



Clean Catch

Joint Action on Sensitive Species Bycatch

Scoping a Passive Acoustic Reflector trial with the Peruvian artisanal gillnet fishery: Report

March 2026



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1. Purpose of the scoping trip

In December 2025, staff from Clean Catch partner organisations (Arribada Initiative, Cefas, and Mindfully Wired) carried out a scoping visit and workshop with small-scale fishers and the NGO **Pro Delphinus** in Peru. **The aim was to scope a potential trial of a prototype Passive Acoustic Reflector (PAR) in a fishery experiencing significant bycatch of dolphins and porpoises.**

The objectives were to:

- Establish rapport between Pro Delphinus and Clean Catch, and between Clean Catch and Peruvian fishers.
- Understand the context of small-scale fisheries which Pro Delphinus works with.
- Showcase the PAR to Pro Delphinus and fishers.
- Create an initial design for a PAR trial in Peru.

Pro Delphinus facilitated visits to the fishing ports of San José and Santa Rosa near Chiclayo, and Pucusana near Lima. At these locations, the Clean Catch team spoke with fishers, and observed maintenance of vessels and unloading of catch; in San José, the team also spoke with a local association of fishermen’s wives. Separately, Clean Catch and Pro Delphinus held a workshop at the latter’s office in Lima to create the initial design for a PAR trial.

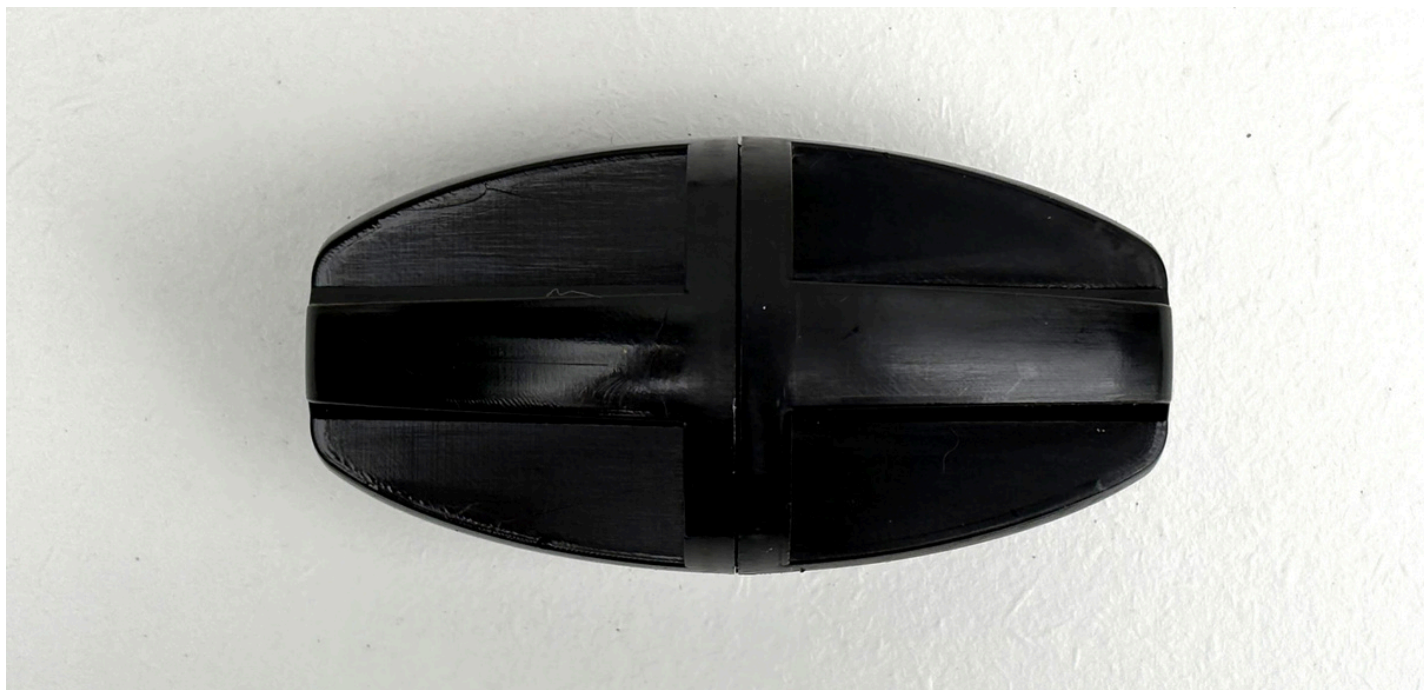


Image: Arribada Initiative’s prototype Passive Acoustic Reflector

Our Passive Acoustic Reflector (PAR)

PARs are made with materials designed to reflect the echolocations produced by dolphins and porpoises, and to therefore alert these animals to the presence of a net they might otherwise become entangled in. The approach is similar to that of “pingers”, a device already commonly used in fisheries around the world to avoid small cetacean bycatch, but the key differences are that PARs don’t need batteries or maintenance.

