoustic detectors were deployed in locations where vaquitas had been observed in and prior to 2015, after which the vaquita's range collapsed. The data

collected from May through September 2025 provided information on the vaquita's current distribution. Thus, the visual survey covered the full area known to have been occupied by vaquitas in 2015 except some areas very close to el Golfo de Santa Clara where they were acoustically detected in 2015.

To provide the Government of Mexico (GOM) with the best possible data on current vaquita distribution and an estimate of minimum numbers, the 2025 ship survey took place in September, the last month of the acoustic distribution and abundance effort that had begun in late May. The survey length was increased to account for both the larger area covered and the known windier conditions which would make many days unsuitable for seeing and tracking vaquitas.

Conditions for seeing and tracking vaquitas were worse in 2025 than in 2023 and 2024 despite the survey duration being longer to account for fall weather. The surveys were of different lengths, so good weather is best expressed per day, which translates to 3.7 km/day of good conditions in 2025 compared with 15.9 km/day in 2024 and 13.9 km/day in 2023 (Table 1). Survey coverage in 2025 included 104.2 kilometers (km) with very good conditions (winds less than 7 km/h) compared to 302.4 km in 2023 and 194.2 km in 2024. Two days of very good weather in 2025 yielded no sightings along offshore tracklines that covered areas where vaquitas had been seen in 2015, but a few acoustic detections were recorded in such areas. We were obviously unable to determine whether the vaquitas using those offshore areas in 2025 were different from the individuals seen during recent surveys inside the ZTA and EA area.

Table 1. Comparison of very good sighting conditions from 2023, 2024 and 2025 from the Seahorse.

Beaufort 0 and 1	**Distance (km) 2023** **May 11-24** **14 days**	**Distance (km) 2024** **May 5-24** **19 days**	**Distance (km) 2025** **Sept 3-30** **28 days**
Total	302.4	194.2	104.2
Average/day	***13.9/day***	***15.9/day***	***3.7/day***

The use of 2 vessels and 6 bigeyes gave the team of expert observers a good ability to see vaquitas, resulting in more than double the number of sightings in 2024. However, 40% percent of the 2025 sightings lasted less than a minute. All of the 2023 and 2024 sightings that lasted longer than 20 minutes resulted in photographs allowing vaquitas to be individually identified. Sightings lasting longer than 20 minutes comprised 43% of the 2023 sightings, 55% of the 2024 sightings but only 32% of the 2025 sightings. Only half of those 20-minute sightings resulted in photo-ID photographs. The weather, including larger swell than is normally experienced in May, was clearly a factor in limiting ability to identify individuals, but the possibility that the presence of two large ships made vaquitas more skittish than usual cannot be ruled out.

Figure 2 shows the tracklines of the two ships and the locations where vaquitas were seen and heard.

Relatively high numbers of detections, both acoustic and visual, were made to the northwest of the EA and all the way to the boundary of the Vaquita Refuge.

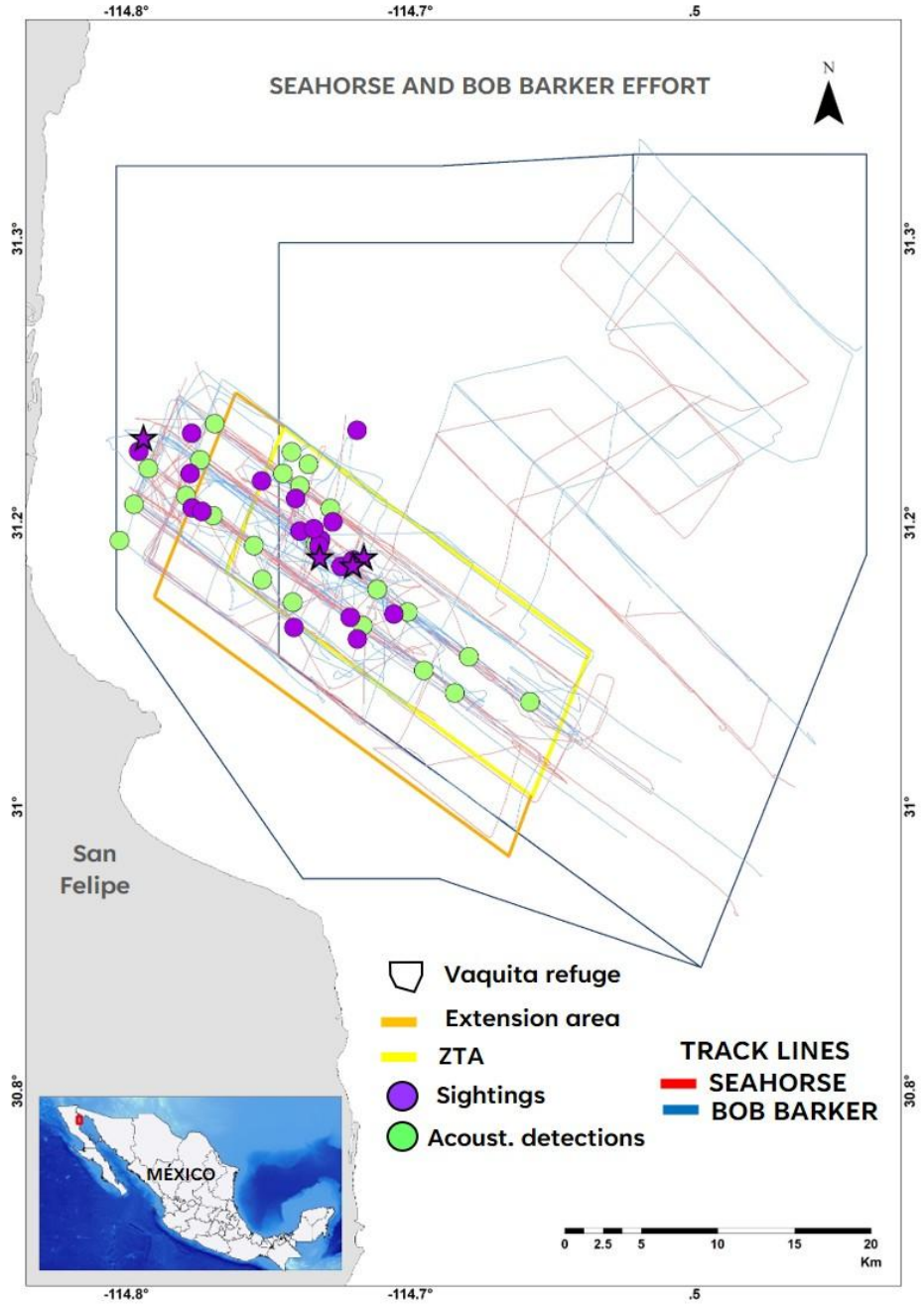

Figure 2. Summary of vaquita acoustic and visual detections during the May 2025 survey. The ZTA is outlined in yellow and the Extension Area (EA) in orange. Sites with acoustic detections are green dots. Sightings (purple dots and purple stars for definite mothers and calves) are 80% within the EA plus ZTA and 20% outside the area protected by blocks with hooks but within the Vaquita Refuge (black outer boundary). Tracklines of the Seahorse are in red and the Bob Barker in blue.

Another difference between the previous May surveys and the September 2025 survey is that in May calves are 2 months old and can be identified reliably compared to September when calves are 7-8 months old and cannot be easily told from adults unless observers have very good looks or drone footage is obtained. Therefore, the Expert Elicitation question concerning the number of unique calves seen, which was addressed for the May 2023 and 2024 surveys, could not be addressed for the September 2025 survey. However, at least 1 or 2 calves were seen. The mother of one calf is called Frida. She has a bent fin and her name is inspired by the famous Mexican artist Frida Kahlo who lived a full life despite her wounds. Frida was the mother of a calf in 2023 and was seen with another individual that was not a calf in 2024, resulting in a two-year calving interval. The only other individually identified mother had a calf in two sequential years.

Drone measurements from sightings 18 and 24 were both about 132 cm and could be one or two individuals of unknown sex. This length corresponds to females approximately 2.5 years old or males about 3.5 years old. These measurements therefore indicate one or two sexually immature vaquitas and confirm the survival of individuals born after about March 2022. Together with the observation that Frida's calf is about one year old, probably born in the fall rather than spring, these findings provide encouraging evidence of recent and continuing reproduction in this species.

Expert Elicitation uses facilitators to work with vaquita observers to reach a consensus concerning the frequency distribution in this case of numbers of vaquitas seen. We addressed the following question: "What is the number of unique vaquitas seen in the ZTA+EA study area?", which is the same question as in 2023, and 2024. There was a 67% probability that the total number of different individuals seen in 2025 was between 7 and 10 compared with a 75% probability of 6 to 8 seen in 2024 and a 67% probability of 8 to 12 seen in 2023 (Figure 3). There is too much uncertainty in visual estimates to make strong conclusions about a trend in vaquita numbers. What can be said is that, based on these data, there is no evidence of a decline of the magnitude reported several years ago (about 45% per year), at least within the study area.

