DTU Aqua
National Institute of Aquatic Resources

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Ludvig Ahm Krag, Esther Savina, Mette Svantemann Lyngby and Rikke Frandsen

DTU Aqua Report no. 421-2023

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Content

Preface

This report presents the results from the project “Real-time kameraobservation i trawlfiskeriet – teknologibaseret intelligent fiskeri (TEKNOFISK)” with journal no. 33112-I-17-047, which received financial support from the European Maritime and Fisheries Fund and the Danish Fisheries Agency.

The aim of the TechnoFish project was to transfer and operationally mature a scientifically developed real-time camera technology for trawl fisheries to two different Danish fishing vessels. The development work in the TechnoFish project has been carried out in close collaboration with an industry follow-up group consisting of the skippers / vessel owners of the two fishing vessels involved as well as the equipment manufacturers who have supplied and installed winches and trawl cameras on board the vessels. Further have the Danish fisheries organizations DFPO and DPPO actively participated in project with advice and coordination of meetings.

Hirtshals, March 2023

Professor
Ludvig Ahm Krag

European Union
European Maritime and Fisheries Fund

HAV & FISK

Resumé [Dansk]

Projektet overfører og industri-modner et realtids kabelbaseret kamerasystem, udviklet i EU H2020 SmartFish projektet i samarbejde med Atlas Maridan og tidligere udviklet og testet ombord på DTU Aquas forskningsfartøj. Kamerasystemet kan, i realtid, under selve fiskeriprocessen, vise hvilke arter og størrelser der går ind i redskabet via et kabel der forbinder kameraet i redskabet med styrehuset. Kameraet kan også flyttes rundt på redskaber for at vise redskabets geometri, selektive anordninger eller andre områder med speciel interesse. Teknologien ændrer dermed fiskeri med trawl fra at være en blind proces hvor fangstsammensætningen først kendes når redskabet kommer til overfladen, til at være en informeret proces, hvor fiskeren kan tilpasse sit fiskeri undervejs i selve fangstprocessen. Systemet vil muliggøre at den enkelte fisker kan begrænse sin indsats, med tilhørende miljøpåvirkning og brændstofforbrug til områder hvor fangstsammensætningen er optimal. Samtidig minimeres fiskeriaktivitet i områder hvor effektiviteten er lav eller hvor bifangst-profilen ikke er gunstig. Teknologien vil være grundlagsskabende for næste generation af mere intelligente fiskeredskaber. Disse vil i højere grad udnytte tilgængelig ny teknologi til at sikre bedst mulig størrelses- og artsselektion samtidig med at de leverer detaljeret dokumentation af selve processen. Den etablerede moniteringsplatform vil muliggøre udviklingen af mere interaktive fiskeredskaber hvormed man kan reagere på det man ser i redskabet og dermed direkte kan vælge fangstkomponenter til og fra i fiskeri-processen. I dette projekt er kamerasystemet succesfuldt overført til kommercielle fiskefartøjer og der er opnået et operationelt niveau og en optimeret on-bord håndtering og system-integrering så systemet kan anvendes rutinemæssigt under kommercielt fiskeri.

Baggrunden for projektet
Den fælles fiskeripolitik har fokus på øget bæredygtighed i fiskeriet og på at stoppe udsmid af fisk ved implementering af en landingsforpligtelse. Dette betyder at fangst af kvoterede arter, også juvenile individer, fratrækkes fartøjets kvote og landingsforpligtelsen kobler dermed direkte fiskeriets selektivitet med dets økonomi. En fisker der mere målrettet kan begrænse fangsten til de arter og størrelser der efterstræbes, tjener således flere penge end fiskeren uden denne evne. Den nye fælles fiskeripolitik ændrer dermed konditionerne for optimering af både biologisk og økonomisk bæredygtighed i fiskeriet og selve forretningsmodellen for sektoren. Dette er en ambitiøs målsætning og det er derfor helt afgørende at fiskerisektoren sikres nogle stærke beslutningsværktøjer, der har en tilstrækkelig høj opløsning for at sikre en succesfuld implementering af den fælles fiskeripolitik, herunder specielt i forhold til landingsforpligtelsen. Muligheder for at følge fangstprocessen i real-time, samt at kunne reagere på oplysningerne, sikrer et sådant beslutningsværktøj. Realtids informations flowet er helt afgørende i denne sammenhæng. Kamerasystemer der ikke giver en realtidsdokumentation af processen, vil ikke give mulighed for at ændre fangstsammensætningen undervejs i fiskeriet. Et fungerende realtidsmoniteringssystem vil ikke alene bidrage til et mere bæredygtigt fiskeri og en større værdiskabelse i selve fangstsektoren. Systemet vil også på sigt kunne etablere en detaljeret dokumentation af den enkelte fangstoperation, og dermed understøtte en prisoptimering af produktet ude i afsætningsleddet for fiskerivarer i Danmark, ligesom det ses for flere produkter fra landbruget.

