Veterinary capacity building to fill vital knowledge gaps for the endangered Indus River dolphins (Platanista minor) rescued from irrigation canals.

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EXECUTIVE SUMMARY

The Indus River dolphin (*Platanista minor*) is an endangered cetacean species listed on the IUCN Red List, with an estimated population of only about 2,000 individuals fragmented into six populations due to gated water infrastructure - barrages and habitat loss. These dolphins face severe threats from water extraction, entrapment, bycatch in fishing gear, and pollution. For over 20 years, dolphins have been trapped annually in irrigation canals, often resulting in death unless rescued. Existing rescue operations lacked veterinary personnel with aquatic mammal expertise who could leverage these opportunities to gather crucial species-specific data during ongoing rescues and translocations. Despite devastating flooding in 2022 that left one-third of Pakistan underwater and a resultant humanitarian crisis, we successfully met our objectives through 1) two in-country project efforts, one for project inception and stakeholder engagement and one for attendance at the 2023 rescue efforts in Sukkur, where we provided scientific and veterinary review and support and disseminated a veterinary kit for use during

future rescue efforts; 2) rescue, health assessment, and necropsy training of local personnel, to include the identification and training of a Pakistani veterinary lead, Dr. Ziaullah Mughal, and a formal agreement with the University of Veterinary and Animal Sciences in Lahore, Pakistan which aims to promote research and training in aquatic mammal medicine to increase the availability of trained experts for future rescue and translocation events; and 3) community outreach efforts to increase awareness surrounding the conservation of the Indus River dolphin through the support of ongoing community-based efforts, scientific and public presentations, a formal press release, social media posts, and traditional media. Our project culminated with the execution of The International River Dolphin Veterinary Health Assessment Workshop held in Valencia, Spain, and the Canary Islands in December 2023. Here, experts from NMMF, Oceanogràfic Valencia, and the University of Las Palmas de Gran Canaria trained participants from Pakistan, Cambodia, Brazil, and Colombia through lectures, discussion, and hands-on training in rescue, translocation, live animal health assessments, and necropsy. This final workshop brought together river dolphin veterinarians from multiple countries, serving as a unifier and catalyst for broader veterinary collaboration, culminating in establishing a dedicated international river dolphin veterinary working group. In light of Brazil's recent unusual mortality event, where over 300 river dolphins died from excessive heat and drought secondary to climate change, this collaborative initiative strengthens international veterinary capacity for river dolphin conservation at a critical time. Our veterinary working group is now formally integrated into SARDI (South American River Dolphin Initiative), and while we achieved our objectives and have made significant progress as part of this grant, future work remains essential. This initiative begins a comprehensive and sustained effort to enhance conservation actions for the Indus River dolphin through veterinary data gap-filling and support. Continued collaboration, targeted training and employment, and ongoing data collection and research are vital to understanding the health and the impact of anthropogenic stressors on this species. These efforts will aid our response to future crises, such as those in South America, and inform future mitigation and conservation strategies to ensure the long-term survival of this endangered species. The success has also motivated other river dolphin countries in Asia to realize the need to build veterinary capacity. We are grateful for generous support from the Society for Marine Mammalogy Conservation Fund, the Lever for Change Swift Grant, Dolphin Quest, Scott & Jessica McClintock Foundation, WWF Pakistan, and the NMMF Operace GRACE Conservation Medicine program for making this project possible. Oceanogràfic Valencia, the University of Las Palmas de Gran Canaria in the Canary Islands, YAQU PACHA e.V., Organization for the Conservation of Latin American Aquatic Mammals, and Nuremberg Zoo provided additional financial and logistical support for the veterinary training workshop.

BACKGROUND

The Indus River dolphin (*Platanista minor*) is a newly recognized cetacean species endemic to the Indus River system in Pakistan and India (Braulik et al., 2021). ***This freshwater dolphin is classified as Endangered on the IUCN Red List***. Following the construction of numerous dams and irrigation barrages and large-scale diversion of water for agriculture, the species has undergone an 80% reduction in distributional range and now survives in five habitat fragments in a short section of the river, only around 700km in length (Braulik et al., 2014). This endangered freshwater cetacean is thought to currently number approximately 2000 individuals, with the single largest subpopulation numbering approximately 1150 animals (Aisha and Khan, 2021).

Multiple threats to their continued existence remain, including decreasing water flow, bycatch in fishing gear, canal entrapment, pollution, and construction of dams (Braulik et al., 2015). ***The entrapment of Indus dolphins in irrigation canals is designated as one of the high-priority threats*** to this species, requiring urgent attention (Braulik et al., 2015). Between 1992 and January 2021, 194 dolphins were

reported as trapped in canals, approaching 20% of the local subpopulation. While rescue operations often occur, they are typically conducted by trained local fishers, and without the support of biologists, veterinarians, or scientifically trained personnel. Scientific data collection and systematic veterinary monitoring and assessment hasn't been feasible, resulting in occasional animal deaths and missed opportunities to acquire knowledge or learn more in order to help conserve this poorly known species. Many critical knowledge gaps exist for Indus River dolphins, with little known about their basic biology, diet, movements, or the influences on their decline. As such, the best conservation approach for the Indus dolphin remains uncertain.

