

Darwin Initiative Innovation Annual Report

Darwin Initiative Project Information

Project reference	DARNV002
Project title	Innovation of Bait Fisheries for Live-bait Conservation
Country/ies	Maldives
Lead Partner	International Pole and Line Foundation
Project partner(s)	Safety Net Technologies (SNTech)
Darwin Initiative grant value	£177,792.00
Start/end dates of project	01st April 2022 - 31st March 2024*
Reporting period (e.g. Apr 2022 – Mar 2023) and number (e.g. Annual Report 1, 2, 3)	April 2022 - March 2023
Project Leader name	Craig Turley
Project website/blog/social media	https://ipnlf.org/unlocking-a-huge-potential-for-ocean-conservation-and-climate-change-ipnlf-maldives-and-sntechs-innovation-seeks-to-limit-wild-caught-bait-fish-in-pole-and-line-tuna-fishing/
Report author(s) and date	Craig Turley 22/04/2023

1. Project summary

Pole-and-line fishers are highly dependent on live-bait to attract schools of tuna. Livebait resources are becoming increasingly scarce from over- exploitation, climate change, and other anthropogenic impacts to coral reefs, which can lead to the collapse of the tuna fishery.

This Darwin Innovation project experiments with alternative stimuli to livebait (e.g. programmable LED lights, playback of recorded sounds and use of olfactory stimuli and lures) to induce skipjack into a feeding frenzy.

Programmable LED lights and Artificial Intelligence integrated cameras are cutting-edge technologies and their application as proposed in this project are entirely novel.

Exploring alternatives to livebait fish is also relatively unexplored with few published studies with limited success

AS such the proposed experiments are innovative and will contribute to novel scientific knowledge.

If successful the innovations have potential to positively disrupt traditional pole and line fishing methods by reducing the dependency on livebait which could have poverty reduction and biodiversity protection benefits across one-by-one tuna fisheries globally.

Forage fish species, referred to as baitfish, are a critical component of the marine food webs (4). Globally, they are currently targeted in huge quantities by several different fisheries, including for human consumption, as well as for fish meal and fish oil processing. This has meant that baitfish stocks in many geographies are subject to overfishing and have become depleted. In the short

term this has the potential to undermine the livelihoods of one-by-one fishing communities who are reliant on baitfish, whilst continued harvesting despite being overfished has the potential to undermine the sustainability credentials of one-by-one fisheries. In the longer term, unchecked overharvesting of baitfish could result in a trophic cascade leading to ecosystem collapse.

Therefore this project is designed to reduce the extractive use, and dependency of the pole and line fisheries on baitfish, in order to allow for conservation of baitfish species which can support a healthier more resilient marine ecosystem.

The conservation of baitfish is important for all who are reliant on the ocean ecosystem as a source of livelihood and protein. In the case of this project the direct beneficiaries of our technological experiments are the Maldivian pole and line fishers, whom, by reducing their baitfish consumption and reliance on livebait, help protect marine food chains and secure their own livelihoods.

Coastal communities in the Maldives and elsewhere throughout the world are dependent on the productivity of pole and line fisheries as well as the baitfish stocks, both as a source of livelihood and a key source of affordable protein. The pole and line fisheries also support a vast ecosystem of jobs and livelihoods for both men and women in the primary and secondary processing sectors and associated value chains and supply affordable protein to consumers all around the world. Therefore, the continuation of these fisheries is extremely important to the social and economic wellbeing of coastal communities, both in the Maldives and globally.

In many places the issues related to baitfish overextraction have already materialised, resulting in dangerous and ever riskier bait-fishing practices with diminishing returns; or even closure of once thriving pole and line fisheries such as in Cabo Verde or Senegal. In other geographies issues regarding baitfish are foreseeable in the future where the effects of climate change and species range shifts are likely to impact the sensitive baitfish species.

The livebait issue in the Maldives is complicated and multifaceted. Livebait resources inhabit coral reefs and associated environments which are becoming increasingly impacted by climate change (e.g. periodic episodes of coral bleaching, resource depletion, anthropogenic activities and competing human factors on resource allocation (between tourism and fisheries) (5). Fishermen are having to spend more time and use more fuel in search of live-bait, increasing their overheads and carbon footprint (IPNLF, unpublished data). Due to depleting resources of live-bait, fishers are increasingly resorting to using unconventional, and often disruptive methods of harvest such as SCUBA diving. A lack of adequate SCUBA training and poor maintenance of diving equipment can also become a health and safety concern on particular vessels if left unmanaged.

2. Project stakeholders/ partners

This project is a partnership between the International Pole and line Foundation (IPNLF), our regional office based in the Maldives, IPNLF Maldives, and technology partner, Safety Net Technologies (SNTech).

The partnership stemmed from IPNLF's ongoing work in the Maldives which began at the Charity's inception in 2012 and led to the establishment of the regional entity in 2018. SNTech were approached as technology partners prior to this project inception because of their work on precision fishing gears using programmable LED lights with the use of cameras.

All formal partners have been involved in project planning, monitoring, and decision making throughout the project and on a continuous basis; which has included a series of scheduled and ad-hoc meetings, either in person or online. There have been 16 of these meetings between all partners to-date.

The experimental trials were due to commence at the end of february 2023 and would have involved all project partners, as well as participation from private sector members from IPNLF's

member network (see paragraph below.) However, a disruption in the project due to the rejection of a research permit by the Maldives Ministry of Fisheries Marine Resources and Agriculture resulted in the experimental activities being delayed (details in section 3 below).

The project has received vocal and written support from many of IPNLF's commercial members throughout pole and line supply chains, both locally and internationally, as well as from some private sector members in the Maldives. These private sector members include ENSIS and MIFCO, two of the Maldives largest tuna processors, as well as International supply chain members, including Marks & Spencers and Sainsbury's from the UK, Woolworths from South Africa, and Fish Tales from the Netherlands.

Additionally, Gert Le Roux, of Woolworth's, South Africa, and Abrizal Ang from PT Samudra Mandiri Sentosa, Indonesia, have provided specialist technical input based on their respective previous experience regarding baitfish and the potential for innovation.

Public sector support came from the Maldives Marine Science Institute, who attempted to assist in applying for the research permit required for experimental trials.

Two local vessels (Sea Sun and Daafa 3) have been involved in the baseline data collection and were provided with a small incentive for any potential lost fishing opportunities, as a result of helping IPNLF collect the baseline data. Both crews provided invaluable feedback regarding camera rig design and potential experimental set-ups to trial the lights and sounds.

MIFCO provided the IPNLF team with free accommodation in Koodoo, before they departed for baseline data collection onboard Sea Sun vessel.

3. Project progress

Note: The project has recently undergone a major disruption (detailed in 3.1 below) and a change request form has been submitted to DEFRA requesting (1) To relocate the project to Indonesia, (2) A 6 month no-cost extension to make up for the lost project time, (3) Some transfer of unspent funds from year 1 to year 2. This change request is still pending and will be included as an annex.

3.1 Progress in carrying out project Activities

In year one, baseline data collection, which involved the underwater recording of normal fishing conditions with regular baitfish utilisation, were recorded and the target of >20 successful fishing events were recorded over 3 field trips (Activity 1.1). Data collection protocols were developed, adapted and standardised to allow for repeated baseline data collection of key variables, including bait utilisation to account for variation in the amount of baitfish an individual vessel/crew member threw. An underwater camera rig was developed through a practical research and development process to record the underwater behaviour of skipjack. Major challenges included designing the rig in a way that was removable, easily and quickly deployable and could withstand the extreme drag imposed on the rig as the vessel moved forward with its 1400HP engines. These challenges were overcome by developing a removable camera rig out of stainless steel.