The Clean Catch PAR, development of which has been led by partner Arribada Initiative, has been designed to fit seamlessly into daily fishing operations by replacing floats used on the headlines of gillnets. So far it has undergone **robustness testing** in a UK fishery. However, because in UK waters the bycatch of porpoises and dolphins can be rare for individual fishermen, a UK trial to test the effectiveness of the PAR in reducing bycatch would likely need to last a much longer time to provide confidence in the results. Small cetacean bycatch happens more frequently in the Peruvian artisanal gillnet fishery, so a trial there could deliver results in a much shorter timespan.

2. Fisheries overview

Across Peru

Peruvian fisheries regulations define an artisanal (or small-scale) fishery as one comprising boats that are fewer than 15 metres in length, have a maximum of 32.6m³ of storage capacity, and are 'principally based on the use of manual work during fishing operations'.¹ The most recent estimate for the size of the Peruvian small-scale fisheries (SSF) fleet is 18,000 vessels, representing an increase of 185% between 1995 and 2015.² The total fishing effort of this fleet is substantial in terms of potential sustainability impacts; for example, according to a 2010 estimate, SSF gillnets in terms of kilometres of nets have a total fishing effort 14 times greater than that of Taiwanese squid driftnets before these were banned on the high seas.³

The national government tends to focus management efforts on species of highest export value. The Peruvian mahi-mahi fishery is currently in a Fisheries Improvement Project (FIP)⁴ and the fishery for Peruvian Humboldt squid (also known as giant squid or 'pota') entered the MSC Improvement Program in December 2025.⁵ Also of note is the recent announcement that from January 2026, the US market will cease imports from Peru of mahi-mahi and several other fish species caught with gillnets; this is to comply with the US' Marine Mammal Protection Act (MMPA) which restricts imports from fisheries deemed to have high bycatch risk for marine mammals.⁶

For the majority of commercial fish species, there are few or no restrictions in terms of minimum sizes, quotas, and seasons, while regulations that do exist can suffer from low enforcement. Stock assessments are carried out but are poorly resourced and reliant on fisher participation. Conversely, fishers in Peru have demonstrated significant political power; for example, when the mobulid fishery was banned, affected fishermen closed off highways in protest until the government backed down.

According to fishers and representatives we spoke to, outside of communities reliant on the fishing industry, fishing is "out of sight and out of mind" for the average Peruvian. There is also little interest in provenance and little demand for sustainability among companies (business-to-business and business-to-consumer) and the Peruvian public as a whole.



Fisher unloading catch at Pucusana

The port and fishing community of San José

The port of San José is located near Chiclayo, Peru's fourth largest city. It hosts vessels of a range of scales, although large purse seine vessels (15–20 large vessels of up to 32 gross registered tonnage, fishing further offshore) make up a smaller portion than the coastal SSF fleet. Vessels out of the port altogether catch a diversity of species, such as pota (giant squid), mahi-mahi, bonito, and various sharks and rays.

The industry provides employment for 80% of people in San José, and the San José fishing association includes 278 member vessels. Vessels are increasingly forced to go further offshore; over the last few decades, small-scale fishermen have seen catches decline 60–70% and many commercial species can no longer be caught. Even so, the fishers which the Clean Catch team spoke with all expressed pride in their way of life.