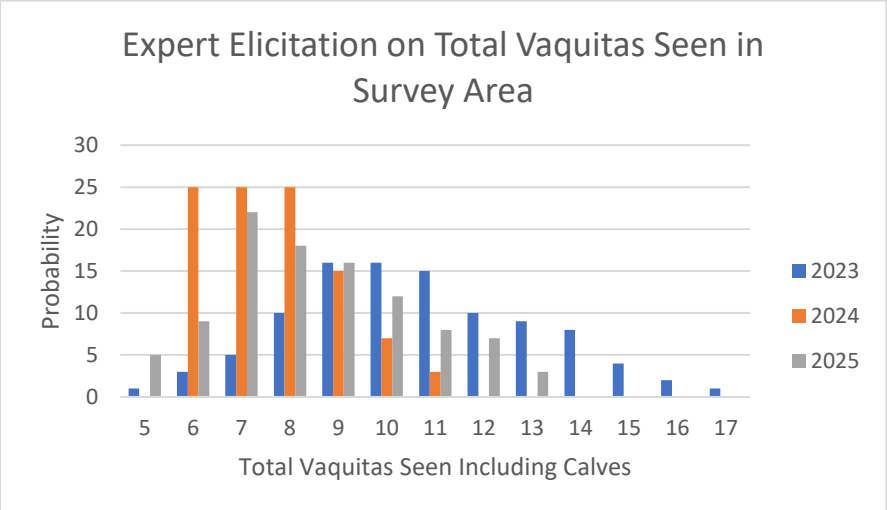

Figure 3. Frequency distribution for the number of vaquitas seen in the ZTA+EA study area in 2023, 2024 and 2025.

As emphasized in earlier reports, vaquitas move freely into and out of the ZTA, therefore the number seen in the ZTA study area at the time of the survey should be interpreted as “there are at least this many vaquitas surviving”. The movement of vaquitas out of the ZTA was highlighted on a very calm day when the 2 ships surveyed the entirety of this protected area without a single sighting. While it is possible that vaquitas escaped the notice of observers, it cannot be ruled out that most or all of them were elsewhere on that day. Even if vaquitas are in the survey area, they remain very difficult to see. This difficulty in seeing vaquitas has been quantified in earlier surveys. Under perfect conditions a vaquita on the trackline would have a 97% chance of being detected from a ship with 3 pairs of bigeyes and expert observers. Much of the 2025 survey was with winds around 10 km/hour and a swell of 0.6m. The probability of detection of vaquitas on the trackline under those conditions drops to around 20%.

This survey, and the surveys in 2023 and 2024, continued training community members on visual survey methods and provided them with experience in detecting vaquitas. Seventeen young community members from San Felipe observed from both ships. The trainees were enthusiastic, and many saw vaquitas. The National Commission of Natural Protected Areas (CONANP), through staff from the Biosphere Reserve of the Upper Gulf of California and Colorado River Delta, oversaw the training program. Continued investment in the program, coupled with more training from experienced observers, and more time on the water, can go far in creating a dedicated team of vaquita and ecosystem monitors. Local community monitors are a way to continue vaquita observations in non-survey times, and for building community knowledge and enthusiasm for the species and the local marine ecosystem. It is our hope that this valuable program can be supported with committed funding from the government into the future.

The ZTA functions as a sanctuary from gillnets and the 2025 research confirms that vaquitas spend most of their time within this very small protected area. However, the 2025 research also shows that vaquitas range outside the ZTA. The area northwest of the ZTA+EA seems to be a particularly important habitat for vaquitas. This area between the EA and the western boundary of the Vaquita Refuge needs immediate protection to guarantee the safety of these last vaquitas, including the critical mothers and calves, from death in gillnets.

Introduction

The decline in vaquita numbers has been well documented. The first survey of the full vaquita distribution used visual line-transect methods (Jaramillo-Legorreta et al. 1999). Observers noted the difficulty of sighting vaquitas due to their small group size, inconspicuous surfacings, and avoidance of the survey vessels. The imprecision of abundance estimates limited the ability to detect and measure trends in a timely manner (Taylor and Gerrodette, 1993). Acoustic monitoring methods were developed to increase the precision of both abundance and trend estimates (Jaramillo-Legorreta et al., 2017). A combination of visual and acoustic methods was used to estimate abundance in 2008 (Gerrodette et al., 2011) and 2015 (Taylor et al., 2016). Acoustic monitoring indicated that the vaquita population was continuing to decline rapidly (Jaramillo-Legorreta et al., 2019).

Recent developments have made both acoustic monitoring and visual line-transect surveying difficult. Fishermen have removed acoustic devices and their moorings. So many acoustic detectors were taken in 2019 that the data were too incomplete to estimate trends within the Vaquita Refuge. To prevent the loss of data and equipment, the acoustic instruments need to be deployed without surface markings (buoys) and retrieved by using either pop-up devices or grappling hooks. Identifying a pop-up system suitable for the Upper Gulf remains a challenge, as those tested thus far have not produced the expected results. Acoustic monitoring, as previously done throughout the Vaquita Refuge, remains extremely difficult.

The visual line-transect approach presents a different problem. If a line-transect ship survey were carried using the same (or similar) vessels as used in the past (*David Starr Jordan/Ocean Starr*), it would be possible to estimate abundance with relatively few sightings, because the probability of detection is known for these large ships. The number of sightings from the *Seahorse,* the ship used in surveys from 2023-2025, may be sufficient to estimate a detection function. However, any systematic survey with so few vaquitas remaining is bound to produce an estimate with high uncertainty.

Faced with these difficulties, vaquita researchers have increasingly made use of photographic identification (photo-ID), which requires high-quality photographs of individual animals. Photo-ID of vaquitas began in 2008 (Jefferson et al. 2009) but was not considered promising until 2017 when some success was achieved during the VaquitaCPR project (Rojas-Bracho et al., 2019). The September 2018 photo-ID effort produced the first evidence that vaquitas could calve annually (Taylor et al., 2019) and showed that at least 6 healthy animals remained, all seen together in a small area near San Felipe, Mexico. The 2018 abundance estimate used the 2015 abundance estimate together with acoustic data to estimate trend. Initial population projections were less than 6, but that number was demonstrably false given the known lower bound of 6 from photo-ID (Jaramillo-Legorreta et al., 2019). Such

projections were removed from the abundance analysis and proved quite influential on the final results (Thomas et al. 2019).

Surveys focused on photo-ID were again conducted in 2019 (Rojas-Bracho et al., 2019). No within-year matches were made that would allow an abundance estimate. Instead, Expert Elicitation (EE) was used to estimate the number of unique individual calves seen and the number of unique individual vaquitas seen (including adults, juveniles and potential calves) within the survey area in 2019 (Rojas-Bracho et al., 2019). A similar survey was conducted in 2021 (Rojas-Bracho et al., 2022). The 2019 and 2021 survey results were interpreted as indicating that the population was no longer declining at 45%/year as estimated earlier and that, instead, they could be declining only slightly, if at all. Both surveys took place in October and only 4 to 5 calm sea days were suitable for spotting vaquitas.

The 2023 vaquita survey was moved to May to take advantage of more days with low winds compared to the fall period. The basic strategy was the same: use acoustics to indicate areas where sighting effort should focus and use EE to interpret sighting data. The 2023 and 2024 surveys used the *Seahorse* and a smaller vessel (the *Sirena de la Noche*), and nearly the same team of observers with the same number of 25 power binoculars (aka bigeyes), making the 2023 and 2024 surveys the most comparable (methodologically) to date. Both surveys resulted in photo-ID matches and provided direct evidence on the number of vaquitas seen within the surveyed area. In 2024, the survey area was enlarged to encompass extensions to the southeast and southwest of the ZTA where vaquitas had been seen in 2017. The survey period was lengthened by 5 days to ensure comparable survey effort to 2023. Neither vessel could accommodate observers overnight, so they slept on shore and either departed very early in the *Sirena* or were taken pre-dawn to the *Seahorse* by panga.

In 2024 fewer unique vaquitas were estimated to have been seen within the study area and no calves were sighted. However, the last sighting was of 4 vaquitas and included an individual last seen in 2019. The reduction in sightings together with the reappearance of an individual not seen during any of the last three surveys suggested that vaquitas may be reoccupying habitat outside the ZTA area. However, it is not certain that this individual was outside the ZTA area because vaquitas are difficult to see and consequently there is the possibility that this individual was present in the ZTA area but was missed. Subsequent acoustic research in August and September, 2024 detected vaquitas in areas frequented by vaquitas in 2015.

Two interconnected but distinct research projects were designed to provide up-to-date information on where vaquitas occur and how often, on how many remain, and generally on whether vaquitas are healthy and continue to produce calves. The first project used acoustic recorders to obtain thousands of days of data throughout the area where vaquitas had been observed in 2015, with the objective of

addressing questions related to overall distribution and abundance. The second project, the subject of this report, used both acoustics and visual survey methods with the following objectives:

Objective 1: To obtain an estimate of the number of vaquitas and the number of calves seen in the study area using Expert Elicitation (discussed below).

Objective 2: To obtain information on body condition of vaquitas.

The visual survey used Sea Shepherd Conservation Society's (SSCS) 2 vessels to search for vaquitas, with cruise tracks informed by data from the summer acoustic research to map where vaquitas would most likely be seen. The visual and acoustic methods were similar to those employed in 2023 and 2024. A difference was that 2 large ships with onboard overnight accommodations for scientists were used to cover the more distant areas of the Vaquita Refuge. During each sighting, an attempt was made to obtain photographs and drone footage to help determine whether calves were present and whether vaquitas seen outside the ZTA were different from those seen inside the ZTA. All photographs have been compared to the Vaquita Individual Identification Catalog to evaluate whether vaquitas that have not been seen inside the ZTA since 2019 might have moved outside the ZTA.