The initial desk study exploring existing research on baitfish alternatives was drafted and remains a working document that is updated as other relevant studies are identified (activity 2.1). During the research we made an exciting discovery that auditory stimuli (sound) might be successful in eliciting a feeding response in tuna, as indicated by several sources, most promisingly an expired patent from 1972. This prompted us to add recorded-soundscapes to the potential list of stimuli which we want to experiment with, which was not included in the original application and a change request form was submitted to Darwin in December 2022 to request a change to the budget to accommodate the purchase of specialised underwater recording and sound equipment. The equipment has since been purchased and delivered to the Maldives ready for experimental trials that were due to start in February 2023.

As a result of adding sound to the list of stimuli we will experiment with, we also added Gert Le Roux of Woolworths, South Africa to the project steering committee. Gert has previous experience in trialling the use of underwater sound to alter fish behaviour in an aquaculture

setting. Gert has advised on equipment needs and experimental protocols in combination with SNTech who assisted with experimental rig design and will assist with implementation (Activity 2.2).

Due to challenges associated with recording the baseline footage on a working pole and line vessel (e.g. disruption in fishing activity due to data collection causing potential income loss to fishers, as well as frustration, and the chaotic and dynamic nature of the ocean ecosystem making it difficult to discern individual skipjack feeding behaviours (as indicated by review of the baseline footage, Activity 1.2)), It was decided by all project partners that the experimental phase should be broken into two phases. The first phase which has two components would be deploying an static experimental rig, which uses different combinations of sound, light and olfactory stimuli to first determine whether skipjack tuna can be attracted to the rig (Component 1) and whether the skipjack can be enticed to feed with reduced use of livebait (component 2). If phase 1 proves to be successful, then phase 2 will include adapting the rig, with the successful stimuli, to be deployed on a working pole and line vessel and the efficacy of the experimental treatments to be tested in real-world pole and line fishing setting (Activity 2.3).

Experimental trials were due to commence in February 2023 (Activity 1.3, 2.3)) and several of the project team including Managing Director Martin Purves, and Gert Le Roux from Woolworths had travelled to Maldives, whilst project lead Craig Turley and SNTech's Fishery Scientist Craig Syms were due to fly out later that day. However, in the morning of the 23rd of February, we received news from the Maldives Ministry of Fisheries, Marine Resources and Agriculture that our research permit for experimental trials had been rejected.

All efforts to overturn this decision have since been exhausted and moving forward with experimental trials without the research permit could lead to negative repercussions for IPNLFs other active projects in the Maldives. As a result, and following discussions with Darwin, IPNLF have submitted a change request form to Darwin / DEFRA in April 2023 requesting to relocate the project to Indonesia, where IPNLF have active projects in the pole and line fishery and a full time staff component. If this change request is granted, then this will include a 6 month no cost extension to allow for time to relocate the project and experiential materials to Indonesia. It will also include transferring the staff component from our Maldives staff to Indonesian staff.

IPNLF's Communication Manager, Stuart Hablutzel had also travelled to the Maldives in February 2023 in order to capture high-resolution images and video of the experimental protocols being conducted (Activity 4.1), in order for IPNLF to later produce a 2-3 minute video of the experimental protocol and methodology (Activity 4.2) and to produce a high-resolution promotional video to be released in the second year of the project (Activity 4.3). However, the disruption caused by the rejection of our research permit meant Stuart was unable to capture the required video and photos for the project. We therefore reallocated his time to other ongoing IPNLF projects in the Maldives, and we will re-conduct activities 4.1,4.2 and 4.3 if the project relocation to Indonesia is accepted by DEFRA.

Our first bi-quarterly blogpost was released in October 2022 (activity 4.4). Our second was due March 2023, but due to the disruption to the project in the Maldives, this Blogpost has been delayed until further notice from DEFRA on the relocation of the project to the Maldives. We are therefore behind on this indicator.

Overall, the project is about 3 months behind the original timeline, which is why IPNLF have requested a 6-month no cost extension to allow for the project to be relocated and project activities to be completed in Indonesia.

3.2 Progress towards project Outputs

Output 1 Observe and document the existing tuna feeding response to live-bait as a control treatment to advance scientific knowledge

The target for baseline data collection has been completed in February 2023 (22 out of 20 baseline fishing events recorded) and the videos have been uploaded to a shared google drive and preliminarily analysed to determine likely indicators of the voracity of skipjack feeding behaviour (e.g. darting vertically, rapid changes in pace and direction and mouth flaring/gaping). However more insights on these indicators are likely to be gleaned once we compare the baseline footage to the experimental footage recorded during phase 2 experimental trials, the date of which is pending on the acceptance of the change request.

Output 2 Develop experimental treatments to test as an alternative to live-bait including innovative use of alternative technologies

Experimental rigs have been designed and built for phase 1 experimental trials in February 2023 which allow for combinations of programmable LED lights, underwater playback of seascape sounds, reflective materials and olfactory products recovered from fish processing (e.g. fish scales, skin and blood). This was informed by our desk-study which indicated recorded seascape sounds as a promising area of exploration, and subsequent inclusion in project design. However, none of our 40 planned experimental fishing events have been conducted due to the rejection of the research permit in the Maldives. However, if DEFRA grant the change request to relocate the project to Indonesia and the no-cost 6 month extension, then IPNLF are confident we can still achieve this output and will begin experimental trials in late second quarter or early third quarter of year 2, after the project has been transitioned to Indonesia and the experimental rigs have been shipped and received.

Output 3 Establish standard protocols for testing feeding response in tuna to a range of alternative stimuli that is replicable in commercial tuna fisheries to contribute to scientific methodology.

The protocols were due to be developed during the planned field trip in the Maldives in February 2023. These protocols will be developed during initial trials in Indonesia, if DEFRA grant the change request for this project, which is projected to take place in the late second quarter or early third quarter of 2023.

Output 4 Produce video, photographic and written communication outputs to promote project activities and outputs through social media websites and relevant public fora.

So far only one blogpost has been published that was released in October 2023 and was well received resulting in several of our supply chain members reaching out to IPNLF to ask how they can support the project. Two of these members will be actively involved and invited to the project steering committee if DEFRA grants the relocation of the project to Indonesia. For updates on the videos, photos and other blog posts - see section 3.1.)

3.3 Progress towards the project Outcome

Outcome: Dependency of pole-and-line fisheries in the *Maldives on livebait is reduced by developing innovative technologies as an alternative to live bait resources

*Note that if the project is relocated to Indonesia then the outcome will change to reflect the location change, although the outcome itself will remain the same.

As experimental trials are yet to be conducted, relatively little direct progress has been made towards achieving the outcome. However, if the change request is granted and the project can move to Indonesia, then we would expect to be able to demonstrate the outcome on a limited number of trial vessels, provided that the innovative baitfish alternatives prove to be successful in eliciting a sustained feeding response in skipjack tuna.

Indicator 0.1 By the end of the project at least three alternatives to livebait have been prototyped and trialled in the Maldivian pole and line tuna fishery.

More than three alternative stimuli to livebait have been identified including, programmable LED lights, combined with reflective materials, the underwater playback of a range of seascape sounds including but not limited to, tuna feeding frenzies and associated noises e.g. birds diving, dolphins, baitfish schools as well as more isolated sounds such as baitfish schooling over a reef or specific frequencies that appear to elicit a reaction and olfactory stimuli that are harvested from the byproducts of the fish processing industry, which will include, dried fish scales and fish skin, frozen blood and other offal.

However the efficacy of these alternative stimuli is yet to be tested during our project and depends on the outcome of the change request.

Indicator 0.2 By the end of the project at least one developed baitfish alternative is able to elicit a feeding response in tuna significant enough to justify reduced use of livebait.