Image: Example of a Lancha (Credit: Pro Delphinus)



Image: Example of a Chalana

SSF métiers

SSF vessels are called either *chalanas* (nearshore boats) or *lanchas* (offshore boats). *Lanchas* can be up to 15m in length, while *chalanas* can be as short as 3m. All vessels use driftnets, with configuration and operation as follows:

- At least 25 panes per boat.
- Each pane is 150m in length and 15m in height; in the water, driftnets tend to be much wavier compared to standard illustrations which depict them forming long straight lines.
- Nets are set and hauled by hand, although an increasing number of vessels are adopting winches (this enables nets to be set in deeper water where catches can be greater).
- Nets are stored in a pile at the back of the boat.
- *Chalanas* trips last 1–2 days; nets are typically set at 5pm and collected early the next morning.
- *Lanchas* trips last 2 weeks or longer, often transferring catch to smaller vessels to bring onshore.

All vessels carry at least 2 different mesh types. Different mesh types and net depths are variously deployed as follows:

- By target species (e.g. 7–12 inch mesh for sharks).
- Flexibly depending on catch success; if a shallow net fails to catch anything, the net will be deployed deeper.
- In the winter season (June–September), mesh type will be switched and nets will be set near the seabed more often.

Clean Catch speaks with fishers at San José



Other infrastructure aspects

- Nets are no longer handmade and are instead bought premade.
- All vessels use VHF radio to communicate with each other, including to warn about aggregations of mobulids (see section 3.2).
- Some vessels used Starlink for a period (especially *lanchas*), but a price rise has made this unaffordable.
- Use of technology such as GPS and fish radar can give an 'edge' to fishermen who can afford it, and some fishermen will use online temperature maps to identify where target fish may be found.

Workforce and demographic aspects

- *Chalanas* crews are formed of at least 2 fishers, including the skipper-owner, although 3 is considered more ideal. *Lanchas* crews include 5 fishers. (By comparison, a fisherman from the neighbouring port of Santa Rosa reported that gillnetters used to have 5-10 crew members but now must limit this to 4 to remain economically viable.)
- Crews change over time with fishermen sometimes recruited to other fisheries and ports, particularly the Peruvian anchovy fishery; this can result in local crew shortages.

- Dynamics of fishing communities are changing, with many entering the fishing workforce from the Peruvian Andes and from Venezuela (which also accounts for much of the growth in SSF vessels). In the view of long-time fishermen in the port, these new entrants lack a culture of respect for the sea and its wildlife.
- Fishermen we spoke to said that some of their children do not want to continue the family tradition of being fishers.
- While there is – in the words of Pro Delphinus – a 'machismo culture' among Peruvian fishing communities, wives of fishermen are often able to have quiet influence and some are joint owners of vessels with their husbands (some women also own vessels singly). In ports such as San José, women's associations are helping to improve women's economic and social standing.



Clean Catch meets with the San José fishermen's association

The San José women's collective

Formed in 2019 with funding from the Global Environment Facility, followed by funding from Walton Foundation and support from Pro Delphinus, the San José women's collective currently comprises 35–40 members who are all fishermen's wives. 40% of them work in fish processing.

According to the women whom the Clean Catch team spoke to, the collective has empowered them by raising their profile in the community and increasing their knowledge about their role in conservation; in turn, this has allowed them to raise awareness of conservation issues in the wider community.

As funding from the Walton Foundation was due to end in December 2025, the collective is currently exploring ways to become financially sustainable.



Members of the Clean Catch and Pro Delphinus teams with the San José women's collective

Economic aspects

- Gear represents a considerable investment; per vessel, a driftnet pane costs 2,000–3,000 sol (S/) so that a full driftnet set-up costs up to 75,000 S/ or 22,000 USD.
- *Chalanas* must be hauled up on the beach. Private contractors run the tractors and charge 80 S/ each way. (A pier was recently built to service the port, but is too high to be safely used by SSF vessels.)
- Fuel costs are approximately 100 USD per month.
- Catches from San José are mainly for the domestic market – meaning that the MMPA may provide less of an incentive for change.
- The price of fish in general has been stagnant for many years and fishermen are vulnerable to exploitation from middlemen who can trap them in a cycle of debt.

The port and fishing community of Pucusana

The port of Pucusana is located in the southernmost district in Lima Province. While our visit here was briefer, we were able to view a variety of vessels at anchor and in the process of landing catch, including small-scale longliners and gillnetters. The gillnets seen during the visit use thicker rope than that typically used by fishermen whom Clean Catch work with in the southwest of England, which may require enlarging the holes in the PAR through which the rope is threaded.

Two indications of sustainability initiatives were seen during the visit: a poster outside the fish market and landing area providing information about the closed season for mahi-mahi; and a poster at a nearby seafood restaurant providing 'Red/Amber/Green' ratings for local species.