Reports from scientists, photographs, and drone footage were used to assess whether any of the vaquitas seen were in poor condition. Such evidence can be used to determine if individuals appeared emaciated (e.g., visible ribs) or had skin conditions (e.g., lesions, ulcers).

Expansion of the survey to include the distant parts of the Vaquita Refuge necessitated the scientific team to stay aboard the ships for the entire survey. The 2025 survey used 2 vessels (Figure 4) each equipped with 3 pairs of bigeyes and staffed with experienced observers. The use of ships equipped with advanced sonar also made it possible to collect data on depth and acoustic backscatter which could improve understanding of vaquita habitat preferences. Nighttime tracklines were run on both ships to obtain these data.

Figure 4. The Bob Barker and the Seahorse (top) with nearly identical observation setups. Each had 3 25 power Fujinon binoculars and a computer station located ahead of the bridge (bottom).

This survey, like the surveys in 2023 and 2024, incorporated a training component to introduce interested young community members to visual survey methods and provide them with experience detecting vaquitas (Figure 5). CONANP, through staff from the Biosphere Reserve of the Upper Gulf of California and Colorado River Delta, oversaw the training program in 2025. Throughout the year, the Biosphere Reserve has continued to support the group through follow-up activities and with resources provided by Colossal through Pronatura Noroeste. Local staff from the Biosphere Reserve also participated in the training in visual survey methods. Both ships hosted trainees, and experienced members of the survey teams engaged with the training operations. Navy and CONANP personnel

observed the survey operations and facilitated communications with Navy vessels in the area. Dignitaries and media representatives visited the surveys.

Figure 5. Community observers

Methods

Tracklines and waypoints were designed to partially match the locations of acoustic detectors within the ZTA (Appendix 1). Acoustic detectors were placed as they had been in 2023 and 2024 within the ZTA but also placed in the EA and some additional areas nearby (Appendix 2). Survey speed was between 4-6 knots. The two vessels followed parallel tracks, staying about 2-4 km apart so that when vaquitas were sighted, the vessels could converge to track and photograph them. Observers were housed on the *Seahorse* and on the *Bob Barker*.

Because vaquitas are exceptionally rare and difficult to detect, it is critical that experienced scientists carry out the surveys, both acoustic and visual. Acoustic personnel included: Gustavo Cárdenas-Hinojosa, Edwyna Nieto-García, Job Olguin Hernández, Rosa Burciaga and Lorenzo Rojas-Bracho. Visual personnel included: Barbara Taylor, Jay Barlow, Robert Pitman, Sarah Mesnick, Juan Carlos Salinas, Ernesto Vázquez, Annette Henry, Sergio Martínez, Pamela Martínez, Felipe Triana, Anna Hall, Adam Walleyn, Rodrigo Huerta, Adam Ü, Jasivi Arcos, Heidi Malizia, Fabián Rodríguez, and Mary Applegate. Two vessels were used for the 2025 survey – the *Seahorse* with an eye height of 7.57m and the *Bob Barker* with an eye height of 8.05m. Eye height is the average eye height above the water that is used to calculate distance to sightings. SSCS crew included drone pilots on both ships to obtain video footage of vaquitas. The drone pilot on the Bob Barker, Fabián Rodríguez, used a drone with an altimeter so that vaquita length and girth could be estimated for use in assessing health and determining age-class.

The *Seahorse* was equipped with 3 pairs of big eyes (25X) Fujinon binoculars on loan from the Southwest Fisheries Science Center, National Marine Fisheries Service, National Oceanographic and Atmospheric Administration, U.S. Department of Commerce. The *Bob Barker* was equipped with 3 pairs of big eyes (25X) Fujinon binoculars owned by SSCS. Scientists staffed the visual effort on each ship, which proved to be a very stable platform for keeping high-power binoculars steady even in 1 m of swell, something that is essential for carrying out effective vaquita surveys. Data were recorded in WinCruz software that allowed mapping of the vaquita sightings so that the animals could be tracked (Figure 6) and when possible, photographed. The locations of sightings also provided data on swim speeds between within-day sightings. Such data help determine whether sightings could be duplicates of earlier sightings or are of 'new' individuals.

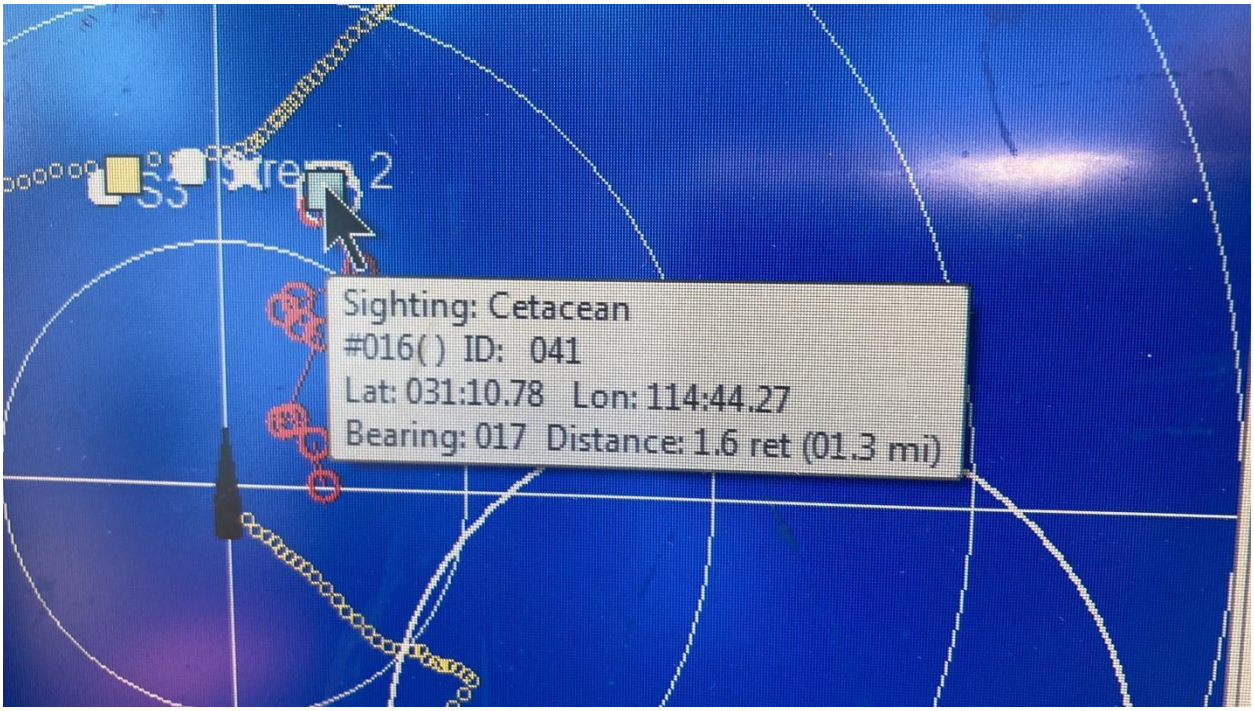

Figure 6. Example screenshot. The black ship in the center depicts the position of the Seahorse with its path shown by yellow circles. The path of a mother/calf pair of vaquitas observed in 2023 is in red open circles with the last position shown where the cursor is pointing and in the text box. Each white circle extending from the Seahorse is a nautical mile (1.85 km).

For the Expert Elicitation (EE) exercise, all experts were required to take 3 hours of online training. During the survey, each sighting was written up in detail in an Evidence Dossier. Group meetings of observers were held regularly to discuss sightings and verify that the Dossier contained all relevant data. Photographs were included to allow between-sighting comparisons by experts. An independent matching effort was made by a photo-identification expert, Paula Olson, and was appended to the summary information in the Evidence Dossier.

The elicitation was facilitated by experts from St. Andrews University who had also led the elicitations in 2019, 2021, 2023 and 2024. The elicitation took place on October 7, 2025 for 4 hours. Experts independently allocated "probs" (likelihood values) for this question: "What is the total number of unique vaquitas seen in the ZTA and EA study area (including calves)?" The experts were asked to give their rationales verbally. They were then allowed to change their "probs" if the discussion resulted in changing their understanding. The St. Andrews experts then compiled the independent distributions into a single distribution and led a discussion toward a consensus distribution that the group believed could be convincingly argued to a Rational Impartial Observer. A more complete description of this method is given in Rojas-Bracho *et al.* (2022) and Appendix 4.

Acoustic detectors were placed in a grid formation similar to previous years but also in the EA and some nearby areas. Placement of detectors in the area northwest of the ZTA+EA was done to ensure that the full distribution in that previously poorly assessed area received sufficient effort. Attempts were made to ensure that areas where vaquitas had been detected were surrounded by acoustic detectors to ensure proper delineation of the current distribution. Detectors were deployed using a mooring with a buoy on the surface to mark his location, and were replaced as weather allowed with regular acoustic reports (Appendix 2) relayed to the visual effort to allow focus on areas with higher chances of locating and photographing vaquitas.