As above, the efficacy of the alternatives to livebait are yet to be trialled, however the desk study and the limited previous research suggest that it is likely to be a combination of stimuli that will elicit a feeding response in skipjack tuna. Therefore, it might be more appropriate for the indicator to state that 'at least one experimental set-up is successful in eliciting a feeding response in skipjack tuna'. There may also be two behaviours which we may need to distinguish. One being the attraction of the tuna to alternative stimuli out of curiosity or to initiate feeding, and another might be the sustained feeding of skipjack tuna, which is what is required for a successful fishing event. This is why we hypothesise that some form of byproduct of the fishing industry will likely have to be used in order to give the fish something to feed on and sustain their feeding response, as well as acting as an olfactory stimulus.

Indicator 0.3 By the end of the project, pole and line fishers on the trial vessels are using less livebait to catch similar quantities of tuna resulting from use of developed livebait alternatives.

No direct progress has been made toward this indicator regarding the trialling of livebait alternatives on trial vessels. However the baseline of the amount of tuna caught during a regular livebait fishing can be extracted from the data sets of pole and line observer data that IPNLF has been collecting through our observer program in both the Maldives and Indonesia.

3.4 Monitoring of assumptions

0.1 All important variables are identified and observable.

This assumption remains true - The variables that indicate success of an experimental trial would be an observed feeding response in skipjack similar to that of a live-bait fishing event. This can be quantitatively by the observed catch by weight of skipjack and qualitatively by surveying the fishing crew on their opinions as to how the livebait alternatives performed.

0.2 stakeholders are willing trust IPNLF to experiment with alternatives, new research published and accessible, experimental inputs are readily available.

This assumption remains partially true. Fisheries stakeholder, including vessel owners and crew have shown a willingness to participate in the trials and there is broad support from stakeholders within the fisheries value chain. However, a key stakeholder, the Ministry of Fisheries, Marine Resources and Agriculture have rejected the required research permit on the grounds that it promotes an issue in the fishery that they do not wish to draw attention to (despite widespread support from the value-chain). The project has had to manage this issue by proposing to relocate the project to Indonesia, where IPNLF also have value chain support for the project. Formal

endorsements will be sought, after DEFRA responds to the proposed change request submitted in April 2023.

0.3 live bait alternatives are successful to elicit a sufficient tuna feeding frenzy so that fishermen and stakeholders replicate it on fishing vessels

This assumption is yet to be tested during the experimental trials. However, the innovative nature of the project means this assumption is not certain.

1.1. Cameras are able to record every activity

This assumption remains true. The cameras have been able to capture the underwater feeding behaviour of skipjack in a sufficiently high-resolution to be able to determine individual skipjack and school behaviour. To our surprise, the cameras are also able to detect the livebait that is being thrown from the vessel during baseline data collection.

1.2 All the variables are observable and recorded.

This assumption remains true. The key variables we require to determine the success or failure of a feeding response in skipjack tuna are captured by the underwater cameras. In addition, these variables can be corroborated by the actual catch rates of skipjack tuna during the phase 2 experimental trials on a working pole and line boat.

2.1 New research is documented and published

Very little research was found on the subject with much of the available research dating back to the 1970s. However, the research did indicate that this is a promising area of research that remains relatively unexplored, confirming that this indeed novel and innovative research.

2.2 Experimental inputs are available for development or procurement

This holds true. All the materials required for experimental trials have already been procured.

2.3 Stakeholders are willing to trust IPNLF to experiment with alternatives on their vessels

This assumption remains true. Vessel owners and crew have shown a willingness to participate in the trials and IPNLF offer a small but reasonable compensation in order to compensate for disruption to fishing and subsequent loss of income due to experimental trials. This compensation is negotiated on a vessel by vessel basis, depending on the relationship held with the vessel and is lower depending on whether it is a baseline data collection event, with lower disruption to fishing events, or higher for experimental trials, which may cause complete disruption to a fishing event.

3.2 Stakeholders are willing and interested to read new research on alternatives to livebait.

This assumption holds true. IPNLF's first blog post was distributed to our member network and was well received with multiple supply chain members reaching out to ask how they can support the project, including Marks & Spencers and Sainsbury's in the UK, Fish Tales and PT Samudra in Indonesia and Woolworths in South Africa.

3.3 Stakeholders are receptive to engage with the findings and the protocol

This assumption is yet to be tested, but based on responses from IPNLF's blogposts it is anticipated that there will be active interest to engage in the findings of this project and to replicate the protocol in other geographies where reduced livebait availability is impacting the traditional pole and line fisheries.

3.5 Impact: achievement of positive impact on biodiversity and poverty reduction

Impact: Reduce reliance on livebait in pole-and-line tuna fisheries through the use of innovative alternatives, thereby enhancing fisheries sustainability, operational efficiency, reduction of carbon footprint and conservation of vulnerable baitfish resources

If experimental treatments are successful in eliciting a tuna feeding response comparable to livebait, they could reduce or remove the need for livebait in one-by-one fisheries. The reduced need for use of live-bait can have transformative longer term benefits for both biodiversity and poverty reduction in many low and middle income developing coastal states, in which development of low impact, sustainable fisheries could provide dignified and even lucrative livelihoods in a sustainable blue economy.

Furthermore, reduced reliance on baitfish would increase the operational efficiency and reduce the carbon footprint of pole and line fisheries by reducing the time and fuel spent searching for baitfish resources.

Lastly, Reducing or removing dependency on live-bait in one-by-one tuna fisheries means that those forage fish can remain in the ocean to reproduce, fulfilling their ecosystem function as the prey fish that underpin the marine food web. Healthier more abundant stocks of forage fish contributes to better overall ecosystem health and resilience in the face of climate change and the biodiversity crisis.

If successful, the research from this project will strengthen the capability of low impact one-by-one tuna fishers to sustainably harvest their marine resources and further minimise their ecosystem impacts, by removing the need for baitfish. This in turn enhances the capacity of coastal fishers in low and middle income developing countries to participate in sustainable fisheries which have a low barrier to entry and can offer dignified, sustainable and potentially lucrative employment and livelihoods.

4. Project support to the Conventions, Treaties or Agreements

At this stage, the project has not directly contributed to national policy or the development of conventions, treaties or agreements that the Maldives is signatory of.

IPNLF and project partners have also not have any direct interaction with the convention focal points over the last 12 months.

5. Project support to poverty reduction

If successful the research from this project will strengthen the capability of low impact one-by-one tuna fishers to sustainably harvest their marine resources and further minimise their ecosystem impacts, by removing the need for baitfish. This in turn enhances the capacity of coastal fishers in low and middle income developing countries to participate in sustainable fisheries which have a low barrier to entry and can offer dignified, sustainable and potentially lucrative employment and livelihoods.

By openly publishing the data and scientific reports and widely disseminating the outputs via digital communications outputs, the research conducted in the Maldives/Indonesia can help lower barriers to experimentation in other one-by-one fisheries and research institutions, catalysing a new frontier of research in one-by-one fisheries. The research will also provide insight for fisheries management authorities into potential ways to proactively address baitfish issues.

Furthermore, reduced reliance on baitfish would increase the operational efficiency and reduce the carbon footprint of pole and line fisheries by reducing the time and fuel spent searching for baitfish resources.

6. Gender equality and social inclusion

The project doesn't make any specific actions to differentiate engagement between specific genders, especially as the primary harvesting sector in the Maldives is exclusively male. At present both trial vessels engaged in baseline data collection have entirely male crews. However, women are an important part of the post-harvest value chain in the Maldives and make up over 75% of the employment and small-business owners. Therefore both men and women who rely on one-by-one fisheries value chains are beneficiaries of the project outcomes.

Please quantify the proportion of women on the Project Board ¹ .	25%
Please quantify the proportion of project partners that are led by women, or which have a senior leadership team consisting of at least 50% women ² .	0%

7. Monitoring and evaluation

As data collection involves directly recording fishing events from underwater, whilst recording other variables relating to baitfish utilisation above water, the video generated is a very tangible way to record progress towards our data collection targets. As of the time of writing, 22 baseline fishing events have been recorded and are shared with all project partners on a shared google drive.