The port of Pucusana

3. Bycatch in the small-scale fisheries of San José

San José fishers experience bycatch of and/or depredation from a range of wildlife species, with often marked negative impact on their livelihoods. The fishermen we spoke to ranked the severity of impact by species as follows, with 1 being most severe:

1. Sea lions (high-impact, all year round)
2. Mobulids (high-impact but seasonal and more sporadic)
3. Whales (high-impact but winter season only)
4. Turtles
5. Dolphins, porpoises, and seabirds

3.1 Sea lions

In the words of one of the San José fishers, South American sea lions *Otaria flavescens* are 'a nightmare'. They are present all year round – although less present in summer – and consistently enter nets to take fish. They appear to particularly target flounders which are a high-value fish for fishers. Monofilament nets are often broken, while the sea lions can become entangled in multifilament ones. Fishermen are sometimes forced to spend longer at sea and catch more fish to make up for losses from sea lions.

Fishers have experimented with playing sounds of orcas to keep sea lions away, but the animals quickly habituate. No other mitigation measures have yet been tested, although illegal shooting sometimes occurs.

Conservation risk: South American sea lions and South American fur seals *Arctocephalus australis* are protected species under Peru law, with populations estimated at ca. 120,000 and 8,000 respectively.⁷ The species live in colonies along the Peru coastline, many of which are marine protected areas. Fishery interactions, including depredation and bycatch, are common in industrial and small-scale fisheries but information is absent on the scale of the interactions and potential population impacts.



3.2 Mobulids

San José fishers colloquially describe the mobulid rays they encounter as "mantas", although these are likely to be species of mobula ray (e.g. devil ray *Mobula mobular*) rather than oceanic manta ray *Mobula birostris*. These rays are primarily bycaught when large groups of them – in numbers of 100 or so – swim into nets and sink them with their weight, preventing fishers from being able to retrieve the nets. These lost nets can cost hundreds or even thousands of dollars to replace.

By way of mitigation, fishers patrol their nets during soak-time, to remove rays before the net can be sunk. They are not able to patrol nets at night. Fishers also warn others when large groups of rays are sighted, so that the area can be avoided or nets hauled back in.

Conservation risk: Five species of mobulids occur in Peru waters and Peru is among the top five nations globally for mobulid landings. They are primarily for direct human consumption in domestic markets. Peru has a National Action Plan for sharks, rays and related species, but management measures for mobulids are limited and information lacking on population impacts of fishery landings.



3.3 Whales

Fishers are primarily affected by migrating humpback whale *Megaptera novaeangliae*, less commonly fin whale *Balaenoptera physalus*, and rarely blue whale *Balaenoptera musculus*, during the winter season. The whales can be seen within nearshore waters. If a whale swims into a net they are able to break the net or sections of the net, and in some cases drag the entire net away with them, at great financial cost to fishers.

The only mitigation currently is to avoid certain areas or stop fishing at certain times. Whale pingers are available but have not yet been trialled with San José fishers. There is no whale disentanglement network in Peru, although the IWC has conducted training for this in the country.⁸

Conservation risk: 80% of whales found stranded along the Peru coast from 1995–2012 showed signs of fishery interactions.⁹ While multiple species of whales are found in Peru waters and interactions with fisheries are documented (particularly small-scale net fisheries), interactions with humpback whales from the increasing Southern Pacific Stock G are of greatest concern as they migrate north annually to breeding areas off northern Peru and southern Ecuador where they can be found between July and November. A trial of ‘whale pingers’ in northern Peru in 2022–2023 reported a 53% decline in humpback whale interactions when the pingers were used.¹⁰

3.4 Turtles

Sea turtles found in Peru’s waters included leatherback turtle *Dermochelys coriacea*, olive ridley turtle *Lepidochelys olivacea*, green turtle *Chelonia mydas*, loggerhead turtle *Caretta caretta*, and hawksbill turtle *Eretmochelys imbricata*. They are often found in the same areas as commercial fish species, increasing the likelihood of interactions with fishing gear (both gillnets and longlines).

Conservation risk: Critically Endangered Pacific leatherback turtles are the most at risk population impacted by fishery bycatch (primarily mortality in net fisheries) but bycatch of loggerhead turtles from the declining South Pacific stock and of hawksbill turtles (given ongoing trade in tortoiseshell) are also of continuing conservation concern.