Depth and backscatter data were gathered from both ships throughout the survey (Appendix 6). Nighttime tracklines were designed to cross back-and-forth across previously identified ridges. These data will allow analyses to look for habitat correlates with current and past vaquita distribution.

On days when weather allowed, community trainees transited to each of the Sea Shepherd Conservation Society ships, *Seahorse* and *Bob Barker* (Appendix 5). These teams generally consisted of one CONANP staff member and one or two trainees. An observer rotation was established, with the teams searching from the bridgewings using handheld (7X) binoculars. Open communication enabled the trainees to join efforts to track vaquitas during a sighting and to observe visual, acoustic and drone operations.

Results

The acoustic effort of September 2025 increased coverage significantly in time and space when compared to what was applied in the 2023 and 2024 May surveys. Those earlier acoustic efforts consisted of a sampling grid of 35 sites within the ZTA. In 2025, acoustic detectors were deployed at 35 sampling sites within the ZTA, 10 sites in the EA, and 21 sites in nearby waters. Only two acoustic

detectors were lost during the study period, which was minimal in comparison to previous years. A total of 93 acoustic encounters of vaquitas were recorded at 24 of the 66 sites from 02 to 28 September 2025. Vaquitas were more active acoustically in the northwest and middle parts of the ZTA, but detections were also recorded in the northwest part of the EA and outside the EA all the way to the border of the Vaquita Refuge (Figure 7). Detailed reports of the approximately weekly retrieval of acoustic detectors are given in Appendix 2.

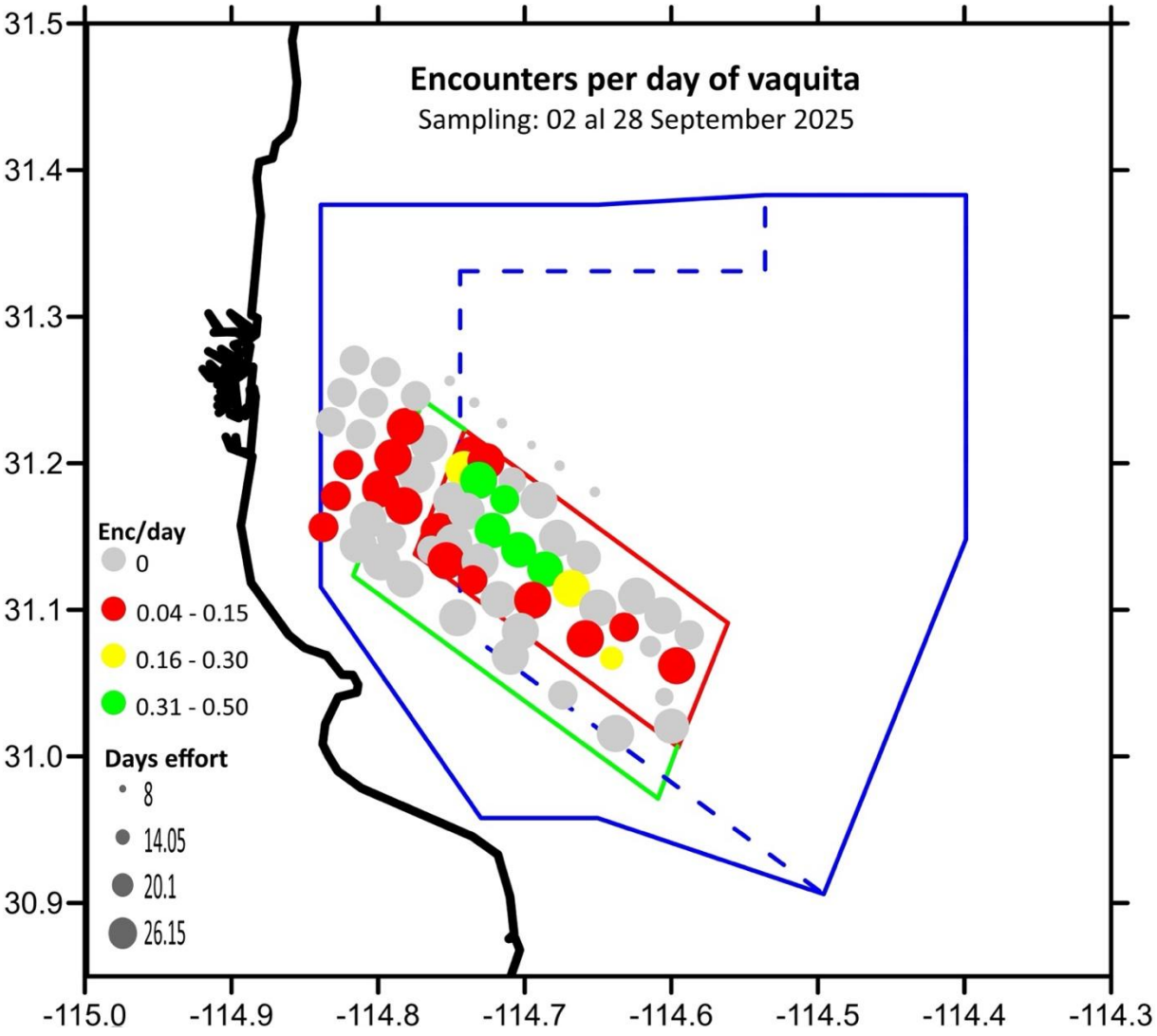

Figure 7. Map showing the acoustic encounter rate of vaquitas per day from 02 to 28 September 2025. The ZTA is the red polygon, the green polygon is the EA, the blue polygon is the Vaquita Refuge. The size of the circles indicates the days of effort per sampling site, and the colors show the acoustic encounters per day.

Visual survey efforts were guided by regular reports of acoustic data indicating where vaquitas were detected (Appendix 2).

September 3 was the first day of visual effort. Typically, vaquitas can be seen and tracked for photographs only in very calm conditions (Beaufort 0-2 with wind less than 13 km/h). The May weather conditions in both 2023 and 2024 consisted of calm nights and early mornings followed by increasing winds in the afternoon. September patterns were the opposite with windy mornings and reduced wind in the afternoons. Because the 2025 research was interested in both our usual objectives of estimating minimum numbers and also sighting vaquitas to obtain additional distribution information, surveying was carried out in Beaufort 3 and 4 conditions. Although sightings were made in those conditions, tracking the animals was very difficult. Figure 8 shows the survey tracklines coded by Beaufort sea state. Distances surveyed in different sea states are given in Table 1. Raw data files (called DAS files) are available from CONANP upon request and are also maintained at the Southwest Fisheries Science Center.

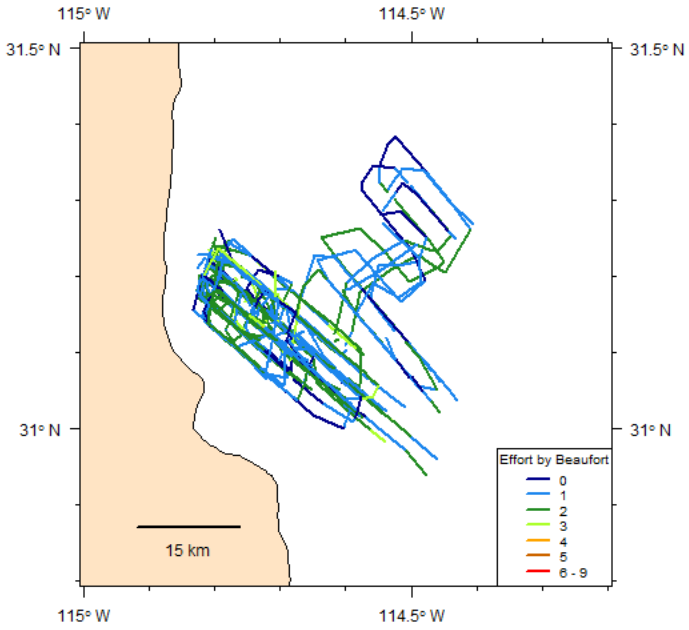

Figure 8. All tracklines followed by the Seahorse and Bob Barker during the 2025 vaquita survey, under different Beaufort sea states.

The number of kilometers covered by the Seahorse in different sea states shows that coverage of the survey area was better in 2024 than in 2023 and worse in 2025 despite the longer survey (Table 2).

Table 2. Kilometers of survey effort for Seahorse only in sea states Beaufort 0 through 4 in the ZTA and EA area.

Beaufort	**Distance (km) 2023** **May 11-24** **14 days**	**Distance (km) 2024** **May 5-24** **19 days**	**Distance (km) 2025** **Sept 3-30** **28 days**
0	43.7	64.1	12.8
1	150.5	238.3	91.4
2	205.4	304.8	307.5
3	44.8	138.1	487.7
4	112.3	108.8	67.7
TOTAL ***Average of Beaufort 0 and one conditions/day***	***620.8*** ***13.9/day***	***857.0*** ***15.9/day***	***967.2*** ***3.7/day***

The importance of both Beaufort and swell height was quantified in the 2015 vaquita survey (Taylor *et al.* 2016). In that survey, only Beaufort conditions of 2 or less and swell less than 0.3 m were used in abundance estimation. Figure 9 shows the derived relationship between these sea conditions and the probability of detecting vaquitas on the trackline: g(0). The probability of detecting vaquitas on the trackline in B0 and no swell is 0.975. Much of the survey was conducted with 0.6 m swell and Beaufort 2 which results in reducing the probability of detecting vaquitas to around 0.2, in other words, vaquitas would not be visible 80% of the time.