Direct comparison between baseline footage and experimental footage will allow us to compare skipjack feeding behaviour, between livebait usage and experimental trials, although the qualitative metrics are yet to be determined once initial experimental trials have been conducted.

The metric which will determine the efficacy of the experimental livebait alternatives beyond doubt will be the catch rates on the trial vessels in a real world fishing setting compared to regular levels of livebait consumption. However we are yet to trial the experimental livebait alternatives on a working pole and line vessel. This will be conducted in phase 2 experimental trials.

The final measure of whether we have met our project outcome would be how many vessels are willing to trial the experimental technologies based on our findings.

Project monitoring is conducted by IPNLF and transparently shared with all project partners during our regular meetings.

Monitoring and evaluation also includes financial monitoring and has been conducted by updating two spreadsheets on a regular basis 1) Financial forecasting spreadsheet and 2) Actual expenditure spreadsheet.

The financial monitoring is conducted by IPNLF with detailed expense reports from IPNLF Maldives field staff.

¹ A Project Board has overall authority for the project, is accountable for its success or failure, and supports the senior project manager to successfully deliver the project.

² Partners that have formal governance role in the project, and a formal relationship with the project that may involve staff costs and/or budget management responsibilities.

8. Lessons learnt

A key component to project implementation has been planning sessions between all project staff and partners at the beginning of the project to commit to timelines and assign people responsibilities for aspects of the project. A tool that has been very useful in bringing some of the project activities into a realistic and achievable timeline with measurable outcomes has been the detailed financial forecasting. We started our forecasting process after the first field trip in August 2022. However in the future, we would recommend to begin this planning and forecasting process right at project inception.

Flexibility in the plans has also been a key component of the project so far. As our project works with fisheries, which are notoriously hard to forecast and plan as activities are entirely dependent on weather and fishing conditions, which are factors beyond our control. This has meant that we have had to frequently pivot our plans in order to achieve the desired outcomes for project activities. Building contingencies in the project plan and activity schedule helps when trying to plan for field trips which involve international staff or project partners which may have limited time and an incurred a cost, to ensure that the time is used cost-effectively. For example, back up plans for when fishing conditions or weather conditions do not allow for baseline data collection or experimental trials. Often flexibility in timelines and a willingness to change plans at a moment's notice are the most important factors. As such, in the future we would build longer field trips into the project plan so that it allows for as much flexibility as possible.

The rejection of the research permit has been a major disruption to the project and although identified in the risk register back in October 2022, was not perceived to be a major risk. Fortunately, as IPNLF has active projects and staff components in a pole and line fishery in Indonesia, IPNLF are in a position to propose a location change to an eligible country. However, this was IPNLF's last choice of action before exhausting all other avenues to continue the project in the Maldives.

In the future, confirmation of research permits and any other required permissions will be sought prior to the commencement of project activities and a contingency plan considered in the event of a similar situation. We would highly recommend that other projects consider this risk and prepare adequate contingency plans.

9. Actions taken in response to previous reviews (if applicable)

Feedback: The activity on testing novel stimuli doesn't appear to explicitly include comparing with data from control situations. Clarity on this would be welcomed;

Response: Each experimental design is linked directly to a control situation, both in phase 1 experimental trials, where both a control rig and experimental rig will be deployed at the same time, and in phase 2 experimental trials, where the experimental livebait alternatives will be compared to a control of regular fishing through livebait both through underwater footage of skipjack feeding behaviour in both the control and experimental scenarios, as well as by comparing catch rates between control and experimental treatments.

Feedback: scope for scaling and replication in lower income countries seems good, but it would be useful to know to what extent equipment costs would be a barrier to this;

Response: Final equipment costs are yet to be determined by assessing which of the treatments proves to be most successful. If one, or a combination of the experimental treatments proves to be effective in reducing the amount of livebait required in pole and line fishing operations, then project partners SNTech will look at how they can make their component of the technology more cost-effective and accessible. Even at the prototype phase, the entire experimental rig is less than £15,000. This cost will inevitably come down with scaling and if refinements are made to the rig design. Towards the end of the project, we will be able to

guage the potential for fuel and time saving, which will allow us to calculate the return on investment for our proposed rig.

Feedback: It would be good to see evidence of community demand for the project and if this viable option as there is little engagement with local partners (apart from IPLNF Maldives);

Response: IPNLF have had positive engagement from industry members in the Maldives, mostly through written emails as well as parts of the international supply chain, from retailers in UK, South Africa and Netherlands. We have also had many fishing vessels recognise the value of the research and show a willingness to participate in experimental trials, with letters of support and vessel captains and crew providing feedback on effective rig design when conducting baseline trials.

However, with the likely cessation of the project in the Maldives, and pending relocation of the project to Indonesia, IPNLF will need to seek new letters of support from value chain actors in the Indonesia, including vessel captains, boat owners, commercial value chain members and international value chain members. Email conversations with value chain members such as Fish Tales in the Netherlands (who source from Indonesia pole and line fisheries) and local processors PT Samudra, already confirm their support and willingness to participate in the project. However, more formal letters of endorsement will be sought once we have approval from DEFRA on the project relocation.

Feedback: The reduction in baitfish collecting from around reefs would have a positive impact on biodiversity but the linkage to poverty is not well set out and gender equality aspects could be stronger. The application states that a collapse in the fishery would result in poor outcome for females, but this project is about an alternative approach to capturing tuna, not a reduction;

Response: There are two poverty reduction components: (1) The first poverty reduction impact is in regard to securing existing livelihoods into the future. A collapse in the baitfish fishery would in turn lead to a collapse in the tuna fishery, which would result in a loss of livelihood for both male fishermen and male and female value chain stakeholders. (2) The second poverty reduction impact is in reviving pole and line livelihoods in low-income countries in which baitfish availability has already led to collapse of the pole and line sector, such as in Senegal and Cabo Verde. If the project is successful in demonstrating pole and line fishing with a reduction in the need for livebait, then pole and line fisheries in these other low-income countries could be revived with greatly improved sustainability credentials.

Feedback: On the logframe: indicators are SMART, but many of them are only timebound to the project end. This may make the monitoring process difficult. Consider including interim indicators. It currently doesn't include any training of local fishers in these new techniques (which perhaps should be included at Outcome level).

Response: During the course of the project, project partners will endeavour to advance the technological concept as much as possible, but realistically by the end of the project we can expect the technological components of the project to be at a technology readiness level of 3-4, which is still in the prototype stage. As such the technology will still need to be commercially developed in order to become available to fishers as a ready-technology. Therefore training of fishers in the technology may be premature to be included in this project funding round.

Feedback: further clarity is required regarding the 20% VAT allocated to 'Other' on the partner tab of the budget template.

Response: SNTech's invoicing to IPNLF for the Pisces lights and their consultancy time on this project includes 20% VAT as they are a UK registered commercial company.

10. Risk Management

No new risks have arisen in the past 12 months. Only minor changes to project activities had to undergo minor rescheduling due to: (1) Weather/fishing conditions delaying baseline data collection, (2) development of the underwater camera rig requiring 3 rounds of modification and

at-sea trials before being able to with stand the drag associated with a moving pole and line vessel.

However, the rejection of the research permit from the Ministry of Fisheries, Marine Resources and Agriculture was the actualization of a risk identified in the risk register in October 2022. IPNLF had confidence that the research permit would be granted due to IPNLF's long precedence of carrying out research and projects in the Maldives and verbal conversations with individuals in the Ministry assuring that there would be no issue. However, the rejection of the research came from the highest level in the Ministry and based on a personally held position by the Minister that drawing attention to the sustainability of baitfish use in pole and line fisheries will be problematic to the fishery.