In 2020, following a workshop in Nuremberg, Germany, the Integrated Conservation Planning for Cetaceans (ICPC) initiative under the Cetacean Specialist Group sounded the alarm for a broader, more integrated approach to the conservation of at-risk small cetaceans (Taylor et al., 2020). The extinction of the Yangtze River dolphin (*Lipotes vexillifer*) in China and the catastrophic decline of the vaquita porpoise (*Phocoena sinus*) in Mexico were noted as examples of why waiting too long to consider all conservation options and fill critical knowledge gaps should be avoided. ***Indus River dolphins were highlighted as one of the seven species of small cetaceans of most significant concern, with an urgent recommendation to build capacity in veterinary health assessments during annual rescue operations.*** Similarly, the South Asian River Dolphin Task Team meeting of the International Whaling Commission highlighted that conservation translocation and rescue of canal-stranded dolphins were important priorities for Pakistan and that there was a need to strengthen data collection on dolphin health, genetics, and eco-toxicological studies (IWC 2020).

On-site training was recommended to commence as soon as possible, potentially during the 2020 rescue season. Due to the COVID-19 global pandemic, difficulty of travel, and lack of sufficient funding, training efforts in Pakistan and veterinary support for the rescues had not occurred. There remained an urgent need for veterinary and scientific personnel to participate in the annual dolphin rescues, as well as for a specialized training and mentorship program to improve canal entrapment emergency response. These efforts would also create opportunities to gather vital information on health and other important parameters for the continued survival of this endangered species.

Through generous support from the ***Society of Marine Mammalogy Conservation Fund*** and other outside funding sources outlined in the financial report, our collaborative project team, including the National Marine Mammal Foundation (NMMF), World Wildlife Fund Pakistan (WWF), Sindh Wildlife Department (SWD), and the University of St. Andrews (USt.A), set forth to advance these initiatives. Despite multiple challenges, including widespread local flooding in the study region and security concerns for project partners from the United States, we successfully executed most of our project goals as outlined in the report below. ***Although we achieved significant progress toward expanding veterinary capabilities and infrastructure, additional work is needed to sustain these critical initiatives.***

AIM AND OBJECTIVES

Our project aimed to assist ongoing Indus River dolphin rescue operations by supporting, employing, and training in-country specialists to build veterinary capacity for health assessments and critical data gap filling, with the potential to serve as a model for other at-risk small cetaceans. In addition to veterinary support, the project took a comprehensive approach and provided funding for WWF Pakistan personnel to engage in additional scientific efforts and community engagement. These additional scientific efforts provided insights into the health of the Indus River dolphin, while community engagement initiatives fostered stewardship and awareness among residents and further data collection.

Together, these efforts aimed to create a sustainable veterinary framework for helping to protect and recover the Indus River dolphin population. We identified the following three primary objectives:

Objective 1. Provide veterinary and scientific support for Sukkur, Pakistan's 2022 and 2023 rescue seasons.

Objective 2. Provide local rescue and health assessment capacity building through the employment and mentorship of Pakistani veterinary first responders.

Objective 3. Launch an international outreach effort to increase awareness of Indus River dolphins using social media and traditional media outlets.

APPROACH

This pilot project was the first time aquatic mammal veterinary experts from NMMF attended the Indus River dolphin rescue efforts. For that reason, NMMF's participation needed to be complementary to the efforts that have been ongoing for the last 20 years. The NMMF was committed to building relationships before and throughout the project to learn as much as possible from the partner organizations and community members and build long-lasting relationships of respect and trust between the international team.

KEY PERSONNEL

This project was a truly collaborative effort involving multiple partners. Due to her significant contributions and lead role within the project, Hamera Aisha, Senior Manager of Wildlife Conservation, WWF, Pakistan, was added as a Co-Investigator after the project's commencement. Additional personnel and organizations joined as the project progressed, including key SWD personnel, Imran Malik and the entire WWF Pakistan field team, community fishers involved in the Sukkur rescues, Dr. Ziaullah Mughal (UVAS), Dr. Ashley Barratclough (NMMF), Dr. Daniel Garcia, Dr. Carlos Rojo and the entire Oceanogràfic Valencia veterinary team, the scientific team at the University of Las Palmas de Gran Canaria in the Canary Islands, Megan Dalo (NMMF), Brenda Bauer (NMMF), and Kristina Martz (NMMF). The project team acknowledges that this initiative would not have been possible without their help.

RESULTS

Project Inception: Initial project planning occurred remotely due to the international nature of the working group. The team held regular project meetings leading up to and following the in-person meetings in Pakistan in 2022 and 2023 and throughout the project's duration. Our initial inception phase helped develop stakeholder and project team relationships, ensuring effective execution. We faced initial delays due to stakeholder engagement needs, security concerns, and devastating flooding that left one-third of Pakistan underwater in the late summer and fall of 2022. Despite these obstacles, we successfully met our primary objectives, though the first in-person meeting did not occur until fall 2022. As a result, the 2022 rescue season was not part of our coordinated efforts; however, the following project activities occurred during our first meeting in November of 2022.

1. **Project Planning Meeting at WWF-Pakistan's Head Office (Nov 2022)**
   During the inception phase, a series of meetings took place in Lahore, Pakistan, bringing

together veterinary expert Dr. Forrest Gomez from NMMF, Indus dolphin species expert Dr. Gill Braulik from USt.A, and the senior team of WWF-Pakistan (Figure 1). Attendees included the Director General of WWF-Pakistan, the Asian Region Lead on River Dolphins for the WWF Network, the Senior Director, and the WWF-Pakistan Indus River Dolphin lead, as well as the field team dedicated to Indus River dolphin conservation. The primary objective of these meetings was to review the project's scope, outline the goals, and identify potential partners and stakeholders who could contribute to its success. These meetings served as a crucial platform for knowledge sharing and collaboration, allowing team members to align their visions and ensure clarity on the project's purpose and desired outcomes.