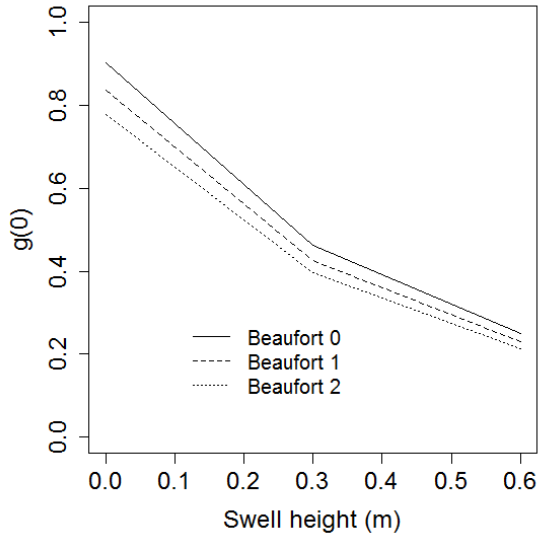

Figure 9. The probability of sighting vaquitas on the trackline (g(0)) by swell height and Beaufort.

All sightings are described in detail in the Evidence Dossier (Appendix 3) and are summarized in Table 3. Forty percent of the sightings lasted less than one minute. All of the 2023 and 2024 sightings that lasted longer than 20 minutes resulted in photographs allowing vaquitas to be individually identified. Sightings lasting longer than 20 minutes comprised 43% of the 2023 sightings, 55% of the 2024 sightings but only 32% of the 2025 sightings. Only half of those 20-minute sightings resulted in photo-ID photographs. The weather, including larger swell than was experienced in May, was clearly a factor in reducing success in identifying individuals, but we cannot rule out that the presence of two large ships made vaquitas more skittish than usual.

Table 3. Vaquita sighting details.

Sighting number	Date in Sept 2025	Vessels	Time	Duration (min)	Photos	Videos	Beaufort	Swell (m)	Closest distance (nmi)
1	3	S, B	8:28-8:38	10	N	N	2	0.6	0.6
2	3	S, B	10:03-10:33	30	N	Y	2	0.6	0.5
3	3	S	11:08	1 sec	N	N	2	0.6	1.1
4	10	S,B	15:36-15:40	4	N	N	2	0.6	1.0
5	11	B	14:47	20 sec	N	N	3	0.6	0.35
6	11	B	15:13-15:14	1	N	N	3	0.6	0.7
7	11	B	15:13	9 sec	N	N	3	0.6	0.58
8	12	B	17:03	3 sec	N	N	3	0.6	0.5
9	12	B	7:56-8:20	24	N	N	1	0.6	0.7
10	13	S	17:27-17:28	1	N	N	1	0.3	0.5
11	14	S	9:27-9:29	2	N	N	2	0.6	1.0

12	15	S	9:06-9:22	17	N	N	1	0.3	0.33
13	15	S	17:54	5 sec	N	N	3	0.6	0.69
14	16	B	11:53	25 sec	N	N	4	0.6	1.61
15	18	B	7:37	1 sec	N	N	2	0.3	1.0
16	20	S	8:19	20 sec	N	N	2	0.3	0.59
17	20	S	11:17-11:44	27	N	N	2	0.6	0.5
18	20	S, B	12:41-14:56	135	Y	Y	1	0.6	600m
19	23	S,B,p	17:59-18:55	57	Y	Y	1	0.3	200m
20	24	B	10:34-10:47	13	N	N	3	0.3	0.53
21	24	S, B	15:27-16:32	65	N	Y	1	0.3	0.6
22	25	S, B	13:42-14:07	25	Y	Y	2	1.3	0.2
23	25	S	14:13-15:00	48	Y	N	2	1.3	0.3
24	28	B	13:43-13:58	14	N	Y	3	0.3	0.7
25	29	S, B	13:48-14:10	22	N	N	2	0.3	0.4

As in the 2023 and 2024 surveys, most sightings were within the protected areas of the ZTA and EA, but in 2025 there were both acoustic and visual detections to the northwest of these areas (Figure 10).

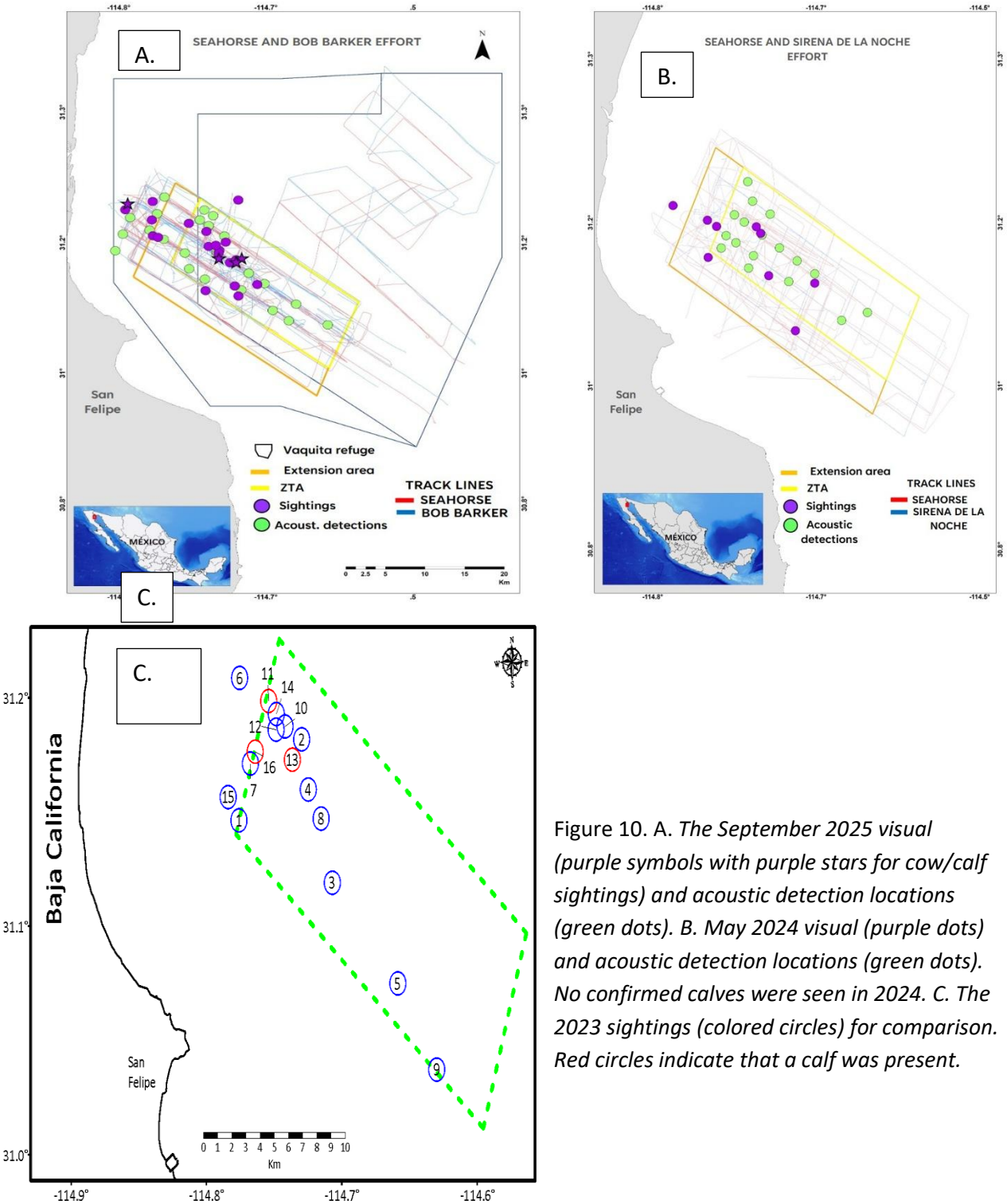

Figure 10. A. *The September 2025 visual (purple symbols with purple stars for cow/calf sightings) and acoustic detection locations (green dots). B. May 2024 visual (purple dots) and acoustic detection locations (green dots). No confirmed calves were seen in 2024. C. The 2023 sightings (colored circles) for comparison. Red circles indicate that a calf was present.*

Figure 11 shows both the acoustic sites where no vaquitas were detected (black dots) and those where vaquita were detected (green dots) alongside the visual detections (purple dots and stars). Although the acoustic and visual detections are generally in the same areas, it is noteworthy that no vaquitas were visually detected in the southeastern part of the ZTA despite a great deal of effort given the acoustic detections in that area. This could result from the swell being somewhat higher in that area, but at least 2 days of trackline in the central southeast ZTA had very low swell.