As mentioned throughout the report, proposing a change request to relocate the project to Indonesia was a significant adaptation to the proposed plan of the project.

11. Other comments on progress not covered elsewhere

Overall the project is about 3 months behind schedule due to the rejection of the research permit. For this reason, IPNLF has requested a 6 month no-cost extension in the change request form submitted in April 2023. The additional three months will give IPNLF enough time to transition the project to Indonesia and establish and socialise the new project with Indonesian fisheries stakeholders.

One major progress in the experimental design of the project was to break the experimental trials into two phases.

Phase 1: Static trials of the experimental rig deployed in the vicinity of an Anchored Fish Aggregating Device with a control rig for direct comparison. This is in order to tease apart the different experimental treatments in a more controlled setting and to modify the rig design, without causing major disruption to real-world fishing events. The experimental treatments which show promise in attracting skipjack tuna and even enticing them to feed will be prioritised for phase 2 trials on an active pole and line vessel. Data will be collected by underwater cameras to allow for direct visual comparisons of skipjack behaviour around the control rig compared to the experimental rig.

Phase 2: Based on the outcome of the phase 1 trials, the rig can then be adapted/modified to be deployed from an active pole and line vessel, at which time, we will test the effectiveness of the experimental treatments to perform in a real-world fishing situation. The behaviour of the skipjack tuna can be directly compared to underwater footage collected from the baseline data collection on pole and line vessels in the Maldives.

A simple desk study was also conducted to determine which equipment set-up was required to both record and playback underwater sound. Based on this study, a hydrophone, recorder, and underwater speaker set-up with an amplifier were purchased and have been delivered to Maldives for inclusion in the experimental trials.

12. Sustainability and legacy

Due to the rejection of the research permit the project has unfortunately become unviable to continue in the Maldives in the short term. IPNLF Maldives senior management expressed concern that continuation of the project without the research permit could threaten IPNLF's other existing programs in the Maldives and lead to increased political tensions. However, stakeholders in the Maldives tuna value chains were broadly supportive of the project and will continue to take an active interest in the outcome of the project.

The Maldives was originally selected for three reasons: (1) IPNLF have longstanding relationships with vessel owners and crews and have access to working pole and line vessels for trials, (2) There is general trend of baitfish scarcity in Maldives, resulting in ever-risker baitfishing practices. (3) IPNLF have a locally registered entity and a full time staff component and finally (4) Maldives is an ODA eligible country, although classified as middle income, but a

positive outcome of this project could have huge impact for pole and line fisheries in many low and middle income coastal states that have existing or extant pole and line fisheries.

All of the assumptions above for the Maldives, also remain true for Indonesia, making it an ideal solution to relocate the project.

The outcomes of the experimental research conducted through this project will be presented in an open access scientific report and will contribute to novel scientific research. The methodologies and results for outputs 1, 2 and 3 all aim to be replicable by other scientists and fisheries and will allow others to advance the research into livebait alternatives.

Should an experimental treatment trialled through this project be successful in cost-effectively eliciting a feeding response in tuna, whilst reducing or eliminating need for baitfish, IPNLF will widely promote the results through our global network, and seek funding to cost-effectively replicate the project results in other fisheries and countries that can benefit from the innovation.

If the result is linked to technology provided by project partner, SNTech (e.g. Pisces programmable LED system), SNTech may explore commercialising the solution and explore making the technology more affordable as a cost-effective solution for fishers in low and middle income countries. However the theory behind the LED light frequencies will be openly published and will therefore be replicable by market competitors.

13. Darwin Initiative identity

IPNLF Released a blog post and newsletter in October 2022 announcing the beginning of the control trials in which is was explicitly stated that this was a Darwin funded project.

The project is primarily funded by Darwin but with matched funding from IPNLF's core funding generated by commercial membership. The fact that the project is funded by Darwin is explicitly mentioned in conversations with any project stakeholders, including interested IPNLF members.

Many of the government level stakeholders in the Maldives were already aware of the Darwin Initiative.

It is one of the outputs of the project to produce a short promotional video in which it will be made explicitly clear that this is a Darwin funded project and we would hope to use the Darwin logo in that video. This output is scheduled for the third quarter of year 2. This video will hopefully form part of the legacy of the project.