3.5 Dolphins and porpoises

Bycatch of small cetaceans typically involves common dolphin *Delphinus delphis*, bottlenose dolphin *Tursiops truncatus*, and dusky dolphin *Aethalodelphis obscurus*. Burmeister porpoise *Phocoena spinipinnis* is more likely to occur closer to shore. As with turtles, dolphins and porpoises are often found in the same areas as fish schools. The small cetaceans can break monofilament nets. They can also become entangled in and sink multifilament nets, drowning in the process. Dolphins and porpoises are seen closer to shore in summer when anchovy are closer to shore. As with mobulid mitigation, some boats are able to patrol surface nets in the day and free dolphins before they drown. Aside from accidental capture, small cetaceans are still intentionally harpooned by some fishermen to use as bait in longline fisheries.¹¹

Conservation risk: The impact of bycatch on populations remains a conservation concern. The bycatch rates for small cetaceans in Peru appear to be falling, which could be due to population decline and/or range shift. However, population estimates are lacking for small cetaceans in Peru in general. An exception is Burmeister's porpoise, with a 2025 study of concurrent abundance and bycatch estimates in northern Peru finding that current bycatch rates are highly unsustainable.¹²



3.6 Seabirds

Seabird bycatch occurs across artisanal net and line fisheries. Commonly affected species include Peruvian pelican *Pelecanus thagus*, Peruvian booby *Sula variegata*, guanay cormorant *Leucocarbo bougainvillorum*, blue-footed booby *Sula nebouxii*, Humboldt penguin *Pheniscus humboldti*, waved albatross *Phoebastria irrorata*, and white-chinned petrel *Procellaria aequinoctialis*. There are also concerns around bycatch of pink-footed shearwater *Puffinus creatopus* and Peruvian diving-petrel *Pelecanoides garnotti*.

Conservation risk: Waved albatross, which primarily forages off the Peruvian coast, is critically endangered. The Peruvian diving-petrel is considered endangered, while the Humboldt penguin and pink-footed shearwater are both considered vulnerable.

Collaborative work on bycatch to date

Pro Delphinus has trialled the following measures:

- *Placing surface nets 1 metre deeper to reduce seabird bycatch.* Target shark catch declined dramatically, so the measure was deemed unsuccessful as this would be unacceptable to fishermen.
- *Glass and plastic bottle Passive Acoustic Reflectors (PAR).* Run with Per Berggren from Newcastle University. A paper is in review. The trial was unsuccessful, although additional trials in Brazil in bottomset gillnets showed a significant reduction in dolphin bycatch. A power analysis found that around 120 sets would be needed, without differentiating dolphins and porpoises.¹³
- *Pingers on driftnet vessels.* These were considered successful in two separate trials, with bycatch declining by ca. 40%¹⁴ and 83%¹⁵ respectively. Fishermen gave positive feedback.
- *Remote Electronic Monitoring (REM).* A 2018 trial found REM to be useful in identifying and quantifying bycatch of sea lion but not of turtles and cetaceans.¹⁶ The fishermen did not like the cameras as they felt watched.
- *Net lights.* These were considered successful – reducing turtle bycatch by 64%–74% without impacting target catch¹⁷ – but costly in terms of batteries. Solar powered net lights could be a viable alternative but are not yet commercially available.



4. Contexts of the UK and Peru small-scale fleets: Key similarities and differences

	UK	Peru
Government	Generally high government capacity and interest in fisheries management.	Low government capacity and interest in fisheries management, with exception of a few high-value species.
Regulatory environment	Generally stringent, with multiple statutory agencies regulating fishing activities and Arms-Length Bodies involved in licensing processes, meaning that applications to test mitigation measures can be complex and take a long time to complete before a trial can take place.	Open access, poorly regulated, and subject to minimal enforcement.
Fisher interest in bycatch mitigation	<p>Can vary between fisheries and individuals.</p> <p>Minimising the practical burdens of measures (e.g. time needed to install, replace batteries, etc.) can encourage participation.</p>	<p>Can vary between fisheries and individuals. Pro Delphinus has sometimes found it challenging to get fishers involved in trials.</p> <p>Minimising the practical burdens of measures (e.g. time needed to install, replace batteries, etc.) can encourage participation. Pro Delphinus notes that PARs are more appealing than pingers given they involve less cost and maintenance. Arribada Initiative notes that the manual setting and hauling of nets, and their storage, could enable the PARs to last longer.</p>