Figure 1: Project team members at the WWF Pakistan Office in Lahore, Pakistan, during the project inception phase (Nov 2022).

2. **Meeting with the Sindh Wildlife Department (Nov 2022)**
   A visit to Karachi, Pakistan, was conducted for an introductory meeting with the Sindh Wildlife Department to finalize the project implementation plan for the January 2023 rescue season. During the initial phase, Dr. Forrest Gomez, Dr. Gill Braulik, the WWF-Pakistan Indus River Dolphin team, and senior WWF-Pakistan staff organized this meeting with the Conservator of the SWD. The meeting ensured that the SWD, a crucial partner in the project, fully understood and was engaged in the project's scope. During the meeting, we identified potential veterinarians from the Sukkur region for training to conduct health assessments on the Indus River dolphin during ongoing rescue operations. A significant outcome of this meeting was SWD's interest in

hiring a veterinarian—a first for the department, recognizing the value of veterinary expertise in enhancing wildlife welfare.

Figure 2: Project team members and SWD Conservator at the SWD headquarters in Karachi, Pakistan (Nov 2022).

3. **Meeting with the University of Veterinary and Animal Sciences (Nov 2022)**
   The team also conducted a detailed meeting with the University of Veterinary and Animal Sciences Vice Chancellor in Lahore. We discussed the project's scope and explored potential collaboration areas. The project team presented information about the project's goals, activities, and expected outcomes, emphasizing the importance of veterinary training in cetacean health assessments and translocation efforts. Dr. Ziaullah Mughal, a UVAS faculty veterinarian with wildlife experience, facilitated this meeting.

Following this initial trip, the project team continued to prepare remotely for the team's attendance at the 2023 rescue season in Sukkur, Pakistan. The following outlines the results of this field effort and other project outcomes, organized by the three priority objectives.

Objective 1. Provide <u>veterinary and scientific support</u> for Sukkur, Pakistan's 2022 and 2023 rescue seasons. Although the entire project team could not attend the 2022 rescue season, notable accomplishments from the 2023 rescue season are listed below.

*1.1: Conduct a thorough **review of the current approach**, equipment, and techniques used during Indus River dolphin rescues to identify veterinary requirements and strategies that will allow for improved animal rescue and survival, as well as the acquisition of critical biological and health data.*

- **Rescue Technique Review:** SWD leads ongoing rescue efforts with support from WWF-Pakistan. The project team reviewed current rescue operations through in-person meetings, focusing on identifying areas to enhance animal handling, monitoring, and data collection protocols. The team engaged local fishers, SWD staff, WWF Pakistan representatives, and veterinarians in practical, hands-on sessions using a dolphin model to review acquisition, transport, and monitoring methods. Productive discussions with local stakeholders gave the team valuable

insights into long-standing rescue techniques for other small cetacean species, with the goal of applying them to Indus River dolphins. Following these exchanges, training sessions led by WWF and NMMF provided actionable recommendations to optimize animal welfare and scientific data collection.

*1.2: Provide **veterinary support to the Indus dolphin rescue** effort.* In 2023, Dr. Forrest Gomez, a dolphin health assessment specialist, traveled to Sukkur to offer direct support for the rescue efforts. Although a lack of strandings during her visit limited the application of hands-on live animal veterinary care and training, the team adapted by engaging in collaborative in-person meetings, discussions, and training between NMMF, WWF, SWD, and the local community fishers. This approach fostered strong working relationships among team members and allowed for didactic training on multiple topics and hands-on necropsy training.

- **Veterinary Training Support:** With no live strandings observed, the team shifted to community engagement, protocol review, and hands-on training for local veterinarians, community members, and SWD staff (see Objective 2 for detailed training activities).
- **Establishment of a Veterinary Response Kit:** Drs. Gomez and Ziaullah Mughal conducted an inventory of veterinary supplies and identified additional needs for effective data collection during future rescue operations. A veterinary kit was assembled and placed in Sukkur and included a portable heart monitor, stethoscope, sample collection supplies (blood, fecal, respiratory), morphometric tools, and a lactate meter, along with standardized data forms and essential consumables for continuity in future rescue seasons. Dr. Mughal offered himself as a reliable resource for future supply acquisition.

*1.3 **Standardize data collection processes** for the Indus River dolphin rescues.* Collecting species-specific health and behavioral data, including morphometrics, genetic samples, and eco-toxicological assessments, remains essential. The team worked to establish systematic data collection, storage, and analysis protocols.

- **Live Animal Data Collection Protocols:** During the team's time in Sukkur, they reviewed existing data collection forms created by WWF Pakistan and used to document dolphin rescues and mortality events over two decades. These standardized forms successfully capture critical data. Building on these forms, the project team adapted protocols from NMMF health assessments for live animal monitoring and data collection to enhance animal welfare and scientific data quality.
- **Necropsy Data Collection Protocols:** Current necropsy protocols, jointly developed by WWF Pakistan and SWD, were assessed to identify areas for data enhancement. The team added procedural details to support future necropsy examinations, providing more comprehensive data for determining population health trends and mortality causes. Although not part of the original project plan, this adaptation aligned with project goals by offering valuable insights from more readily available dolphin carcasses.
- **Sample Analysis and Storage Plans:** Discussions regarding sample storage and analysis continued with plans for storing future samples at SWD, WWF, or UVAS and performing basic processing at Dr. Mughal's veterinary clinic, UVAS, or at SWD with equipment procured through Dr. Mughal. If specialized testing and analysis are deemed necessary at any point in time, the team identified the need to discuss the proper handling and storage of such rare samples, utilizing UVAS and NMMF as resources.