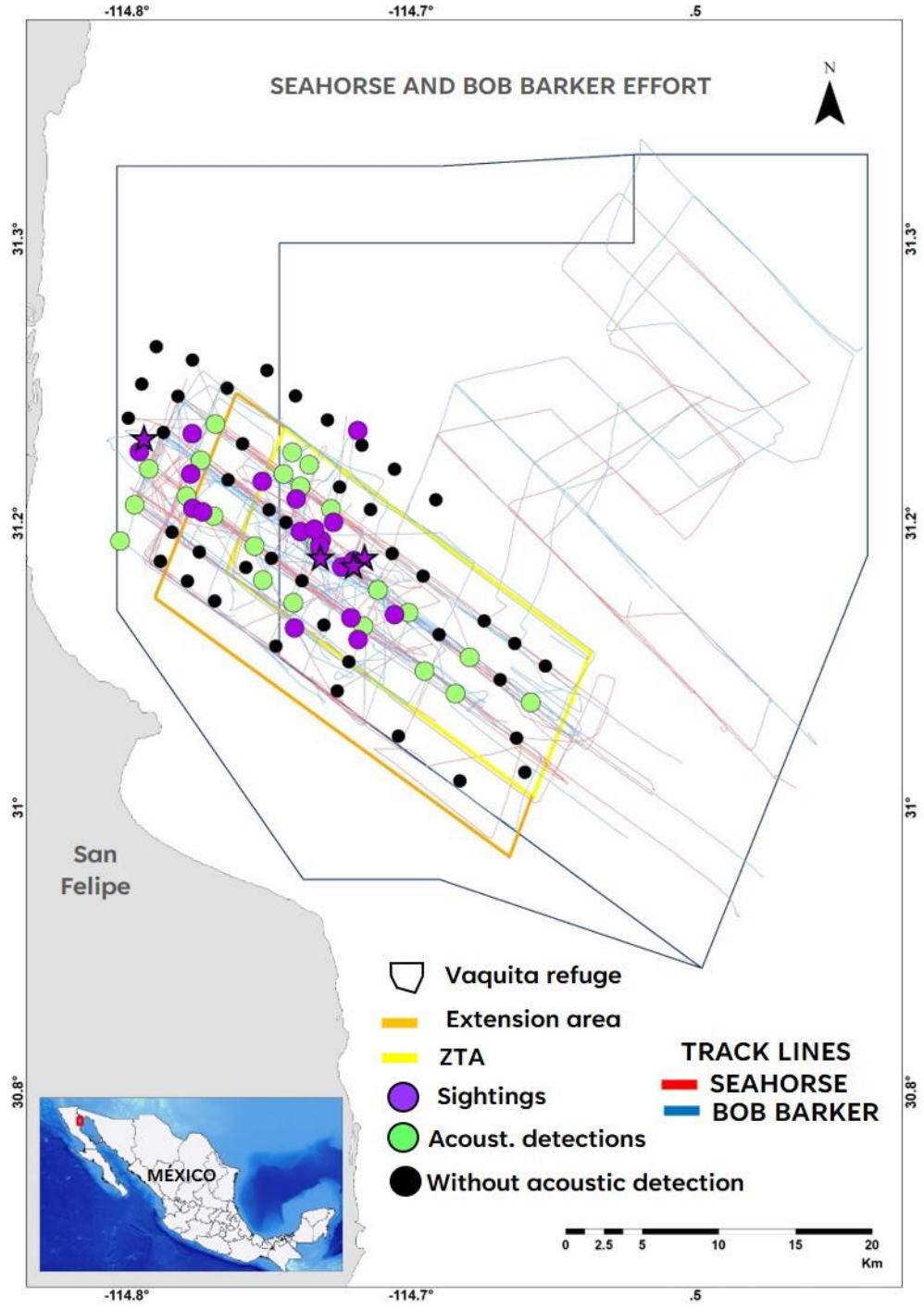

Figure 11. Acoustic sampling sites with no vaquita detections (black dots) and positive detections (green dots) together with visual effort shown by tracklines and vaquita sightings (purple dots and purple stars for sightings with calves).

A DJI Mavic 3 Pro drone equipped with an adapted LightWare LiDAR SF-11 altimeter was used to estimate the total body length of the vaquita. There were 95 drone flights representing 1,365 minutes (22.8 h) of flight effort. The drone was operated at altitudes between 45 and 110 m, positioned directly above the animals, with the gimbal set to –90° to ensure a nadir (vertical) perspective. Vaquitas occasionally exhibited mild avoidance behavior when the drone descended rapidly or hovered directly above them below approximately 70 m. However, when flights approached more gradually or the drone remained at a distance, the animals appeared less responsive, possibly due to lower perceived noise levels. These observations were taken into consideration when planning subsequent operations to minimize potential disturbance.

High-quality 4K 60 fps videos were recorded and analyzed to estimate vaquita body length. Individual frames were extracted from these videos when the animals appeared completely straight at the surface (Figure 12). The camera's optical characteristics were combined with a calibrated equation that converted pixel length into real distance, incorporating the exact flight altitude recorded by the LightWare LiDAR SF-11. All measurements were processed in RStudio to obtain accurate total body length estimates.

Out of 25 total sightings, vaquitas were successfully filmed in five sightings, resulting in seven usable frames (Figures 13–19). Two of these corresponded to the same individual in sighting 18 (2025-S-001, *1.3264 m* and *1.3170 m*; Figure 13 and 14), and four others represented recaptures of a mother–calf pair in sightings 19 and 22 taken 2 days apart (Frida, *1.5063 m* and *1.5101 m*; Frida calf, *1.1109 m* and *1.1129 m*; Figures 15–18). The length of Frida ties with the longest female measured (Torre et al. 2014). The final frame of sighting 24 (2025-S-002*, *1.3189 m*; Figure 19) likely corresponds to a different individual, although its size was similar to 2025-S-001; since no photo-ID match was available, it was treated as a distinct animal.

A summary of all measured individuals, including flight date, ID, altitude, and estimated total length, is presented in Table 4.

Table 4. Summary of vaquita measurements from aerial photogrammetry in September 2025.

Date (Sept. 2025)	Sighting number	Individual ID	Composition	Altitude (m)	Estimated total length (m)	Remarks
20	18	2025-S-001	Single	61.6	1.3264	First measurement
20	18	2025-S-001	Single	75.2	1.3170	Recapture (same individual)
23	19	2025-MC-001 (Frida)	Mother	45.7	1.5063	Mother of calf
23	19	2025-MC-001-Calf (Frida calf)	Calf	45.7	1.1109	Associated calf
25	22	2025-MC-001 (Frida)	Mother	85.4	1.5101	Recapture of mother
25	22	2025-MC-001-Calf (Frida calf)	Calf	85.7	1.1129	Recapture of calf
28	24	2025-S-002*	Single	58.7	1.3189	Possibly new individual

Figure 12. Example of vaquita body posture used for frame extraction.

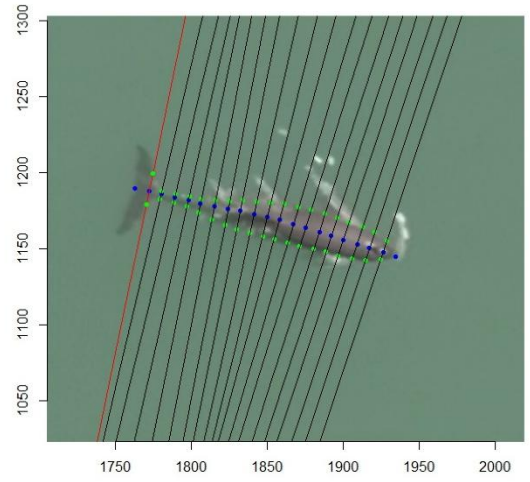

Figure 13. Individual 2025-S-001 measured on 20 September 2025 at 61.6 m altitude (total length = 1.33 m).

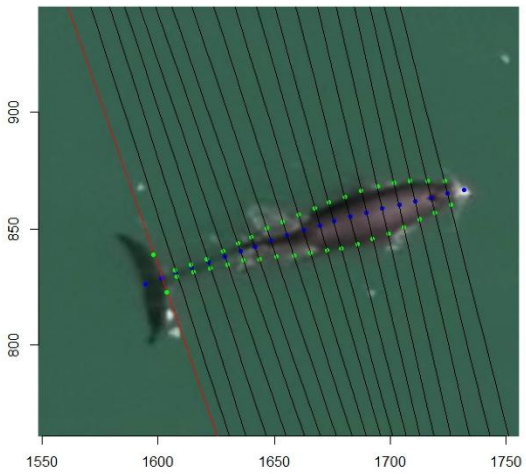

Figure 14. Individual 2025-S-001 measured on 20 September 2025 at 75.2 m altitude (total length = 1.32 m).