Formålet med projektet

Formålet med projektet er at overføre og kommercielt teste og modne et innovativt realtids trawl-kamera ombord på to danske fiskefartøjer. Systemet vil muliggøre at den enkelte fisker kan observere, vurdere og, hvis formålstjenligt, aktivt reagere på fiskeriprocessen. En reaktion kan f.eks. være at afbryde fiskeriet og søge alternativ fiskedyb eller plads. Projektet vil overføre videnskabeligt udviklet teknologi og operativt modne denne til fiskefartøjer der fisker med trawl. Helt specifikt overføres der et realtidstrawl kamera system ombord på to forskellige fiskefartøjer; i) et fartøj der fisker jomfruhummere og fisk i Skagerrak, og ii) et fartøj der fisker rejer i Skagerrak og Nordsøen. Formålet med at overføre state-of-the-art moniteringsteknologi til kommercielle fiskefartøjer er gøre fiskeriet med trawl til en mere intelligent proces hvor der aktivt, og på et væsentligt bedre grundlag, kan foretages beslutninger omkring fiskeriprocessen, hvilket kan sikre et økonomisk og økologisk mere bæredygtigt fiskeri.

Summary [English]

The project transfers and industrially matures a real-time cable-based camera system, developed in the EU H2020 SmartFish project in collaboration with Atlas Maridan on DTU Aqua's research vessel. During the fishing process itself, the camera system can qualitatively show which species and sizes enter the gear in real time via a cable directly to the wheelhouse. The camera can also be moved around to monitor how the gear geometry, implementation of selective devices or other areas of special interest. The technology thus transforms trawl fishing from a blind process to an informed process where the individual fisherman can react during the actual catching process. The system enables the individual fisherman to limit his efforts, with associated environmental impact and fuel consumption in areas where the catch composition is optimal. At the same time, fishing activity is avoided in areas where efficiency is low or where the bycatch profile is not favourable. The technology transferred in the project will form the basis for the next generation of more intelligent fishing gears. These will make greater use of available new technology to ensure the best possible size and species selection as well as detailed documentation of the capture process itself. The established monitoring platform enables the development of more active fishing gears with which you can react to what you see in the gear and thus directly select catch components on and off in the fishing process. The camera system has been successfully transferred to commercial fishing vessels achieving an operational level and an optimized on-board handling and system integration so that the system can be used routinely during commercial fishing.

The background of the project

The joint fisheries policy focuses on increased sustainability in fishing and on stopping the discarding of fish by implementing a landing obligation. This ensures that catches of regulated species, including juvenile individuals, are deducted from the vessel's quota and the landing obligation thus directly links the selectivity of the fishery with its economy. A fisherman who can more purposefully catch the species and sizes he is after thus has a clear financial advantage. The new common fisheries policy thus changes the conditions for optimizing both biological and economic sustainability in fishing and the business model for the sector itself. This is an ambitious objective, and it is therefore absolutely crucial that the fishing sector is provided with some strong decision-making tools that have a sufficiently high resolution to ensure a successful implementation of the common fisheries policy, especially in relation to the landing obligation. Opportunities to follow the capture process in real-time, as well as being able to react to the information, ensure such a decision-making tool. The real-time information flow is crucial in this context. Camera systems that do not provide real-time documentation of the process will not provide the opportunity to change the catch composition during fishing. A functioning real-time monitoring system will not only contribute to more sustainable fishing and greater value creation in the fishing sector itself. In the long term, the system will also be able to establish detailed documentation of the individual fishing operation, and thus support a price optimization of the product out in the market for fishery products in Denmark, just as there are many examples of this in agriculture.

The purpose of the project

The purpose of the project is to transfer and commercially test and mature an innovative real-time trawl camera on board two Danish fishing vessels. The system will enable the individual fisherman to observe, assess and, if appropriate, actively react to the fishing process. A reaction can, e.g., be to interrupt fishing and seek alternative fishing depth or space. The project will transfer scientifically developed technology and operationally mature this to fishing vessels that fish with trawls. Specifically, a real-time trawl camera system is transferred on board two different fishing vessels, a vessel that fishes Norway lobsters and fish in the Skagerrak and a vessel that fishes shrimp in the Skagerrak and the North Sea. The purpose of transferring state-of-the-art catch monitoring technology to commercial fishing vessels is to make fishing with trawls a more intelligent process where decisions can be made more actively and on a significantly better basis regarding fishing practice that can ensure an economic and ecological more sustainable fishing.

1. Background

1.1 Need for high-resolution decision-making tools to ensure a successful implementation of the common fisheries policy

The new common EU fisheries policy focuses on increased sustainability in fishing and on stopping the discarding of fish by implementing a **landing obligation**. Catches of regulated species, including juveniles, are deducted from the vessel's quota and the landing obligation thus **directly links the selectivity of the fishery with its economy**. Having better control over what species and sizes are caught offers a clear advantage for the fisher in the context of the landing obligation.