*1.4: Identify **future rescue and health assessment needs** to support long-term rescue operations and conservation translocation efforts.* Since there were no live animal rescues during the team's time in Sukkur, this aim focused on realizing the need for additional hands-on veterinary training to accomplish our project goals and a more formal collaboration within Pakistan to develop a much-needed network of trained wildlife veterinary professionals. See Objective 2 for details.

Objective 2. Provide Local Rescue and Health Assessment Capacity Building through the Employment and Mentorship of Pakistani Veterinary First Responders. The team achieved this objective through collaboration with our local partner, WWF Pakistan, and their experienced team of scientists, conservationists, and community liaison officers, as well as the regional wildlife department and fishing community. Training, skills building, and local empowerment were the foundation of this objective, which focused on improving the skills and knowledge of local personnel involved in dolphin rescue and translocation. The workshops and collaborative partnerships established under Objective 2 reflected a comprehensive approach to in-country skills building.

*2.1 **Identify, employ, and train a Pakistani veterinarian** for ongoing support of the Indus dolphin rescue program.* While wildlife veterinary science is an emerging field in Pakistan, no aquatic mammal medicine experts were available in the areas where dolphin rescues occurred. Recognizing the need for consistent veterinary support, the project aimed to train and employ a Pakistani veterinarian to participate during rescue seasons and build local expertise.

- **Engagement of a Full-Time Veterinarian in Sukkur, Pakistan**
  Initially, the project planned to hire a full-time veterinarian for health checks and participation in rescue events. However, given that rescues are seasonal and require quick responses, employing a full-time veterinarian for the project was deemed impractical. Instead, SWD agreed to hire a full-time veterinarian at the Sukkur site, ensuring more sustainable support. Additionally, Dr. Ziaullah Mughal, an experienced wildlife veterinarian and faculty member at UVAS, was identified as the appropriate lead veterinary expert for the Indus dolphin project (Figure 3). Although not based in Sukkur, Dr. Mughal's expertise, prior collaboration with WWF, and academic appointment positioned him as the ideal person to receive advanced training. Now, he can assist during the rescue season, mentor emerging Pakistani veterinarians interested in wildlife, and assist in training additional rescue personnel.

Figure 3: Dr. Ziaullah Mughal, an experienced wildlife veterinarian and faculty member at UVAS, was identified as the appropriate lead veterinary expert for the Indus dolphin project.

- **Development of an in-country veterinary capacity-building plan.** To pivot from the initial desire to hire a veterinarian, the project team developed an in-country training plan to further build Pakistan's Indus dolphin veterinary work capacity.
    - Veterinary personnel gap analysis: The team held a series of meetings involving the senior team and field team members of SWD, UVAS, and WWF to assess the existing gaps in capacity and the associated challenges. These consultations aimed to evaluate the current state of wildlife healthcare management in the country, mainly focusing on the capacity to conduct veterinary care for cetaceans, specifically the Indus River Dolphin. During the consultations, discussions were also held with representatives from UVAS and the WWF team to gain insights into the current capabilities and limitations in managing the health and welfare of wildlife, with a specific emphasis on the Indus River Dolphin. The assessment conducted during these meetings helped the team understand the extent of the existing capacity gaps. It facilitated the development of more tailored plans and strategies for enhancing the welfare and health assessment of rescued Indus River dolphins.
    - Training needs assessment: Furthermore, the consultations conducted as part of the Training Needs Assessment (TNA) process assisted in identifying the immediate, medium, and long-term targets that could aid in strengthening the in-country capacity of selected veterinary institutes in Pakistan. These meetings helped identify the areas where capacity building is required, and the consultations paved the way for targeted interventions and initiatives to enhance the expertise and resources available for wildlife health management, specifically focusing on the needs of the Indus River dolphin population.
- **Memorandum of Understanding (MoU) with University of Veterinary & Animal Sciences - Lahore.** WWF-Pakistan signed an MoU with UVAS for five years effective from December 15, 2023. UVAS is a prestigious institution known for its research in veterinary, animal, and zoological sciences, as well as allied fields. With its strong reputation and dedicated focus, UVAS plays a significant role in advancing research, education, and expertise in the country's veterinary and animal sciences and wildlife conservation.
    - Objective: The purpose of the MoU is to combine expertise and resources to advance research, knowledge, and conservation efforts, focusing on wildlife welfare and the preservation of species, especially the Indus River Dolphin. The MoU aims to foster collaboration in creating training programs and guidelines geared towards strengthening the capacity of local wildlife departments. These programs will focus on wildlife rescue, handling, translocation, rehabilitation, and reintroduction, with the overarching goal of addressing the country's wildlife welfare and conservation concerns.
    - Scope: The scope of the collaboration includes enhancing knowledge related to health assessments, necropsies, and sample collection of dead wildlife specimens, with a particular emphasis on the Indus River dolphin in Pakistan. It also aims to promote international collaboration to strengthen in-country capacity for the health assessment and welfare of the Indus River dolphin and other species. The collaborators will achieve this goal by partnering with international organizations, experts, and institutions to facilitate knowledge exchange, best practice sharing, and technical support, ultimately enhancing conservation efforts.
    - Designated Veterinary Wildlife Expert: UVAS's identified expert, Dr. Mughal, now coordinates with WWF-Pakistan and, as part of this project, received advanced training from NMMF experts during the 2023 rescue season and at two workshops as described

below (in Spain and Japan), receiving training in handling species of special concern, including the Indus River dolphin. This trained expert will now support dolphin rescues for health assessments based on established protocols on an as needed basis. With his assistance, WWF will continue to provide training for focal persons in cetacean and other species rescues and health assessments, contributing technical expertise and knowledge base on wildlife health assessments in Pakistan, specifically focusing on the Indus River dolphin.