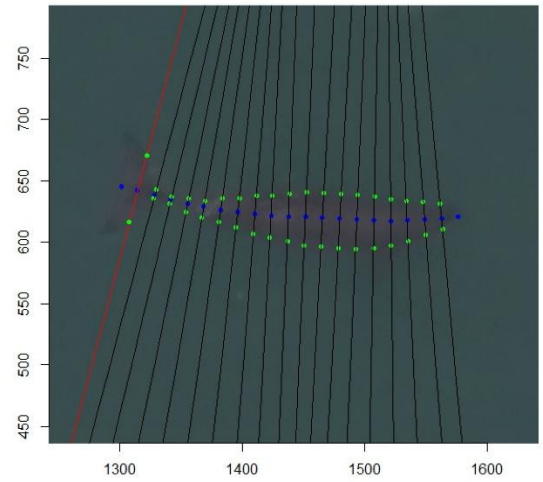

*Figure 15. Mother "Frida" measured on **23 September 2025** at an altitude of **45.7 m** (total length = **1.50 m**).*

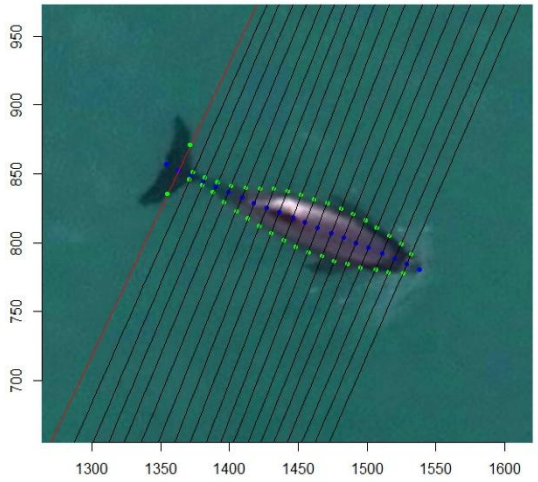

*Figure 16. Calf of "Frida" measured on **23 September 2025** at an altitude of **45.7 m** (total length = **1.11 m**).*

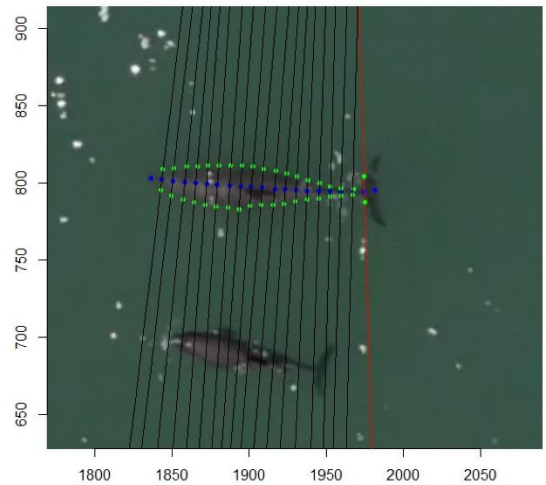

*Figure 17. Mother "Frida" recaptured on **23 September 2025** at an altitude of **85.4 m** (total length = **1.51 m**).*

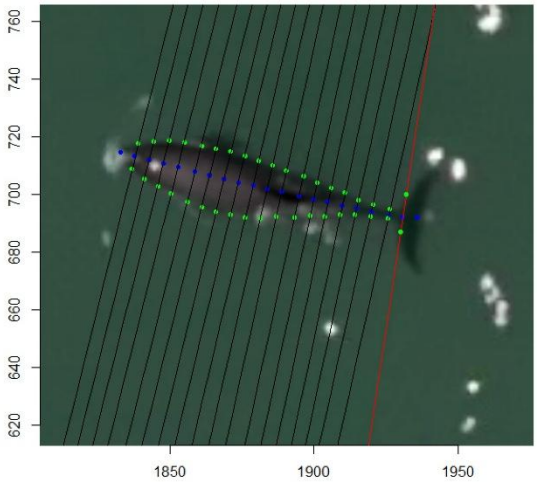

*Figure 18. Calf of "Frida" recaptured on **23 September 2025** at an altitude of **85.7 m** (total length = **1.11 m**).*

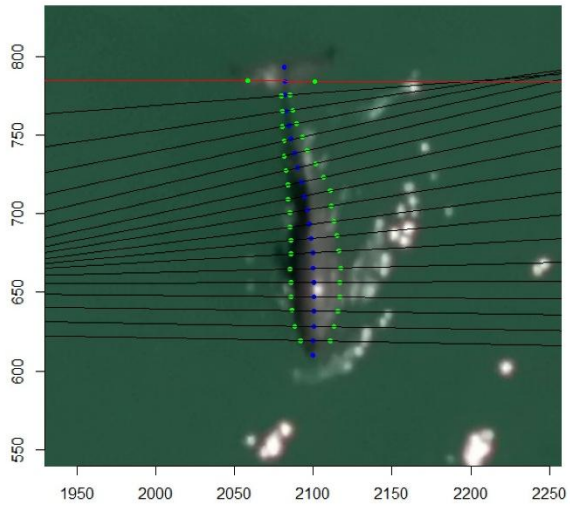

*Figure 19. Adult individual (**2025-S-002***) measured on **28 September 2025** at an altitude of **58.7 m** (total length = **1.32 m**)*

There are 3 measurements of young vaquitas since 2017: 102cm female captured on October 18, 2017 (Rojas-Bracho et al. 2019),, 117-119 cm vaquita from drone photo on May 23, 2024, and 111 cm vaquita from drone photo September 23, 2025. Hohn et al. (1996) give lengths at age, which differs for males and females. Using the Hohn et al. growth curves, the predicted months of birth for these individuals (which is uncertain both because of unknown sex for the drone photos and some measurement uncertainty) are: February for the 2017 female, December to February for the 2024 individual who would have been 16-18 months old when videoed in 2025; and September for Frida's 2025 calf, who would have been just about a year old. Thus, the most recent calf does not fit the birth pulse estimated by Hohn et al. (1996) to have occurred between late February to early April. Most of the vaquitas used in the Hohn paper were obtained during the totoaba season, which may have led to a false conclusion about how peaked calving season is. However, it is also possible that calving seasonality has changed as vaquita's numbers have hugely decreased relative to the amount of food available in the northern Gulf of California.

Measurements in sighting 18 and 24 of about 132 cm correspond to females aged 2.5 years old to males aged 3.5 years old. Thus, these measurements indicate one or two sexually immature vaquitas and also indicate survival of individuals born since about March, 2022.

There was consensus that at least one calf was seen and many thought a second calf was seen, but this could not be confirmed with photographs.

The mean estimate of the number of different vaquitas seen in 2025 was 8.52 compared with 7.62 in 2024 and 10.6 in 2023 (Figure 20). There was a 67% probability that the total number of unique individuals seen in 2025 was from 7 to 10 compared with a 75% probability of seeing from 6 to 8 in 2024, and a 67% probability of seeing from 8 to 12 in 2023. There is too much uncertainty in visual estimates to make strong conclusions about trends in vaquita numbers.

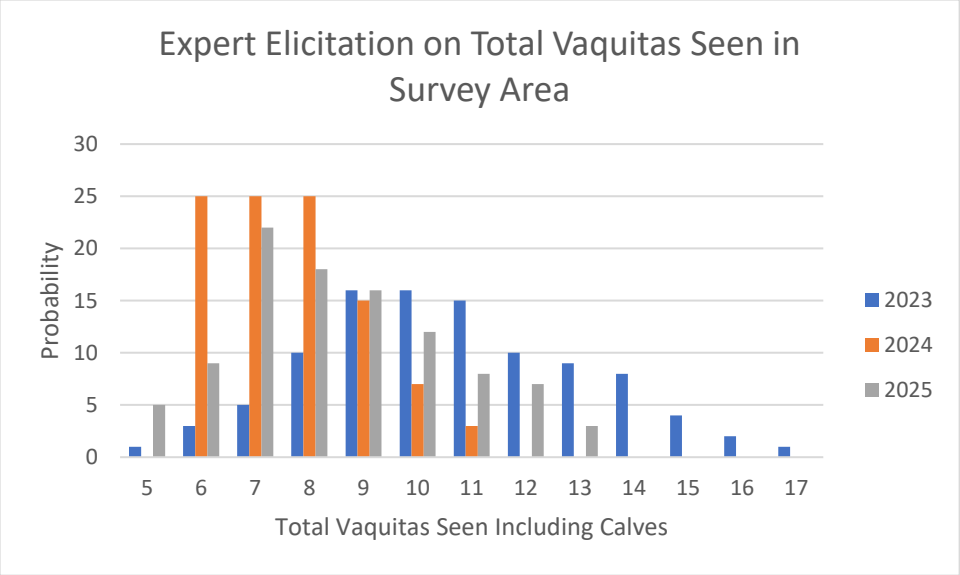

Figure 20. Percent belief from expert elicitation for numbers of unique vaquitas seen within or near the ZTA in May 2023, May 2024 and September 2025.

During the 2025 survey, 17 community members participated in one to five days of effort, accompanied by nine staff from CONANP (Appendix 5). The trainees also participated in sightings of other megafauna in the area, including whales, sea lions, dolphins, seabirds, turtles, and sharks. They observed data recording techniques and the other science projects conducted during the survey, including acoustics and drone operations. A number of the community members saw vaquitas, sometimes for the first time.

Discussion

Following the 2021 survey, a paper was published demonstrating that vaquitas were doing better than expected (Rojas-Bracho et al., 2022). When the decline observed in 2018 was projected forward, the most likely outcome was that the vaquita would be extinct by now. That the species has survived into 2025 is welcome news although the low number of surviving individuals makes breeding between close relatives inevitable and therefore concerns about inbreeding depression continue to be raised. Analysis of genomic data estimates that vaquitas have numbered around 2,800 individuals for over 2,000 generations (or 25,700 years) (Robinson et al., 2022). An individual-based model using vaquita genomic data found a high chance of recovery, even from a population as small as ten individuals, but only if mortality in gillnets is eliminated. In contrast, the probability of extinction increases if bycatch persists, or if the number of remaining vaquitas drops below ten, highlighting that recovery potential depends

critically on the complete cessation of gillnet mortality and showing that, under such conditions, the species could still recover despite its extremely small population size.