Fishing is, until now, a **blind process** where catch composition can be assessed only after the gear is hauled back on deck at the end of the fishing operation. Until now, the fisher can only manage what is caught by relying on the selective properties of the gear, and choosing operational tactics known to optimize the catch of a given target species such as time of the day or fishing ground. It is common to adjust operational tactics based on catch in the previous haul or catch from another vessel fishing nearby. But currently there is no access to information allowing decision making during the fishing operation itself.

To ensure a successful implementation of the ambitious objectives of the common fisheries policy and guarantee a viable activity for the fishing industry, it is crucial that the fishing sector is provided with some **high-resolution decision-making tools**. Such a tool should provide the fisher with information on what is happening in the gear during the capture process in real-time to allow an evaluation of the accumulating catch during the fishing process and actively react on it.

1.2 Technology-transfer to the Danish industry

Technology-based innovation such as underwater real-time observations and artificial intelligence can be adapted to the specificities of the fishing industry to make fishing significantly more targeted and well-documented.

SMARTFISH H2020
Innovation for sustainable fisheries

EU recently invested 40M DKK in technology-based innovation for the fishing sector through the **Horizon 2020 (H2020) project Smartfish** involving 18 scientific and industrial partners in all European waters (2017-2022). As part of the Smartfish project, DTU Aqua developed and tested a **real-time camera system in trawls**.

The EMFF Technofish project ensured a **transfer of the technology to the Danish fishing industry** by adjusting the real-time camera system to the Danish technical, operational, and environmental conditions. We accompanied two commercial vessels to use the real-time camera system during their regular fishing operations, to ensure **optimal commercial uptake** of the system.

2. Stakeholder follow-up group (WP1)

To guarantee that the system is fit for use by the Danish fishers and ensure that the introduction of such a technology fulfills the industry and managers' needs, a **follow-up group** was gathered, consisting of:

- Danish Fishermen Producer Organization (DFPO)
- Danish Pelagic Producer Organization (DPPO)
- Equipment manufacturers and suppliers
- Electricians/blacksmiths with experience in camera-based underwater observation and on-board installation
- Technicians and researchers from DTU Aqua with competence from the EU-H2020 Smartfish project
- Atlas Maridan.

The stakeholder group met several times in subgroups targeting the different Danish fisheries and different stages in the development process, including meetings in fishing harbors and onboard fishing vessels to discuss different details on the system out-lay, vessel mounting, onboard handling/trawl integration and design of onboard control and presentation unit (Figure 1).