- Development of Training Programs: The collaboration will also lead the development of training programs dedicated to the conservation and welfare of species, targeting UVAS, WWF-Pakistan, provincial wildlife departments, and other relevant stakeholders. Jointly organized knowledge exchange programs, awareness-raising sessions, lectures, and training workshops will share expertise and best practices between WWF-Pakistan and UVAS, calling upon outside experts for guest lectures and training opportunities when possible.

2.2 ***Train first responders in handling and transporting Indus River dolphins****.* The team held veterinary and animal handling training workshops for all local participants in Sukkur during the 2023 rescue season. Since hands-on training could not occur during live animal rescues, additional live and dead animal trainings were conducted in Sukkur, Pakistan; Valencia, Spain; the Canary Islands; and Okinawa, Japan.

- **Indus River dolphin rescue and health assessment training:** A comprehensive training program provided essential knowledge and skills to approximately 30 field staff members of SWD, as well as local fishers, focusing on critical aspects of the Indus River dolphin rescue and safe release practices (Figure 4). A team of experienced trainers representing various organizations, including NMMF, SWD, UVAS, and WWF-Pakistan conducted the training and was held during the rescue season of 2023. The training program aimed to reinforce and update the participants' knowledge regarding the Indus River dolphin, a critically endangered species inhabiting the region. It covered many topics, including the dolphin's ecology, behavior, habitat requirements, and conservation challenges. The trainers shared their expertise and insights, providing in-depth information on the species' biology, population dynamics, and the significance of protecting its natural habitat. The training program focused on safe release techniques for dolphins accidentally entangled in fishing nets or otherwise requiring assistance. The participants were educated on the proper procedures for rescuing stranded or injured dolphins, ensuring their well-being during the release process. The training emphasized minimizing stress and harm to the dolphins. In addition to the core aspects of dolphin rescue and release, the training program also addressed the critical issue of human safety. The training provided the participants with guidance on how to carry out rescue operations without putting themselves at risk of physical harm or injuries. They learned the necessary precautions, such as using appropriate safety gear, understanding dolphin behavior cues, and effectively communicating and coordinating with team members during rescue missions.

Figure 4: Indus River Dolphin Rescue and health assessment training (Nov 20023).

- **Necropsy training for SWD, local veterinarians, and WWF-Pakistan team:** A training carrying essential techniques of conducting necropsies of the Indus River dolphin was arranged by the selected senior staff of the Sindh Wildlife Department, veterinarians and WWF-Pakistan staff members during January 2023 (Figure 5). The primary objective of the training was to enhance the capacities of the official staff and wildlife veterinarians in Indus River dolphin necropsies. Dr Forrest Gomez led the training from NMMF. Enhanced capacities of the official and wildlife veterinarians in this discipline would support gaining insight into the cause of mortalities and strandings. This training included a didactic lecture and two necropsies, with the specimens provided by SWD.

Figure 5: Necropsy training for SWD, local veterinarians, and WWF-Pakistan team.

- **International River Dolphin Veterinary Assessment Workshop at Oceanogràfic in Valencia, Spain, and Las Palmas University in the Canary Islands.** Imran Malik, Coordinator of the Indus River Dolphin Conservation Programme at WWF-Pakistan, attended a two-week training workshop on Dolphin Veterinary Care and Health Assessment organized by NMMF and Oceanogràfic Valencia in Valencia, Spain. Dr. Ziaullah Mughal and project team members also attended virtually, participating and providing lectures during the didactic portion of the workshop. ***The overall goal of the workshop was to enhance veterinary skills to advance the knowledge and conservation of the Indus River dolphin through hands-on and lecture-based training on dolphin health assessment and data acquisition techniques.*** During the first week (December 11-15, 2023), participants engaged in live animal training with bottlenose dolphins (*Tursiops truncatus*) at Oceanogràfic Aquarium in Valencia (Figure 6).

Figure 6: *Participants conducting an ultrasound on a live dolphin at Oceanogràfic Valencia, honing essential skills for river dolphin health assessments and conservation efforts worldwide. (December 2023)*

Lectures and discussions complemented this practical experience, led by NMMF instructors and attendees in the afternoons, and the second week (December 18-20, 2023) included hands-on necropsy experiences at Las Palmas University in the Canary Islands, where participants conducted necropsies on two rough-toothed dolphins and eight loggerhead turtles (Figure 7).