Vaquitas continue to produce healthy-looking calves. Drone measurements from 2025 reveal not only Frida's one year-old-calf, but also 1-2 juveniles born since March of 2022. Therefore, calves are not only being born but also surviving at high rates. Given the absence of gillnets within the ZTA and seeing healthy vaquitas apparently feeding undisturbed makes us optimistic that the population can recover. However, two conservation actions are required to allow recovery: (1) genuine sanctuary areas with concrete blocks with hooks to deter gillnet fishing and (2) effective transition from gillnets to alternative fishing gears and practices within the vaquita's historical range.

The numbers of vaquitas seen within the ZTA+EA remain roughly unchanged: there was a 67% probability that the total number of different individuals seen in 2025 was between 7 and 10 compared with a 75% probability that between 6 and 8 were seen in 2024 and a 67% probability that between 8 and 12 were seen in 2023. There is too much uncertainty in visual estimates to make strong conclusions about trends. What can be said, however, is that based on the data collected to date, there is no evidence of a decline of the magnitude reported several years ago (about 45% per year), at least within the study area.

The most important finding of the 2025 research (visual and acoustic) was the significant use by vaquitas of the currently unprotected area northwest of the ZTA+EA but within the Vaquita Refuge. While more vaquitas were seen and heard in this area this year, vaquita have been visually detected there in recent years (Fig. 21). The area northwest of the ZTA needs both protection through blocks with hooks but also enforcement of the laws preventing gillnetting within the Vaquita Refuge.

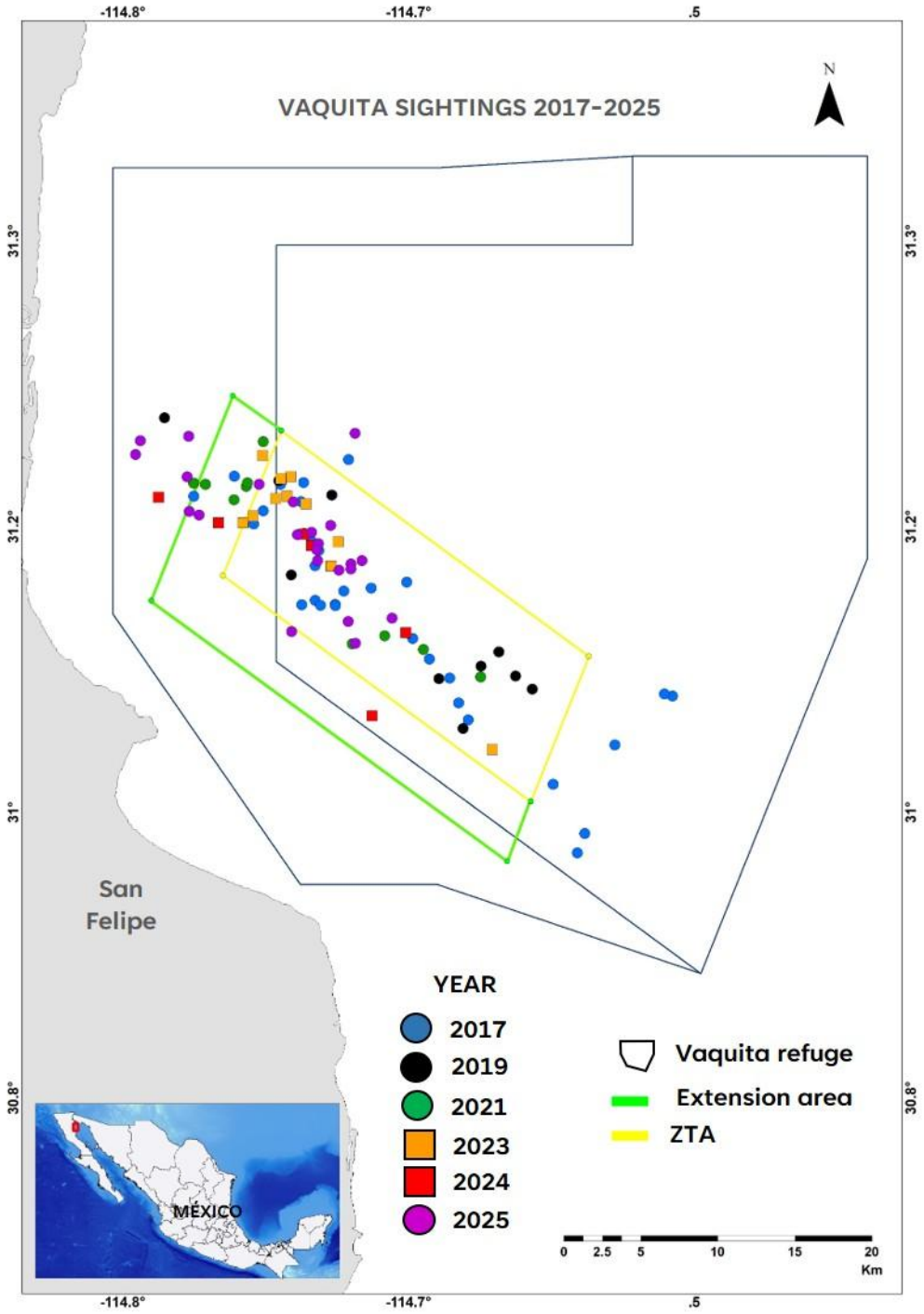

Figure 21. Sighting locations from 2017 through 2025 with circles for fall surveys and squares for spring surveys. Although the area northwest of the EA has been relatively lightly sampled, there have been sightings in fall 2019, and fall 2025. Fall 2025 received more visual effort because of numerous acoustic detections in this area. There was no acoustic effort in this area in other years shown here.

Poor weather in 2025 prevented sufficient photographic coverage to determine whether identified individuals that have been "missing" since 2019 have moved or died. However, it is encouraging that one photo-identified individual with a distinctive bent dorsal fin (Frida) was seen in 2023, 2024 and 2025. She had a calf in 2023 and another calf in 2025 and was seen repeatedly with the same non-calf individual in 2024. Drone footage of those vaquitas and 3 other adults videoed in 2025 appeared healthy. No vaquitas showing ribs or skin lesions that would indicate poor condition were observed in 2025, and this is consistent with all previous visual surveys.

The training program provided a valuable opportunity for community members, many from fishing families, to learn first-hand about the biodiversity in their local waters and, for some, to see vaquitas. The trainees gained experience on the handheld binoculars and exposure to the acoustic and drone projects. The number of program participants, and the proportion who returned for a second or third year, is encouraging. Five of the 17 trainees from last year are now working in the field: two are working for the Biosphere Reserve, two are working at Pesca ABC, and another is the leader of the community training group. One of the 2025 trainees, who also participated in 2024, stands out for their high level of interest, proficiency, and professionalism and will be invited for advanced training. Continued investment in the program, coupled with more training from experienced observers, and more time on the water, can go far in creating a dedicated team of vaquita and ecosystem monitors. Local monitors are a way to continue vaquita observations in non-survey times, and of building community knowledge and enthusiasm for saving the vaquita and preserving the health of the local marine ecosystem. It is encouraging that plans to strengthen the training program in 2026 are underway with coordination, funding, equipment, and support from CONANP, the Biosphere Reserve, Pronatura Noroeste, Colossal Foundation, Marisla Foundation, Intercultural Center for the Study of Deserts and Oceans (CEDO) and Telcel. It is our hope that this valuable program can be supported into the future with committed government funding.

The greatest improvement in both vaquita conservation and our ability to survey for these porpoises was the large decrease in fishing activity compared to surveys prior to the deployment of blocks in the ZTA and EA in 2022 and 2023, respectively. SSCS data indicate a greater than 90% decline in pangas within the ZTA over the full fishing seasons of 2023, 2024 and 2025, from September through June. This is likely due to the installation of concrete blocks with hooks that entangle gillnets, plus the cooperative arrangement between SSCS and the Navy to enforce the gillnet ban within the ZTA. In 2025 the Government of Mexico set the date for opening of shrimp season after the September survey period to ensure the vaquita survey could be carried out without disruption. The survey was unimpeded and no shrimp gillnetting was observed throughout the study area, a stark contrast to earlier years in the fall shrimp season. Furthermore, only two acoustic detectors were lost during the study period, which was minimal in comparison to previous years.

Depth data obtained in the 2025 research confirm that the ridges the vaquitas seemed to prefer within the Vaquita Refuge are a major topographical feature within the species' range. Sightings, however, were all within the ZTA, EA and the area northwest of those areas. The depth and backscatter data will be analyzed together with both acoustic detections and sightings in the near future.

Results from 2025 are encouraging compared to 2024. Despite much poorer weather, and therefore worse sighting conditions, more sightings were made and more calves were observed even though 7-8-month-old calves are difficult to identify. The ability to obtain drone footage greatly increases our ability not only to observe calves but also to assess whether both they and their mothers are in good condition. Drone footage also confirms survival of juveniles with an approximately 18 month-old measured in 2024, and one or two juveniles measured in 2025. These measurements confirm both reproduction and good survival of young vaquitas. Continued reproduction and healthy-looking juveniles and adults confirms prior evidence that vaquitas are not being limited by the environmental carrying capacity, have sufficient food, and show no signs of genetic problems. In other words, there is no reason to believe that vaquitas would not recover if deaths in gillnets were eliminated.

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