	UK	Peru
Fisher motivations and incentives to be involved	<p>Intrinsic concern among some fishermen for cetaceans and other bycatch species.</p> <p>Many fishermen feel a sense of pressure from public and NGO opinion, incentivising them to demonstrate sustainability efforts.</p> <p>Compensating fishermen for their time in trials can encourage those with pre-existing interest in participating.</p>	<p>Comparative less intrinsic concern expressed for bycatch species (among those fishers we spoke to), although fishers did express a sense of awe towards turtles and seeing large groups of mobulids.</p> <p>Fishers do not feel a sense of pressure from public and NGO opinion.</p> <p>As in the UK, compensating fishermen for their time in trials can encourage those with pre-existing interest in participating.</p> <p>Fishers enjoy trying out new technologies, particularly those which have a modern look/feel.</p> <p>It can be possible to “quietly influence” fishers via wives and women’s associations.</p>
Involvement of representative bodies	<p>Fishing associations can be willing to be involved in bycatch mitigation efforts.</p>	<p>Fishing associations can be willing to be involved in bycatch mitigation efforts in the experience of Pro Delphinus, although their capacity varies.</p>
Demographics and workforce	<p>Many skippers are career fishermen, male, and have an average age of 44¹⁸ (although actual ages are often higher among the small-scale fleet).</p> <p>Crew turnover is less of an issue for the UK small-scale fleet compared to large-scale vessels, although the former fleet is shrinking overall in England.¹⁹</p>	<p>Many skippers are career fishermen, male (although wives may be joint owners of vessels). The majority (66%) are aged between 18 and 60. There has been a significant influx of new entrants in recent years.</p> <p>Crew turnover can be high, with skippers sometimes struggling to find replacements.</p>

	UK	Peru
Bycatch Priorities	<p>Mitigating small cetacean bycatch is the highest priority for many fishermen.</p> <p>Small cetacean bycatch can be rare for individual fishermen, but often has significant negative impact when it does occur (in terms of psychological distress, physical risk, damage to gear, and loss of catch). This bycatch also comes with the risk of negative publicity.</p> <p>Seals are increasingly an issue for a large proportion of fishermen, although not consistently so.</p>	<p>Mitigating sea lion depredation is the highest priority for all fishermen.</p> <p>Small cetacean bycatch is generally more common to experience. Many fishers try to avoid it, although a subset profits from selling dolphins to longliners for bait. There is little to no risk of negative publicity. Mobulid bycatch is a higher priority than small cetacean bycatch.</p>



Fishing crew carrying out net maintenance on the beach at San José

5. PAR trial design

Broad tenets of the trial are as follows:

- **Co-design:** Fishers' input on the design and operation of the trial will be elicited from the outset and continually during the trial; with fishers debriefed following the trial's conclusion and analysis of results.
- **Capacity-building:** Participating fishermen will be trained to collect written data on small cetacean bycatch.
- **Equitability:** Fishermen and observers will be compensated for their involvement, and their contributions – as well as those of Pro Delphinus – acknowledged and celebrated.
- **Inclusion of women:** Members of the local women's association will be engaged during the recruitment process, and ideally during and after the trial as per participating fishers.
- **Scientific rigour:** Standard research protocols will apply, with observers included in the trial design to validate fisher self-reporting.

Based on exploratory discussions with Pro Delphinus, specifications for a PAR trial with Peruvian small-scale fishers are outlined below. Several “gold standard” features of a PAR trial are noted in **bold** where additional funding would enable these. This trial could be conducted with either the *chalanas* (smaller, more coastal SSF vessels) or the *lanchas* (larger, more offshore SSF vessels).



Image: Ben Tutt-Leppard (Arribada Initiative) inspects fishing gear on a Pucusana vessel



Lanchas vessels on the beach at San José

Stage 1: Set-up

Tasks

- Agree Memorandum of Understanding and data sharing agreement (Lead: Arribada/Clean Catch).
- Complete ethics procedure (Lead: Pro Delphinus).
- Develop agreement for fishers which covers confidentiality, data handling, and terms of payment. (Lead: Arribada/Clean Catch; Pro Delphinus to translate)
- Create concise communications plan and comms explaining the PAR (e.g. short video) to support outreach by Pro Delphinus (Lead: Arribada/Clean Catch).
- Recruit three vessels using surface driftnets, with two as the “treatment” vessels and one as the control (Lead: Pro Delphinus).
- Recruit observers (Lead: Pro Delphinus).