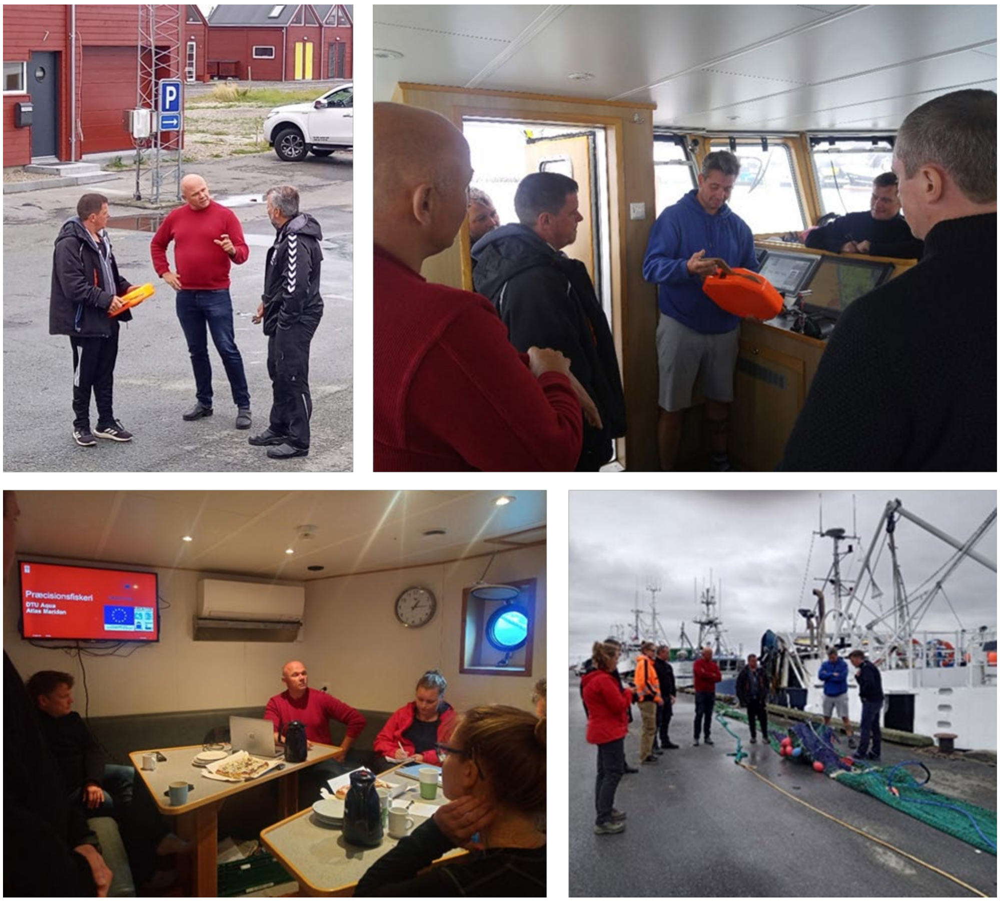


Figure 1. Workshop with the two commercial fishers testing the camera system for Technofish and journalists onboard the DTU research vessel in Standby.

3. Specification of the system (WP2)

3.1 The underwater real-time camera

The camera, which can come as single-lens or in a stereo setup for being able to measure fish length, is compacted in a waterproof case together with LED light source (Figure 2). Both the camera and the lights are powered through the coax cable (see below 3.2). The camera system is then placed in the trawl codend extension (Figure 3).

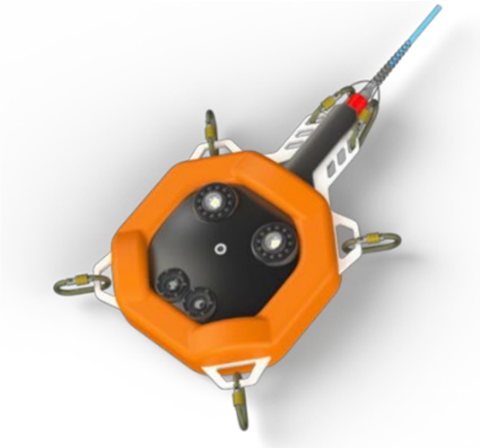


Figure 2. The camera (SeaScout), here in a stereo setup, and LED light source compacted in a water-proof case.

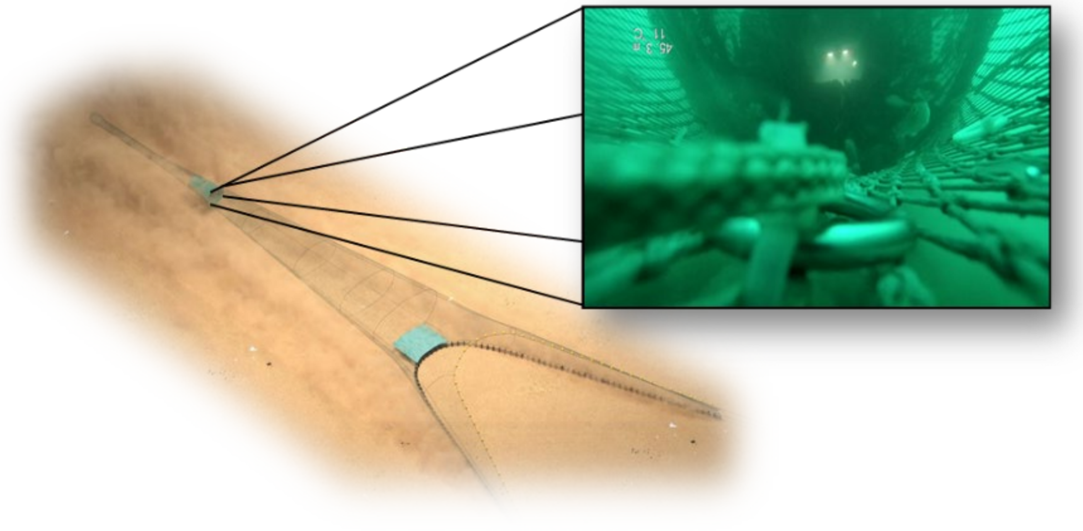


Figure 3. The camera system placed in the trawl codend extension.

3.2 The sediment suppressing system to obtain clear trawl-camera image during demersal fishing

The idea of using cameras in trawl and other towed fisheries to obtain information about the on-going capture process is not new. The development towards such camera-based technology in the trawl fishery has however not been developed for demersal trawl, such as the *Nephrops* fishery, as observation conditions are too poor to obtain any quantitative information. Indeed, because *Nephrops* inhabit muddy grounds and are targeted by low headline trawls, most of the aft part of the trawl is wrapped in the mobilized sediment from the ground gear and the towing-rig during fishing (Figure 4).