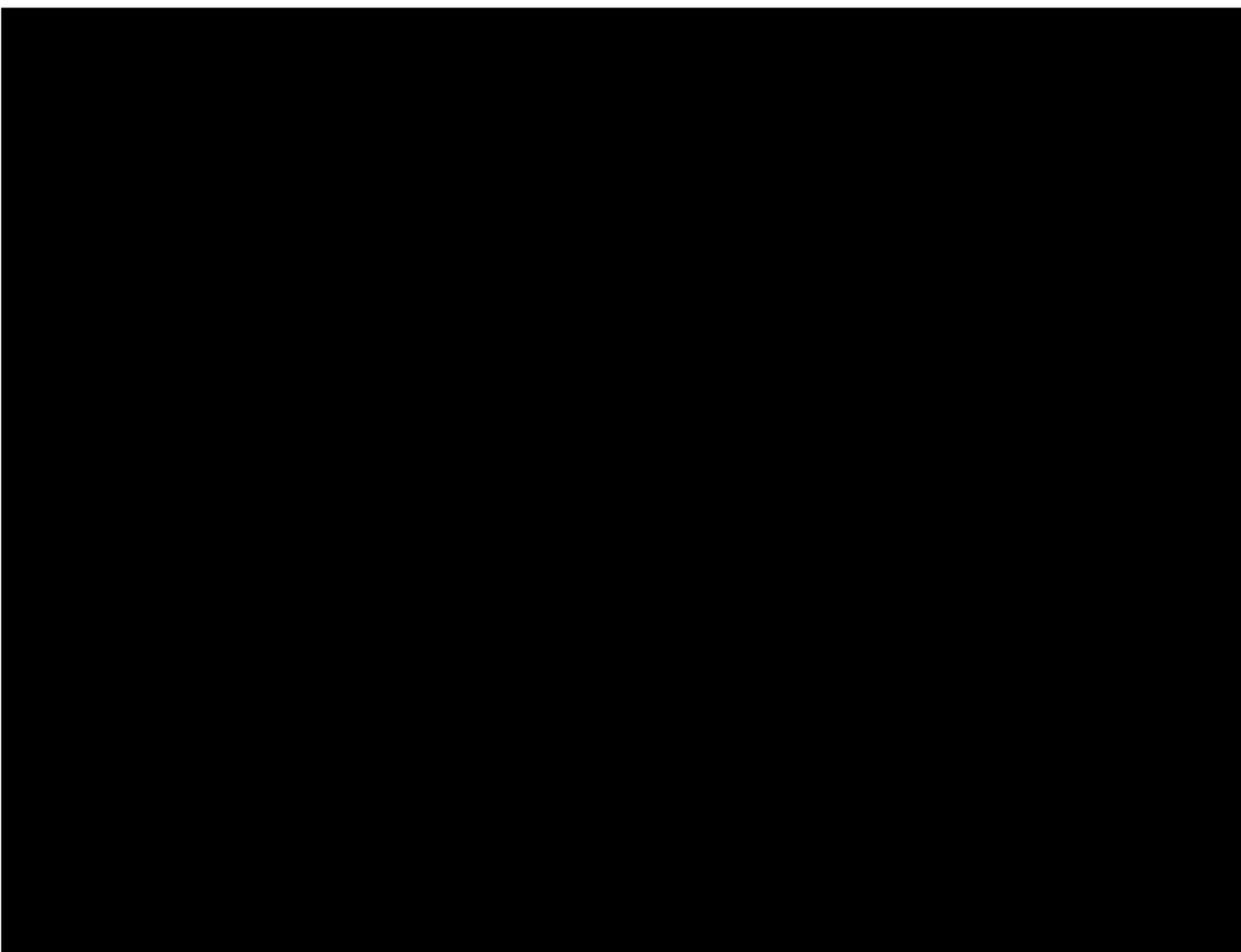
14. Safeguarding

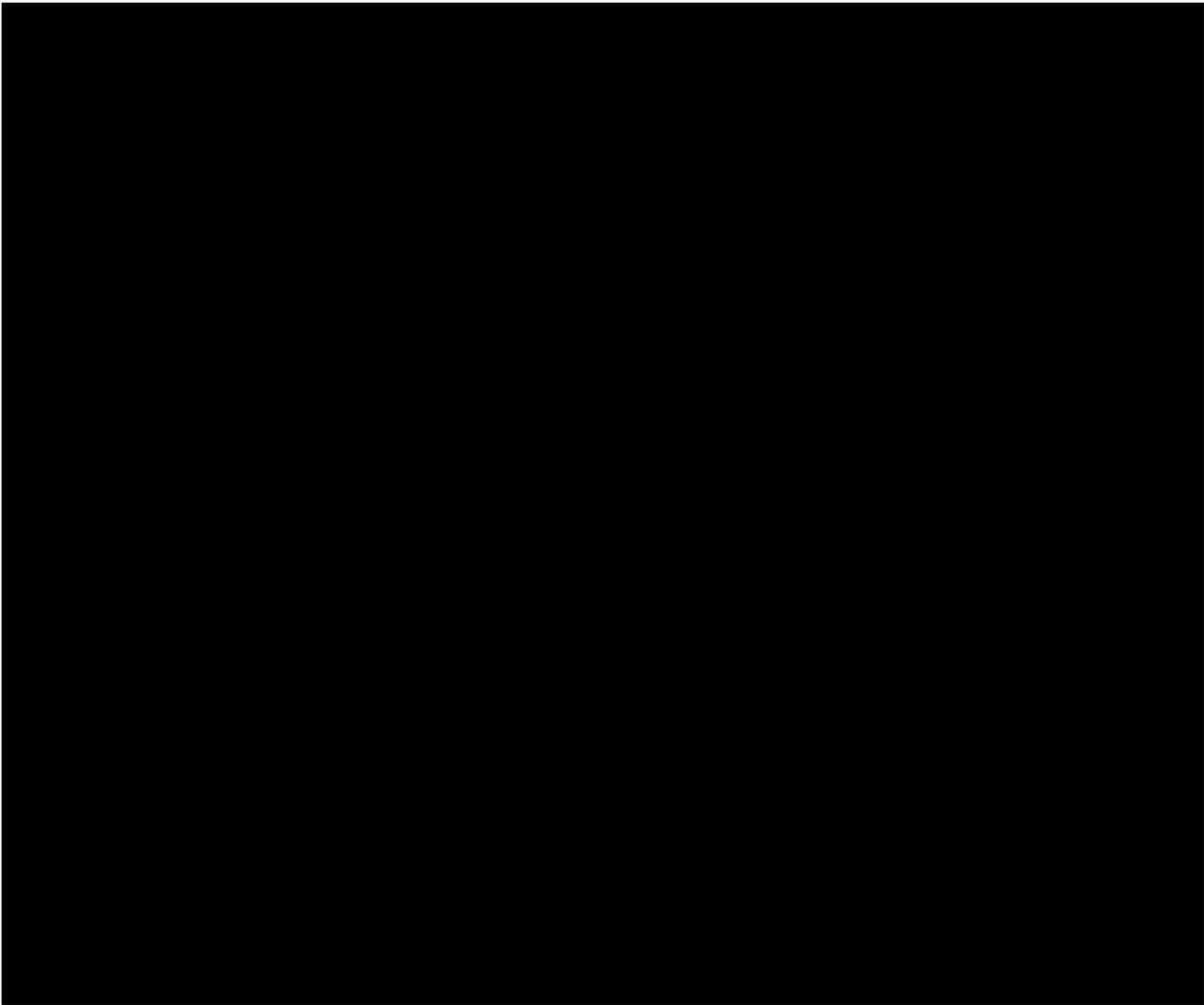
Has your Safeguarding Policy been updated in the past 12 months?	No
Have any concerns been investigated in the past 12 months	No
Does your project have a Safeguarding focal point?	No
Has the focal point attended any formal training in the last 12 months?	No
What proportion (and number) of project staff have received formal training on Safeguarding?	Past: 0% Planned: 0%
<p>Has there been any lessons learnt or challenges on Safeguarding in the past 12 months? Please ensure no sensitive data is included within responses.</p> <p>There has been no issues related to safeguarding in past 12 months.</p>	
<p>Does the project have any developments or activities planned around Safeguarding in the coming 12 months? If so please specify.</p> <p>No specific developments or activities planned. We have safeguarding policies to which all recruited staff to IPNLF are familiarised with during the onboarding process as well as sections in our IPNLF staff handbook.</p>	

15. Project expenditure

i) Table 1: Project expenditure during the reporting period (1 April 2022 – 31 March 2023)

Project spend (indicative) since last Annual Report	2022/23 Grant (£)	2022/23 Total Darwin Initiative Costs (£)	Variance %	Comments (please explain significant variances)
Staff costs (see below)				
Consultancy costs				
Overhead Costs				
Travel and subsistence				
Operating Costs				
Capital items (see below)				
Monitoring & Evaluation (M&E)				
Others (see below)				
TOTAL	£98,757	£70,592		





16. OPTIONAL: Outstanding achievements or progress of your project so far (300-400 words maximum). This section may be used for publicity purposes



17.

File Type (Image / Video / Graphic)	File Name or File Location	Caption, country and credit	Online accounts to be tagged (leave blank if none)	Consent of subjects received (delete as necessary)
				Yes / No
				Yes / No
				Yes / No
				Yes / No
				Yes / No

2) Annex 1: Report of progress and achievements against logframe for Financial Year 2022-2023

Project summary	SMART Indicators	Progress and Achievements April 2022 - March 2023	Actions required/planned for next period
<p>Impact</p> <p>Reduce reliance on livebait in pole-and-line tuna fisheries through the use of innovative alternatives, thereby enhancing fisheries sustainability, operational efficiency, reduction of carbon footprint and conservation of vulnerable baitfish resources.</p>		<p>With the project still in trial phases, no direct impact on biodiversity or poverty alleviation can yet be reported.</p>	
<p>Outcome</p> <p>Dependency of pole-and-line fisheries in the *Indonesia* on livebait is reduced by developing innovative technologies as an alternative to live bait resources</p>	<p>0.1 By the end of the project at least three alternatives to livebait have been prototyped and trialled in the *Indonesian* pole and line tuna fishery.</p> <p>0.2 By the end of the project at least one developed baitfish alternative is able to elicit a feeding response in tuna significant enough to justify reduced use of livebait.</p> <p>0.3 By the end of the project, pole and line fishers on the trial vessels are using less livebait to catch similar quantities of tuna resulting from use of developed livebait alternatives.</p>	<p>01. 3 alternatives to livebait have been identified but are yet to be trialled</p> <p>02. Experimental trials not started</p> <p>03. As above</p>	<p>01. Livebait alternatives will be trialled on working pole and line vessels</p> <p>02. Experimental trials will determine if one of/ a combination of the livebait alternatives can elicit a feeding response in tuna significant enough to justify reduced livebait.</p> <p>03. At-sea experimental trials will assess the efficacy of the innovative technologies.</p>
<p>Output 1. Observe and document the existing tuna feeding response to live-bait as a control treatment to advance scientific knowledge</p>	<p>1.1 In the first year, at least 20 successful fishing events in which livebait are utilised are recorded and observed using AI integrated underwater cameras to determine a baseline control treatment against which experimental treatments can be compared.</p> <p>1.2 At least 3 key variables to determine the voracity of tuna feeding response determined in the first year.</p>	<p>1.1 22 fishing events and skipjack feeding behaviour has been recorded using underwater cameras. The AI component is still being developed by SNTech.</p> <p>These footage are available on a shared google drive.</p> <p>1.2 The 3 key variables of skipjack feeding behaviour have been identified through tentative review of the baseline footage, but will be further verified during the experimental trials.</p>	