Needs and considerations

- Include commitments in the MoU and/or data sharing agreement to make the trial data open-source and to publish a paper on the trial in a peer-reviewed journal. **The “gold standard” would be to make the paper open-access.**
- Pro Delphinus would follow the ethics procedure of the Universidad Científica del Sur, without the need for a parallel ethics procedure to be completed by UK partners.
- Pro Delphinus would likely be the data owner.
- Pro Delphinus to also speak at the women’s association during the recruitment process.
- File format of the database to be Excel.
- Two treatment vessels are not essential but provide buffer in case one vessel is unable to begin or continue the trial.
- Determine level of compensation for fishers and observers.

Stage 2: Co-design and training

Tasks

- Determine with participating fishers:
 - Configuration of PARs on nets with participating fishers, e.g. where to position these, spacing of individual PARs, etc. (Lead: Pro Delphinus).
 - Types of data to be collected (Lead: Arribada/Clean Catch).
 - Whether the role of treatment and control vessels will be fixed or randomised over the trial (Lead: Pro Delphinus).
- Train fishers to collect basic written data on small cetacean bycatch (Lead: Pro Delphinus). **The “gold standard” would be for a member of staff from Arribada to attend the training workshop to support onboarding of the fishers, build rapport, and set a baseline for any future work.**
- Deliver PARs (Lead: Arribada/Clean Catch).

Needs and considerations

- Fully understand gear used by participating fishers (e.g. rope thickness) and how and where the PARs should be attached to the nets. **The “gold standard” for PAR configuration would be to use more PARs and attach them to both the top and bottom of the treatment net.**
- **Fishers would ideally identify whether bycaught small cetaceans are porpoises or dolphins (capturing photos and footage if/where possible).**
- Other data which observers would likely collect include: species identification of small cetaceans (or identification of “porpoise” versus “dolphin”); bycatch of other Endangered, Threatened, and Protected species; water temperature; weather conditions; time of day; and target catch; set location.
- An alternative to having set control and treatment vessels would be to have control and treatment nets on each vessel, as fishers tend to only set one net at a time.
- Manufacture of PARs according to net configuration and gear used by the fishers will take approximately 6 weeks.
- Given the possibility that the PARs could be held up in customs during delivery, Pro Delphinus and Arribada/Clean Catch will further explore best options to minimise this risk.

Stage 3: Deployment and data collection

Based on the results of an earlier trial power analysis and the typical number of sets per trip in the fishery (2 monthly trips; 5 sets per trip), **the trial would ideally run over 12 months (plus 2 months for setup) and involve 240 sets (120 control sets and 120 treatment sets).** Observer trips would be quarterly, i.e. 8 total across the 2 vessels.

Tasks

- Conduct a small rehearsal run for PAR deployment to check how the fishers get on and how the devices sit in the nets (Lead: Pro Delphinus).
- Maintain a feedback loop with the fishers to communicate interim results and updates, and elicit feedback from fishers about their experiences with the PARs (Lead: Pro Delphinus).

Needs and considerations

- If funding was limited, the trial could be run over a single summer, noting there is no seasonality to small cetacean bycatch, although there is seasonality to fishing effort.

Stage 4: Data analysis, offboarding, and dissemination

Tasks

- Analysis of data (Lead: Pro Delphinus).
- Write-up of results, including peer-reviewed paper (Lead: Pro Delphinus).
- Communication of results to fishers (Lead: Pro Delphinus).
- Reporting to funder(s) (Lead: Arribada/Clean Catch).
- Public dissemination of results in the UK and internationally (Lead: Arribada/Clean Catch).

Needs and considerations

- Clean Catch project partners to support data analysis, write-up, and communication to fishers as needed; Pro Delphinus already provides videos to fishers at the end of trials as a matter of course.
- Arribada to determine whether the PARs would need to be returned; however, if the fishers continue to use the PARs, consideration should be given to longer-term monitoring.
- Consideration should be given to how the Peruvian government might be engaged regarding the trial results.
- Public dissemination of results to include targeted comms to the UK fishing industry on applicability to their operations.