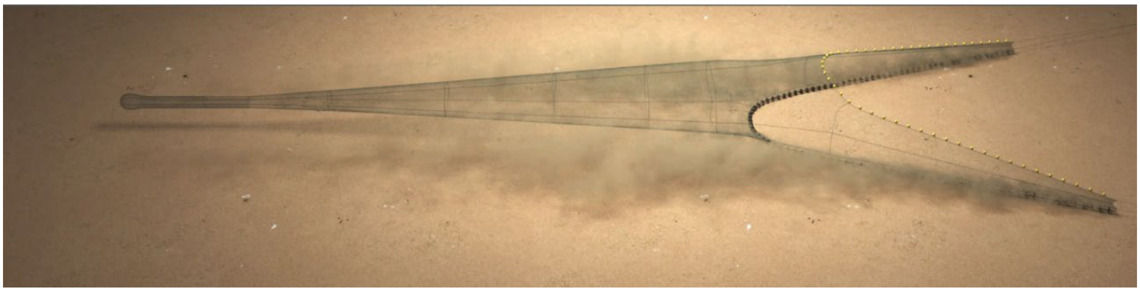


Figure 4. Fishing gears that are towed along the seabed will mobilize sediment into the water column and will increase the water turbidity. This has been the major reason for the limited use of camera technology in demersal trawls.

In the EU H2020 SmartFish project, DTU Aqua developed a system to reduce the sediment mobilization in demersal trawls during fishing (Sokolova et al., 2022). This sediment suppressing system consists of a sheet of canvas in the front of the trawl and a camera observation section in the aft of the trawl (Figure 5). When implementing this setup, it was, for the first time ever, possible to obtain consistent clear images from demersal trawl fisheries.

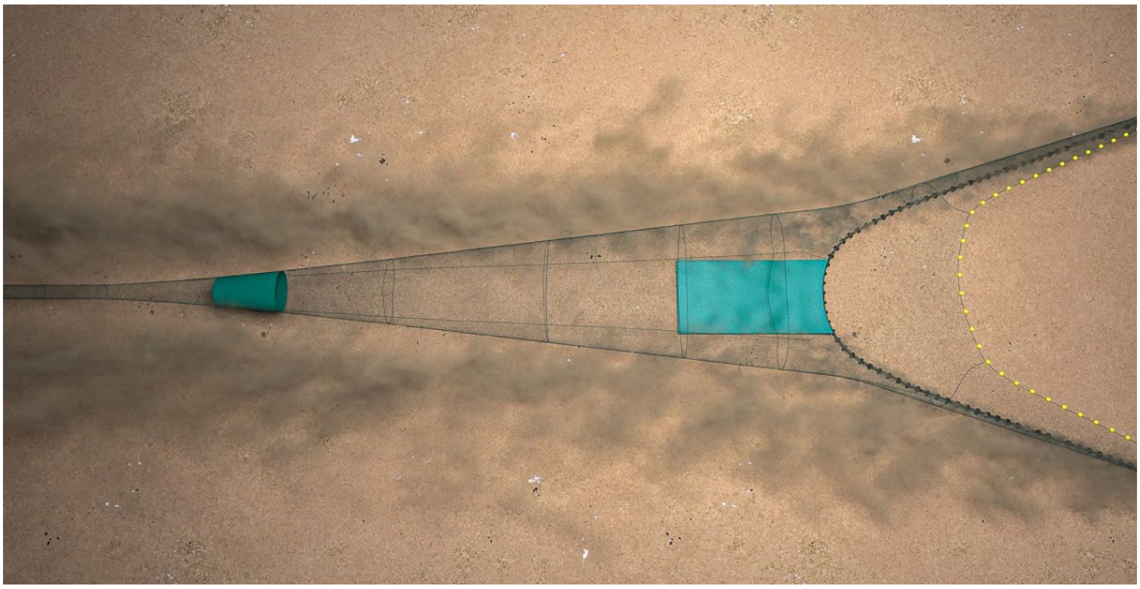


Figure 5. The developed sediment suppression system with the forward sediment suppressing sheet and the aft observation section (cylinder). The trawl camera is integrated in the aft cylinder for catch monitoring but can be moved freely around the gear for gear surveillance.

3.3 The co-axial cable between the camera and the vessel

A coax cable powers the camera system underwater and sends video stream in real time back to the wheelhouse. The cable runs from a separate winch from the vessel down to the gear. A tension-release ring is placed at the headline, to take the main tension from the cable and thereby protect it (Figure 6).

Figure 6. The coax cable and winch onboard the DTU research vessel (left) and the tension release ring (right).

The coax cable runs backwards from the headline of the trawl to the observation scene, where a second tension release ring takes the tension from the cable just in front of the camera. This system ensures that the camara is not damaged by forces working on the cable and makes it applicable for any kind of trawl design, large or small.

3.4 The monitor in the wheelhouse

The video signal is sent in real-time to a monitor in the vessel's wheelhouse displaying the images from the camera system (Figure 7). This enables the skipper to react and adjust on the provided information during the ongoing catch process.