Figure 7: *Participants performing a necropsy at* Las Palmas University in the Canary Islands*. (Dec 2023)*

This workshop was specifically designed to train veterinarians and conservationists involved in Indus River dolphin rescues and translocations in Sukkur, Pakistan, while also addressing the needs of river dolphin personnel from other countries. Attendees included veterinarians and biologists working with the Irrawaddy dolphin (*Orcaella brevirostris*) in Cambodia and the Amazon River dolphin (*Inia geoffrensis*) in Colombia and Brazil. This collaborative setting provided a unique opportunity for professionals working with some of the world's most endangered aquatic mammals. The live animal training aimed to review the purpose of health assessments, emphasizing the importance of filling critical data gaps and discussing how health data can inform conservation efforts movinf forward. The training provided an overview of river dolphin anatomy and physiological adaptations and discussed the essential components of a dolphin physical exam, including morphometrics, body condition, and other key data points. Participants learned monitoring techniques for dolphins in and out of the water, including diagnostic parameters for signs of distress, preventative measures, and key mitigation strategies. Best practices for safe dolphin handling and transporting were reviewed, along with sampling techniques for blood, respiratory, oral, fecal, urinary, skin, and blubber samples. The training also covered basic diagnostic imaging techniques, such as ultrasound and pectoral radiography. Participants were instructed on handling and processing biological samples in the field, including short-term and long-term storage options. The workshop also reviewed diagnostic forms, data management, and data analysis options. Finally, attendees shared presentations on their respective in-country projects and discussed potential collaborative efforts and working groups. Dr. Uzma Khan, Asia Coordinator, River Dolphin Initiative, WWF-International, delivered a presentation covering Indus River dolphin strandings, rescues, and mortalities, work that spans over three decades in Pakistan. WWF team members from Cambodia also attended the workshop.

- **Training of UVAS Veterinarian at the 4th Asian Marine Mammal Stranding Network Workshop 2024 in Okinawa, Japan (Figure 8).** Dr. Mughal, a veterinarian and faculty member of UVAS (focal point of the MoU above), participated in the 4th Asian Marine Mammal Stranding Network Workshop held in Okinawa, Japan, in July 2024. The training focused on enhancing participants' skills and knowledge in marine mammal medicine and conservation. Key training events included veterinary treatment sessions, exposure visits to the Okinawa Churaumi Aquarium's dolphin, manatee, and sea turtle facilities, and a beach training exercise at Kamenohama Beach. The workshop also featured a necropsy skills training session using specimens of beaked whales. Participants conducted and observed the procedure, followed by a summary session. Additionally, the event included plenary talks and case studies covering various aspects of marine mammal stranding and conservation, providing a platform for knowledge exchange and collaboration among experts from different regions.

Figure 8: *Participants gather at the 4th Annual Marine Mammal Stranding Network Workshop, 2024, Okinawa, Japan.*

Objective 3. *Launch an international outreach effort to increase awareness of Indus dolphins using social media and traditional media outlets.* **Project partners leveraged existing community engagement platforms and programs** to amplify messaging around the endangered Indus River dolphin.

3.1 Develop a ***collaborative, international public outreach campaign****.* We leveraged partners' social media and traditional media platforms to circulate information on the species, threats, conservation efforts, research collaborations, project progress, and project results. Project partners circulated a press release upon completion of key project objectives to relevant international media outlets. In Pakistan, WWF incorporated the project into ongoing outreach efforts aimed at increasing Indus River dolphin public awareness via social media and publications.

- **Press Release**: A press release for the International River Dolphin Veterinary Workshop in Valencia, Spain, highlighted the training of international veterinary experts and ongoing conservation efforts for aquatic mammals in Pakistan, Cambodia, and South America.
- **Media Coverage:** The workshop in Valencia and NMMF's participation in the Southeastern Wildlife Expo (SEWE, see below) led to media opportunities that aired in Europe and the United States, further amplifying messaging around the Indus River dolphin.

*3.2 Develop **Indus River dolphin education and outreach materials***. Partner organizations incorporated he Indus River dolphin into educational content for in-classroom and virtual workshops and other public engagement events in Pakistan and the United States.

- **Community Stewardship and Youth Engagement in Indus River Dolphin Conservation (Figure 9).** The project integrates community stewardship as a fundamental aspect of fostering ownership for protecting the Indus River dolphin and other key biodiversity within the Indus River habitat. To cultivate a sense of ownership among youth and to effectively engage them in monitoring and protecting vital biodiversity, eco-clubs have been established in community schools in and around the Indus River Dolphin Game Reserve in Sindh as part of the ongoing Indus River dolphin conservation work of WWF-Pakistan. Key activities for student engagement include participation in citizen river ranger programs and collecting data on dolphin sightings.

Figure 9: Community Stewardship and Youth Engagement in Indus River Dolphin Conservation.

- **Celebration of environmentally important days.**
    - World Wetlands Day: World Wetlands Day was celebrated in Sukkur, with the primary objective of igniting a sense of urgency and commitment towards conserving and restoring wetlands within the region. The gatherings also aimed to foster lively discussions and collaboration among diverse stakeholders invested in the welfare of these critical ecosystems.
    - World Environment Day: Two events engaging representatives from the Sindh and Punjab Wildlife and Fisheries Departments, local fishers, and other partners were organized to mark World Environment Day in Sindh and Punjab in June 2023. The event aimed to highlight the ecological importance of the Indus River dolphin and the need for coordinated efforts for its protection and conservation.

- World River Dolphin Day**:** Two events were organized at the education and information centers in Sukkur and Taunsa in October 2022 to celebrate International Freshwater Dolphin Day. These events aimed to raise awareness about protecting Indus River dolphins and their significance to the local ecosystem. The focus was on interactive conversations between fishers and government wildlife department officials, river guards, and field staff involved in monitoring and rescuing stranded dolphins and fishing activities in the area. Representatives from provincial wildlife and fisheries departments, local fisher communities, students, and other partners participated in the events, which included an interactive session on Indus River dolphin conservation, followed by a walk that over 100 participants attended**.** The World River Dolphin Day 2023 was also celebrated at project sites in Sindh in October 2023, focusing on raising awareness about the importance of the Indus River dolphin and the threats they face. The events, attended by over 100 individuals, highlighted the collective commitment towards safeguarding these majestic creatures and their aquatic habitats. Such collaborative initiatives are pivotal in nurturing a sense of responsibility and stewardship among communities and government bodies.