<p>Activity 1.1 Observe fishing conditions, and baitfish utilisation on commercial Maldivian pole-and-line fishing vessels AI integrated using underwater cameras to capture control conditions.</p>	<p>22 baseline fishing events recorded</p>	<p>Activity complete</p>
<p>Activity 1.2, Assess different behaviours of skipjack from underwater footage to determine measures of voracity of feeding response</p>	<p>The 3 key variables to determine the voracity of skipjack feeding behaviours have been tentatively determined from preliminary review of the baseline footage, but will be verified during experimental trials in the next phase of the project.</p>	<p>Voracity will be determined through comparison between baseline conditions and experimental conditions - Likely looking firstly at the underwater behaviour in phase 1 trials, and by looking at actual catch rates of skipjack tuna in phase 2 trials.</p>
<p>Activity 1.3 Experiment with different variables in eliciting feeding responses in order to isolate effects of the experiments, record and standardise them</p>	<p>No progress made in year 1</p>	<p>Variables for determining the voracity of feeding response will be experimented with during the experimental trials, due to commence in the second quarter of year 2.</p>
<p>Output 2. Develop experimental treatments to test as an alternative to live-bait including innovative use of alternative technologies.</p>	<p>2.1 minimum 3 case studies of existing and new research are identified during desk study 2.2 Experimental treatments using alternative stimuli including LED lights, byproducts of fish processing/artificial bait pods and artificial lures are co-developed with relevant stakeholders and LED lights are procured by end of second quarter. 2.3 At least 40 at-sea trials conducted on a pole and line vessel using a combination of programmable LED lights, byproducts of fish processing/artificial bait pods and artificial lures to elicit a feeding frenzy response in tuna over the project period.</p>	<p><i>2.1 Desk study completed with >3 referenced studies. This remains an active document that will continue to be updated throughout the project as additional research or studies come to light. The desk study resulted in including the use of underwater playback of sound (auditory stimuli) in the project.</i></p> <p><i>2.2 Experimental design rig for phase 1 experimental trials has been designed and built and includes programmable LED lights, underwater cameras, auditory playback of seascape sounds, reflective materials and olfactory stimuli from the byproducts of the fishing industry. All equipment has been purchased and delivered to the Maldives.</i></p> <p><i>2.3 Experimental trials were due to commence in February 2023. However rejection of the research permit has delayed experimental trials. (See section 3.1)</i></p>
<p>Activity 2.1 Conduct desk study to compile case studies of new technology and alternative techniques to live-bait in other countries/fisheries</p>	<p>Desk study is complete but remains an active document.</p>	<p>New studies will be added to the desk study as and when discovered and the final study will be published on IPNLF website towards the end of the project.</p>

<p>Activity 2.2. In consultation with fisheries stakeholders, codevelop alternative stimuli to livebait which have potential to elicit a feeding frenzy response in skipjack tuna.</p>	<p>Experimental rig designed and built with input from SNTech, Gert Le Roux from Woolworth South Africa and practical input from participating vessel captains and crew.</p>	<p>Experimental treatments will continue to be developed with stakeholders and refined during the experimental trial process.</p>
<p>Activity 2.3 Test novel alternative external stimuli such as programmable LED lights, byproducts from fish processing/ artificial bait pods and artificial lures to elicit and maintain a feeding frenzy in skipjack schools</p>	<p>Experimental trials of novel alternative stimuli have been delayed until year two of the project.</p>	<p>Experimental trials due to commence in Q2 of year two (depending on pending change request)</p>
<p>Output 3. Establish standard protocols for testing feeding response in tuna to a range of alternative stimuli that is replicable in commercial tuna fisheries to contribute to scientific methodology</p>	<p>3.1 By the end of the project, experimental protocols are developed standardised, and recorded in a scientific report 3.2 By the end of the project experimental Protocols are widely shared with stakeholders both in Maldives through stakeholder workshops and abroad through communication outputs (output 4).</p>	<p>3.1 Standard protocols for baseline data collection have been established and kept on an active document. Standard protocols for experimental data collection will be refined and documented during the experimental trial phase and recorded in a scientific report. 3.2 Due next year</p>
<p>Activity 3.1 Create a report documenting the trials and standard protocols developed in Maldives, and analysing the potential for scalability and impact in low and middle income countries</p>	<p>Standard protocols for baseline data collection established through a refinement process.</p>	<p>Experiential trials protocols to be developed and refined from Q2, Y2 onwards and report and analysis to be completed in Q4, Y2.</p>
<p>Activity 3.2 Increase stakeholder buy-in and replication using awareness and communications</p>	<p>See activity 4.4</p>	<p>Final report will be widely publicised in IPNLF's member network and through our website and newsletter.</p>
<p>Output 4. Produce video, photographic and written communication outputs to promote project activities and outputs through social media websites and relevant public fora.</p>	<p>4.1 By the end of the project produce at least 4 written articles/blog posts to promote project activities and outcomes. 4.2 By the end of the project an informational video is produced documenting the experimental protocol 4.3 By the end of the project a high-quality promotional film is produced to promote project activities and outcomes. 4.4 Photos and captions regularly posted on IPNLF Maldives and IPNLF</p>	<p>4.1 1 of 4 written blog posts have been completed. 4.2 Informational video was due to be recorded in March 2023, but has been delayed, pending change request (see section 3.1). 4.3 Same as above. 4.4 Darwin posts have been scheduled for regular release on our IPNLF Maldives Instagram channel - but currently paused and dependent on pending change requests.</p>

	social media channels (instagram and facebook)		
Activity 4.1 Throughout project, project staff will capture high resolution pictures and footage of project activities, stakeholder engagement and experimental trials for promotional film		Pictures and footage have been captured from baseline footage. Our comms manager arrived in Maldives to do filming for the project, but was delayed due to developments in the project (see section 3.1).	IPNLF comms manager will come to the project location for filming during experimental trials.
Activity 4.2 Publish a 2-3 minute video experimental methodology and variables required for analysis, which can be used for further scientific study		Delayed to year 2 and pending change request.	IPNLF comms manager will come to the project location for filming during experimental trials.
Activity 4.3 Promotional film edited and produced using footage captured during the project period.		Delayed to year 2 and pending change request.	IPNLF comms manager will come to the project location for filming during experimental trials.
Activity 4.4 4 Blogposts/articles written bi-quarterly		1 of 4 blog posts released in October 2022. Blogpost 2 of 4 was due to be released March 2023, but delayed due to developments in the project.	3 Blog Posts will be scheduled during year 2, dependent on approval of change requests.