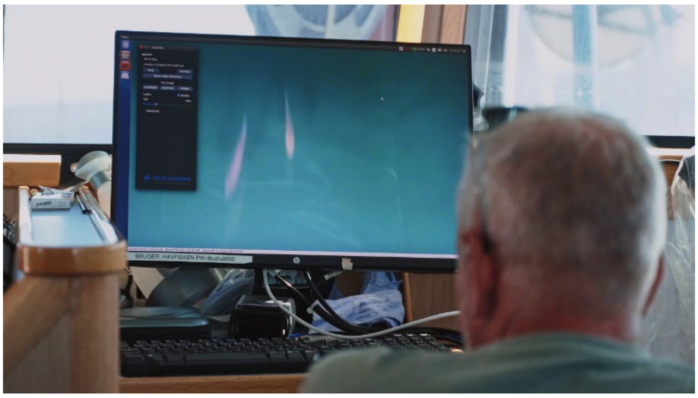


Figure 7. The monitor in the wheelhouse where it is possible to see in real-time the catch entering the codend.

4. Installation onboard vessels and operational adjustments for simple and safe handling at sea (WP3)

4.1 From proof of concept to commercial testing

In the EU H2020 Smartfish project, the development of the trawl camera and observation scene primary focused on establishing a robust and operational system for trawl fisheries (proof of concept). The system was developed by DTU Aqua onboard its research vessel rigged for fishing Havfisken.

The camera system hardware and the software were further improved for commercial uptake thanks to collaboration with the Danish company Atlas Maridan as part of the Technofish project. The technology (Sea Scout) is today available to the industry through Atlas Maridan.

ATLAS MARIDAN
A company of the ATLAS ELEKTRONIK Group

For uptake of new technology on commercial fishing vessels, the practical handling, robustness, and ease of use are very important. It is particularly important that the use of the technology does not reduce the vessel's fishing time and thereby catch. Thus, the Technofish project aimed at further developing and testing the camera system in commercial conditions. The camera system was developed and tested in two Danish fisheries, the mixed Norway lobster (*Nephrops norvegicus*) directed fishery, and the deep-water shrimp (*Pandalus borealis*) trawl fishery (Figure 8).

Figure 8. The two participating fishing vessels, FN 462 Jeanne targeting Norway lobster (left) and HM 424 Westbank targeting deepwater shrimp (right).

Several meetings and discussion were held between DTU Aqua and the two skippers (Peter Hurst and Henrik Christensen) to make sure that the developed system would work best possible onboard their commercial fishing vessels during commercial fishing operation.

4.2 Optimization of the sediment suppressing system for simple and safe handling at sea

The sediment suppressing system was transferred to the Technofish project and modified to fit the dimensions of the two vessels' commercial trawls. The sediment suppressing sheet needed to be positioned in the center of the ground gear without altering the overall geometry in the trawl mouth when fishing. In both fisheries, the sediment suppressing sheet was 3 m wide and 5 m long (Figure 9).

Figure 9. Sediment suppressing sheet installed in the centre of the ground-gear in the Nephrops directed mixed species trawl (FN462 JEANNE). The left picture shows the sediment sheet installed in the lower panel of the trawl, and the right picture shows its attachment forward to the ground gear. The sheet needs to be attached as close to the ground gear as possible.

Commercially fishing for Norway lobster or deep-water shrimp normally operates with a standard twin-trawl in a three-wire towing-rig. With the camera system, a fourth wire is used for communication and power of the system. The observation scene is therefore made without any rigid structure and the camera is installed in a pocket for easy access The dimensions of the observation scene (aft cylinder) are designed in the forward end to fit the number of meshes in circumference – see details below.

4.3 Application to the mixed *Nephrops* directed trawl fishery

The observation scene (aft cylinder on fig. 5) was mounted in the aft end of the trawl where circumference is reduced to approximately 2 meters and where it is possible to observe the entire catch from a single position. The scene is a separate gear section made in a 3.5 m four panels netting section (Figure 13) which allows a fast integration and removal form the trawl. This simple design makes it possible to switch the camera position from a top view to a side view simply by rotating the section 45 degrees. Indeed, a top view gives the best images for detection of *Nephrops* or flatfish, whereas a side view is optimal for round fishes such as cod, as their species characteristics is on the side. The dimensions of the observation scene are designed in the forward end to fit the number of meshes in circumference, where the meshes have an expected opening of 30 degrees based on earlier experience from flume tank measurements. The section was 3 meters long and made with a tapering of 10-20%. The tapering ensured that the observation scene is fully open and stable during towing without the use of rigid structures (Figure 10, Figure 11, Figure 12). The camera was installed in a pocket with easy access (Figure 10).