- **Race for Operation GRACE (Global Rescue of At-Risk Cetaceans and Ecosystems), November - December 2023**. The NMMF launched Race for Operation GRACE, a virtual fundraising and awareness event from November 6 to December 31, 2023. Participants engaged in fitness activities like running, walking, and cycling to raise awareness of endangered aquatic mammals. Throughout the event, participants received informational e-postcards featuring updates on Operation GRACE and conservation efforts focused on endangered aquatic mammals, including the Indus River dolphin (Figure 10).

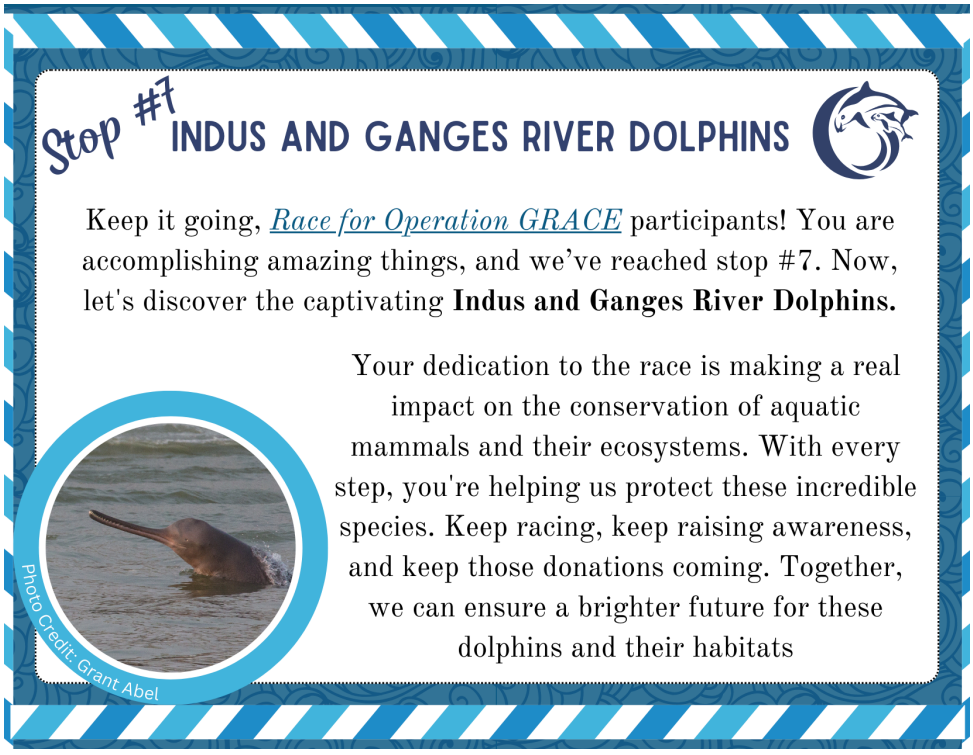

Figure 10: *Participants received informational e-postcards throughout the race highlighting the world's most endangered aquatic mammals, including the Indus Dolphin. These updates kept participants informed and engaged with specific conservation initiatives.*

- **Southeastern Wildlife Exposition (SEWE), Charleston, SC, February 2024.** SEWE brings together nature enthusiasts, conservationists, and artists to celebrate wildlife and the outdoors. As exhibitors for the second year, the NMMF leveraged the platform to highlight Operation GRACE and river dolphin conservation. NMMF hosted three interactive activities:
    - **Dolphin Doctor Workshops**: These workshops captivated approximately 3,400 guests with hands-on demonstrations of aquatic mammal medicine and conservation.
    - **Field Laboratory Experience**: Thousands of attendees explored Operation GRACE's work through exhibits like the interactive conservation map.
    - **Women in Conservation Panel**: Featuring NMMF's Dr. Gomez and board member Julie Scardina, the panel highlighted the challenges faced by women in conservation and showcased the importance of protecting river dolphins.
- **San Diego Padres "Porpoises in the Park" Event, September 2023**
  NMMF hosted an educational booth at the San Diego Padres Foundation's Community Kiosk, featuring quizzes for children and discussions about endangered aquatic mammals, including the Indus River dolphin.
- **Carruth Cellars - Corks for a Cause, March 2024**
  As the featured nonprofit, NMMF shared conservation stories with attendees, deepening local commitment to global aquatic mammal conservation.
- **Kendra Scott Events**
  NMMF partnered with Kendra Scott stores in San Diego, Charleston, and other locations for in-store events, raising awareness of Operation GRACE and endangered aquatic mammals.
- **Scientific and Public Presentations**: Project partners delivered presentations at key conferences, including SMM 2022, IAAAM 2022, and 2023, and other public venues such as the Rotary Club of Point Loma and the Del Mar Foundation's DMFTalks. These talks emphasized the importance of river dolphin conservation and the need for global collaboration.

KEY CHALLENGES

In 2022, Pakistan experienced significant floods, particularly in the project sites, which adversely impacted multiple aspects of the project, including the planned visit of the National Marine Mammal Foundation (NMMF) team to Pakistan. These floods hindered the team's ability to visit the field site as scheduled in November, causing delays in project activities.