Fishing crew process flying fish eggs in Pucusana

6. Estimated costs

Estimates for anticipated costs are set out below. These are preliminary and will be subject to revision in line with refinement of the trial design. If the trial were made cheaper by excluding the items 'UK team member attendance' and 'Journal fee', and using 50% fewer PARs on the nets, the cost would be in the region of 43,200 USD or 32,370 GBP.

Cost	Cost description	Cost amount
Fisher compensation	Covers time and effort for attaching PARs to nets. 5,000 USD per vessel for participation.	10,000 USD / 7,500 GBP
Observer payments	8 observer trips total (4 trips x 2 vessels)	8,000 USD / 6,000 GBP
PAR manufacture - PARs on both the top and bottom of treatment net	Production of PARs (refitting may be needed to allow for thicker rope used in the fishery). Note that this does not include international delivery of the PARs.	35,000 USD / 26,500 GBP
Fisher recruitment and training	Time and materials for recruitment of trial participants and training workshop for data collection.	1,100 USD / 800 GBP
UK team member attendance	Travel, accommodation, and subsistence for 1x UK team member (Arribada Initiative) to attend fisher training workshop.	2,700 USD / 2,000 GBP
Data analysis	Analysis of data by member of the Pro Delphinus team	500 USD / 370 GBP
Journal fee	Fee to publish open-access paper	2,700 USD / 2,000 GBP
Dissemination of results	Production and dissemination of communication materials aimed at international and UK audiences (including fishing industry).	3,600 USD / 2,700 GBP

Total:

**63,600 USD /
47,870 GBP**

7. Risks and mitigations

Risk	Likelihood	Mitigation
Unable to recruit two vessels to the trial.	Low	Work closely with Pro Delphinus and San José fishing association.
Treatment vessel appears to have increased small cetacean bycatch.	Low	Consider setting a “threshold” of bycatch after which the trial must end early.
Treatment vessel appears to have increased turtle bycatch (e.g. PARs could look like prey).	Low	Consider setting a “threshold” of bycatch after which the trial must end early.
Fear among fishermen that PARs may attract sea lions.	Medium	Effective communications and engagement with fishers during the recruitment process to make clear that PARs are extremely unlikely to attract sea lions.
One or more vessels drop out of trial.	Medium	Recruitment process to include identifying fishers/vessels who could replace drop-outs.



8. Additional or alternative projects

Fishermen and Pro Delphinus identified a range of other priorities and concerns which could form the basis of other sustainability projects, including:

- *Sea lion deterrents.* There is great interest in trialling other forms of deterrent which would not have the habituation or “dinner-bell” effect seen with devices already trialled by Peruvian fishers.
- *Radio-frequency identification (RFID) tags for helping to improve evidence base for fishing effort.* These have been used in the Insight360 project in the UK to help detect shooting and hauling of nets. The use of these was explored with Pro Delphinus, as a means of enabling automatic detection/recording of when nets containing PARs are deployed. It was concluded that RFID tags would not be practical for a PAR trial at this time, due to the logistical difficulty which would be involved in mounting 1-2 sensors on each boat. However, Pro Delphinus suggested that RFID tags in combination with cameras could be deployed on a sample of boats to improve the evidence base on fishing effort, as this type of data can be challenging to collect.
- *Whale pingers.* These have shown some success in preventing entanglements of large whales (e.g. humpback whales). A trial of whale pingers in northern Peru reported a 53% decline in whale entanglements when whale pingers were used. Given the substantial impact of whale entanglements on some individual fishers, there is likely to be appetite for these.
- *Improving population estimates for small cetacean populations in Peruvian waters.* Some data are available for Burmeister’s porpoise, but in general, poor data on populations presents a challenge to conservation and sustainable fishery efforts in the region.

- *Working with fishers to reduce the targeting of dolphins for bait.* While only some fishers engage in intentional harpooning of dolphins to sell to longliners for bait, conservation and welfare risks remain. Research involving Pro Delphinus staff suggests that social and economic trade-offs of switching away from dolphin bait may be small or even non-existent for fishers.²⁰
- *Aquaculture.* The San José fishing association is keen to explore farming of lobster, octopus, scallop, and seaweed as alternative sources of income. Seaweed is most preferred due to existence of a natural bank in the area. The association has applied for a permit to establish a farm, but lacks the knowledge to set it up.



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Longline and other vessels in Pucusana



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