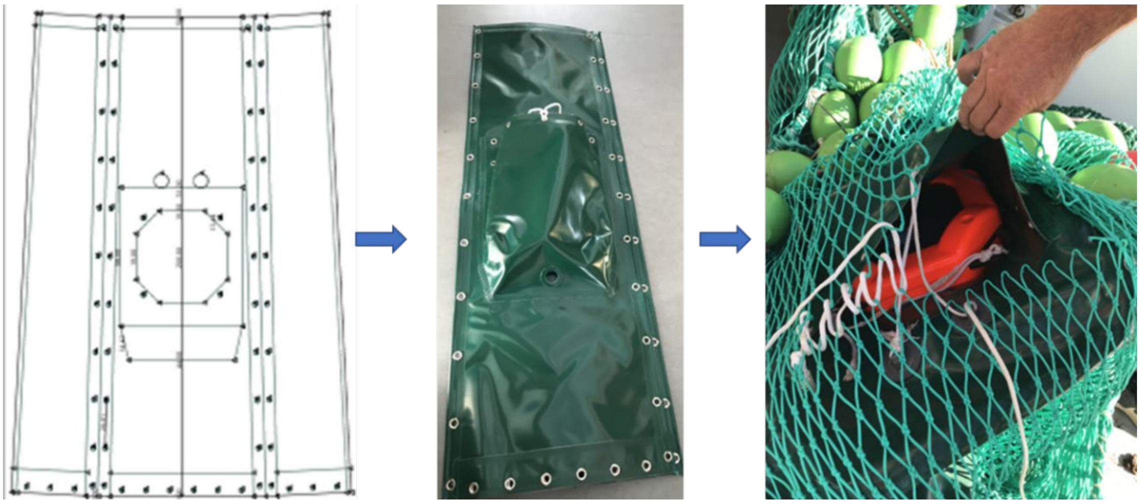
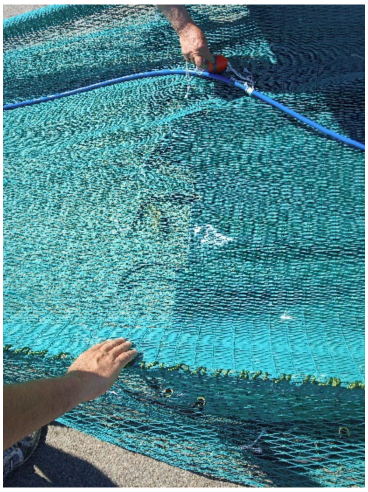


Figure 10. Observation scene with integration of the camara in a pocket as designed for the *Nephrops* directed fishery onboard FN462 Jeanne.

Figure 11. Observation scene (render) designed for Nephrops trawl during towing.

Figure 12. Underwater image looking backwards into the observation section. Cod and whiting are observed holding in front of the observation section before entering and passing through towards the codend.



The observation section was integrated in a separate gear section made in a 3.5 m four panels netting section (Figure 13). The gear section can therefore be integrated into the trawl or remove with ease.

A green color for the observation scene in the mixed *Nephrops* directed trawl fishery was demonstrated to be the best background for discriminating Norway lobster (Sokolova et al., 2021).

Figure 13. The four-panels netting section.

4.4 Application to the deep-water shrimp (*Pandalus borealis*) trawl fisheries

The fishery for deep water shrimp uses larger trawls than those used in the fishery targeting Nephrops. The observation scene was therefore made accordingly bigger and measured 100*100 cm in the front and 90*90 cm aft part and were made in a 3.5 m long section (Figure 14). The design of the camera pocket was identical to the one used in the *Nephrops* fishery (Figure 14).

For deep water shrimp, we used a blue color canvas which is the complimentary color to the color of shrimp, to optimize visual detection.

Due to the large sizes of shrimp trawls, an alternative rigging of the coaxial cable was tested to ease onboard handling with sections of the cable integrated into the trawl and connected with SubCon connecters (Figure 15).

Figure 14. Observation section for deepwater shrimp fisheries. The observation scene is inserted in a 3.5m four panel netting section (left). Camera pocket on the inside (right).

Figure 15. Mounting of camera and connecting transmission and power cable in deepwater shrimp trawl (left). Camera system mounted and ready to go at sea (right).

5. Commercial uptake (WP4)

5.1 Onboard FN462 Jeanne (*Nephrops* fishery)

The full system was installed onboard FN 462 Jeanne in 2021. There was a short break-in period during which the operations of the system's single components were adjusted, after which the full system was operational onboard FN 462 Jeanne. The skippers of both vessels have since kept the camera systems onboard for continues use.

FN 462 Jeanne experimented with different camera positions in the trawl from the trawl mouth (Figure 16) to the aft position in front of the codend (Figure 17). The trawl camera system provided clear images of the trawl performance (forward positioning) as well as quantitative information of the catch entering the observation scene in front of the codend.