3) Annex 2: Project’s full current logframe as presented in the application form (unless changes have been agreed)

Project Summary	SMART Indicators	Means of Verification	Important Assumptions
Impact: Reduce reliance on livebait in pole-and-line tuna fisheries through the use of innovative alternatives, thereby enhancing fisheries sustainability, operational efficiency, reduction of carbon footprint and conservation of vulnerable baitfish resources. (Max 30 words)			
Outcome: Dependency of pole-and-line fisheries in the Maldives on livebait is reduced by developing innovative technologies as an alternative to live bait resources	0.1 By the end of the project at least three alternatives to livebait have been prototyped and trialled in the Maldivian pole and line tuna fishery. 0.2 By the end of the project at least one developed baitfish alternative is able to elicit a feeding response in tuna significant enough to justify reduced use of livebait. 0.3 By the end of the project, pole and line fishers on the trial vessels are using less livebait to catch similar quantities of tuna resulting from use of developed livebait alternatives.	0.1 Scientific reports and video and photographic evidence of livebait alternatives being trialled in Maldivian pole and line fisheries. 0.2 Significant tuna feeding response recorded and analysed using sophisticated AI-integrated underwater cameras (Helios) 0.3 At-sea observations verify significant reductions in use of live-bait, detailed in a scientific report and communications outputs.	0.1 All important variables are identified and observable. 0.2 stakeholders are willing trust IPNLF to experiment with alternatives, new research published and accessible, experimental inputs are readily available 0.3 live bait alternatives are successful to elicit a sufficient tuna feeding frenzy so that fishermen and stakeholders replicate it on fishing vessels
Outputs: 1. Observe and document the existing tuna feeding response to live-bait as a control treatment to advance scientific knowledge	1.1 In the first year, at least 20 successful fishing events in which livebait are utilised are recorded and observed using AI integrated underwater cameras to determine a baseline control treatment against which experimental treatments can be compared. 1.2 At least 3 key variables to determine the voracity of tuna feeding response determined in the first year.	1.1 Cameras are procured and installed on the fishing vessel 1.2 Trip reports from each fishing trip 1.3 Observer datasheets with variables and experiments recorded 1.4 AI integrated video is analysed 1.5 Results presented in a scientific report.	1.1. Cameras are able to record every activity 1.2 All the variables are observable and recorded.
2. Develop experimental treatments to test as an alternative to live-bait	2.1 minimum 3 case studies of existing and new research are identified during desk study	2. desk reports 2.2. procurement reports	2.1 new research is documented and published

<p>including innovative use of alternative technologies.</p>	<p>2.2 Experimental treatments using alternative stimuli including LED lights, byproducts of fish processing/artificial bait pods and artificial lures are co-developed with relevant stakeholders and LED lights are procured by end of second quarter. 2.3 At least 40 at-sea trials conducted on a pole and line vessel using a combination of programmable LED lights, byproducts of fish processing/artificial bait pods and artificial lures to elicit a feeding frenzy response in tuna over the project period.</p>	<p>2.3 fishing trips, trip reports 2.4 Results presented in scientific report</p>	<p>2.2 experimental inputs are available for development or procurement 2.3 stakeholders are willing to trust IPNLF to experiment with alternatives on their vessels</p>
<p>3. Establish standard protocols for testing feeding response in tuna to a range of alternative stimuli that is replicable in commercial tuna fisheries to contribute to scientific methodology.</p>	<p>3.1 By the end of the project, experimental protocols are developed standardised, and recorded in a scientific report 3.2 By the end of the project experimental Protocols are widely shared with stakeholders both in Maldives through stakeholder workshops and abroad through communication outputs (output 4).</p>	<p>3.1 Report is published on IPNLF website and shared with stakeholders 3.2 Results presented in scientific report 3.3 Number of stakeholders validated and replicate the protocol on their vessels</p>	<p>3.2 Stakeholders are willing and interested to read new research on alternatives to livebait 3.3 Stakeholders are receptive to engage with the findings and the protocol</p>
<p>4. Produce video, photographic and written communication outputs to promote project activities and outputs through social media websites and relevant public fora.</p>	<p>4.1 By the end of the project produce at least 4 written articles/blog posts to promote project activities and outcomes. 4.2 By the end of the project an informational video is produced documenting the experimental protocol 4.3 By the end of the project a high-quality promotional film is produced to promote project activities and outcomes. 4.4 Photos and captions regularly posted on IPNLF Maldives and IPNLF social media channels (instagram and facebook)</p>	<p>4.1 Blog posts published 4.2 Informational video published on IPNLF Youtube and promoted 4.3 High quality promotional film published on IPNLF Youtube 4.4 Social Media posts.</p>	

Activities

Activity 1.1. Observe fishing conditions, and baitfish utilization on commercial Maldivian pole-and-line fishing vessels AI integrated using underwater cameras to capture control conditions.

Activity 1.2 Assess different behaviours of skipjack from underwater footage to determine measures of voracity of feeding response

Activity 1.3 Experiment with different variables in eliciting feeding responses in order to isolate effects of the experiments, record and standardize them

Examples of the variables include: type of fishing event, sea state, visibility, time of day, locality, size of school, stomach fullness at start of event, school interactions and depredation events. The standard methodology will be developed during the experimental design phase.

Activity 2.1 Conduct desk study to compile case studies of new technology and alternative techniques to live-bait in other countries/fisheries

Activity 2.2 In consultation with fisheries stakeholders, codevelop alternative stimuli to livebait which have potential to elicit a feeding frenzy response in skipjack tuna..

Activity 2.3 Test novel alternative external stimuli such as programmable LED lights, byproducts from fish processing/ artificial bait pods and artificial lures to elicit and maintain a feeding frenzy in skipjack schools.

Activity 3.1 Create a report documenting the trials and standard protocols developed in Maldives, and analysing the potential for scalability and impact in low and middle income countries

Activity 3.2 Increase stakeholder buy-in and replication using awareness and communications

Activity 4.1 Throughout project, project staff will capture high resolution pictures and footage of project activities, stakeholder engagement and experimental trials for promotional film

Activity 4.2 Publish a 2-3 minute video experimental methodology and variables required for analysis, which can be used for further scientific study

Activity 4.3 Promotional film edited and produced using footage captured during the project period.

Activity 4.4. 4 Blogposts/articles written bi-quarterly

4) Annex 3: Standard Indicators

Note: It was difficult to retroactively fit the Darwin Standard Indicators to this Darwin Innovation project. Project partners will reach out to Darwin in the next quarter to see how we can better fit our project indicators to the standard indicator framework.

i)Table 1 Project Standard Indicators

DI Indicator number	Name of indicator using original wording	Name of Indicator after adjusting wording to align with DI Standard Indicators	Units	Disaggregation	Year 1 Total	Year 2 Total	Year 3 Total	Total to date	Total planned during the project
DIA03	Number of local/national organisations ⁴ with improved capability and capacity as a result of project.	Number of local/national organisations involved in baseline/experimental data collection	Number of organisations	Organisation Type.	2 pole and line vessels 2 Processors providing input National Marine Science Institute providing support			5	N/A
DIC01	Number of best practice guides and knowledge products ¹⁰ published and endorsed ¹¹ .	Number of new data collection protocols developed and published	Number	Knowledge area.	0.5 Baseline data collection established			0.5	1

ii)

iii)Table 2 Publications

Title	Type (e.g. journals, manual, CDs)	Detail (authors, year)	Gender of Lead Author	Nationality of Lead Author	Publishers (name, city)	Available from (e.g. weblink or publisher if not available online)

Title	Type (e.g. journals, manual, CDs)	Detail (authors, year)	Gender of Lead Author	Nationality of Lead Author	Publishers (name, city)	Available from (e.g. weblink or publisher if not available online)

6) Checklist for submission

	Check
Different reporting templates have different questions, and it is important you use the correct one. Have you checked you have used the correct template (checking fund, type of report (i.e. Annual or Final), and year) and deleted the blue guidance text before submission?	✓
Is the report less than 10MB? If so, please email to BCF-Reports@niras.com putting the project number in the Subject line.	✓
Is your report more than 10MB? If so, please discuss with BCF-Reports@niras.com about the best way to deliver the report, putting the project number in the Subject line.	
Have you included means of verification? You should not submit every project document, but the main outputs and a selection of the others would strengthen the report.	✓
Do you have hard copies of material you need to submit with the report? If so, please make this clear in the covering email and ensure all material is marked with the project number. However, we would expect that most material will now be electronic.	✓
If you are submitting photos for publicity purposes, do these meet the outlined requirements (see section 16)?	
Have you involved your partners in preparation of the report and named the main contributors	✓
Have you completed the Project Expenditure table fully?	✓
Do not include claim forms or other communications with this report.	