Risk assessment, securing permits, and ensuring field security for the NMMF team at dolphin rescue sites in Sindh proved cumbersome and time-consuming. Careful evaluation of potential risks and implementation of appropriate measures were required to ensure the safety of the team and the successful execution of the mission, further impacting timelines.

The initial plan to hire a full-time veterinarian dedicated to dolphin rescue operations was deemed unfeasible. This was primarily due to the seasonal nature of dolphin rescues, which occur on short notice and require immediate emergency response. Additionally, engaging a full-time veterinarian in such unpredictable conditions proved impractical. However, SWD agreed to hire a full-time veterinarian stationed at the Sukkur site, which provided a more sustainable solution for continuous dolphin health checks and data collection. Given these adjustments, the project team shifted its focus to building in-country aquatic mammal medicine capabilities and investing in training programs and international collaborations to strengthen long-term veterinary support.

FUTURE WORK

The recent unusual mortality event in Brazil, where over 300 river dolphins died due to extreme heat and drought caused by climate change, underscores the urgent need for global collaboration in river dolphin conservation. This project's success has positioned the newly formed River Dolphin Veterinary Working Group—now formally integrated into the South American River Dolphin Initiative (SARDI)—to play a pivotal role in advancing veterinary capacity for aquatic mammal conservation at a critical time.

While the project achieved its primary objectives, future work remains essential to sustain and enhance these efforts. This initiative marks the beginning of a comprehensive and sustained conservation strategy for the Indus River dolphin, focusing on the following areas:

- **Collaboration and Training**: Continued engagement with local partners, universities, and NGOs to **strengthen in-country veterinary expertise** and first-responder capabilities.
- **Data Collection and Research**: Ongoing live animal health assessments, dead animal sampling, and environmental monitoring to better understand the **impact of anthropogenic stressors** on the species.
- **Crisis Preparedness**: Building on the lessons from the Brazil mortality event, develop and adapt **emergency response protocols** for deployment in future crises.
- **Global Collaboration**: Expanding the scope of the veterinary working group to **foster international cooperation** and share best practices across river dolphin conservation projects in Asia and South America.

These continued efforts are critical for closing data gaps and optimizing animal welfare during future rescues and translocations. The project has already inspired other river dolphin range countries in Asia to invest in veterinary capacity building, further extending the impact of this initiative.

PROJECT FUNDING

The success of this project was made possible through generous support from the following organizations:

- **Society for Marine Mammalogy Conservation Fund**
- **Lever for Change Swift Grant**
- **Dolphin Quest**
- **Scott & Jessica McClintock Foundation**
- **NMMF Operation GRACE Conservation Medicine Program**
- **WWF Pakistan**

Additional support for the veterinary training workshop was provided by:

- **Oceanogràfic Valencia**
- **University of Las Palmas de Gran Canaria in the Canary Islands**
- **YAQU PACHA e.V., Organization for the Conservation of Latin American Aquatic Mammals**
- **Nuremberg Zoo**
- **National Marine Mammal Foundation**

For additional details, please see the project financial report.

The first increment of funds received from the Society of Marine Mammolgy provided WWF-Pakistan with the money needed to execute field efforts to rescue Indus River dolphins from irrigation canals in January 2023, including rescue and necropsy procedure training and storage space for rescue supplies in Sukkur and Taunsa. The funds also helped provide participation in veterinary training workshops for Imran Malik and Dr. Ziaullah Mughal in Spain and the Canary Islands. As explained in the technical report, a full time veterinarian was not identified, so the funds identified for this salary were reallocated to Mr. Malik as the primary WWF reponder in Sukkur, Pakistan, and Dr. Mughal as the new lead veterinarian identified by WWF for the Indus River dolphin rescue program. NMMF provided the additional $12,500 of funds in advance of the second SMM award increment for travel and supplies needed for successful project execution.

Full Project Support

Society of Marine Mammalogy grant award	
World Wild Fund for Nature - Pakistan	$12,000
Travel to Pakistan for Dr. Gomez to attend project kickoff meeting & rescue effort	$5,770
Travel to Spain for Drs. Gomez & Smith to attend veterinary workshop	$3,881
Indus River dolphin veterinary response kit & field supplies	$1,201
General and Administrative costs	$2,148
SMM Total	$25,000
Lever for Change Swift grant award	
World Wild Fund for Nature - Pakistan	$9,978
Gill Braulik - travel to Pakistan	$3,000
Labor for Dr. Gomez during rescue effort	$9,874
General and administrative costs	$2,148
LFC Total	$25,000
NMMF's Operation GRACE (Board of Directors & Donor Support)	
Labor for Dr. Gomez to plan & attend the project kickoff meeting in Pakistan	$9,300
Additional labor for Dr. Gomez during 2023 rescue effort in Pakistan	$1,955
Labor for Dr. Gomez to plan and attend the veterinary workshop in Spain	$9,500

Labor for Dr. Smith to attend the veterinary workshop in Spain	$3,300
Labor for Dr. Barratclough to assist with workshop planning & coordination	$3,000
General and Administrative costs	$2,543
NMMF OG Total	$29,598
In-Kind Support	
Labor for Dr. Smith for providing veterinary & scientific expertise	$36,400
NMMF Community Engagement Team for Objective 3 tasking	$10,300
Dr. Gill Braulik, University of St. Andrews, for providing scientific expertise, project guidance, and team leadership	$10,000
In-Kind Total	$56,700
Full Project Cost	**$136,298**