Figure 16. Image from the wheelhouse of FN462 Jeanne during trawling. Here the camera is mounted in the forward part of the trawl to monitor the operational performance of the gear.

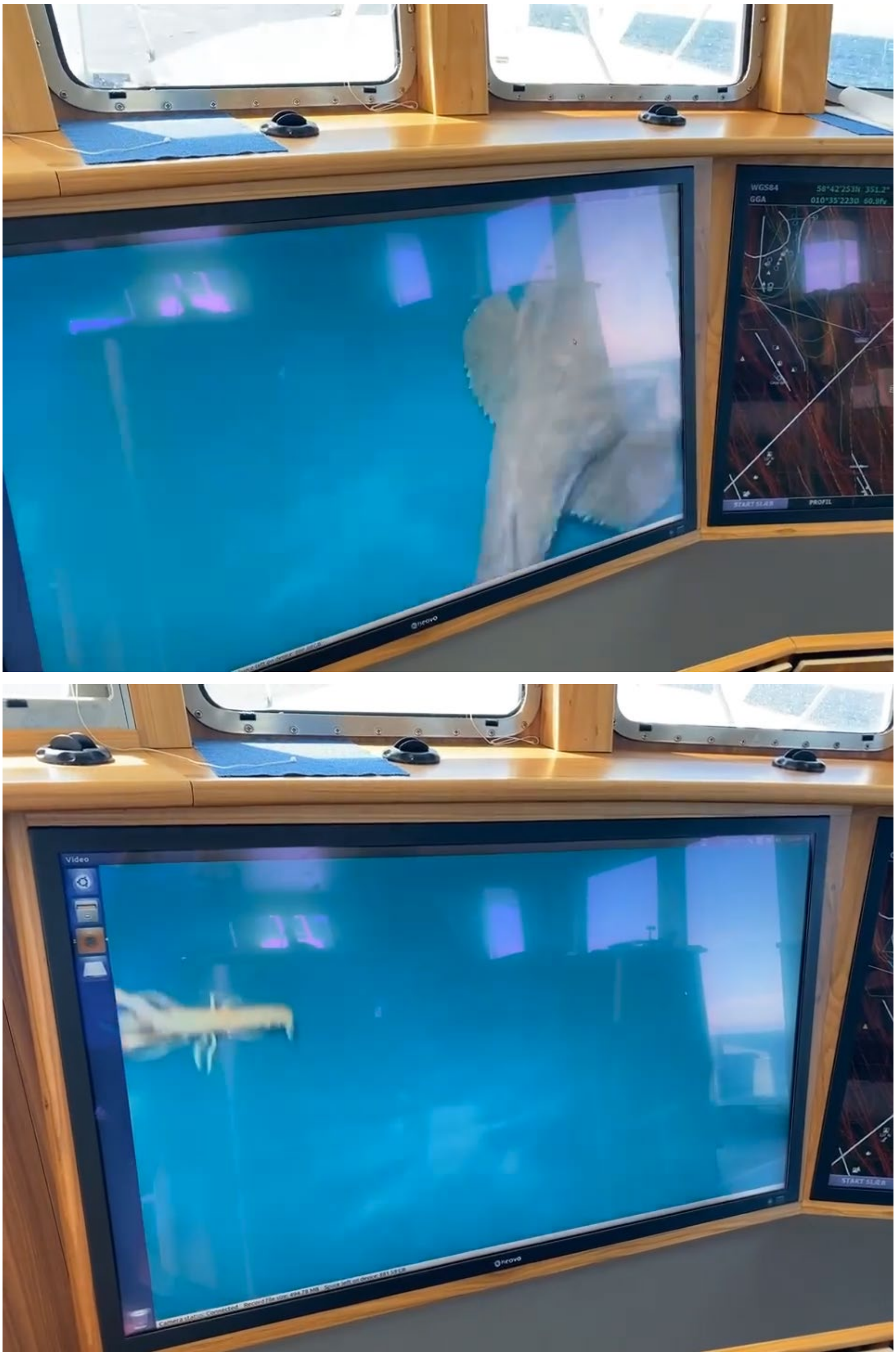


Figure 17. Image from the wheelhouse of FN462 Jeanne during fishing. Here the camera is mounted in the observation section and the catch entering the codend is shown, a large monkfish (up) and a *Nephrops* (down) entering the codend.

5.2 Onboard HM 426 Westbank (deep-water shrimp fishery)

The full system was installed onboard HM 426 Westbank in 2022, but the system did not reach operational performance during the duration of the project. Work towards an operational performance onboard Westbank however continues with strong engagement from the skipper of the vessel.

Due to the large size of the shrimp trawls, an alternative rigging of the coaxial cable was tested to ease onboard handling with sections of the cable integrated into the trawl and connected with SubCon connecters. The system eased practical handling but lost signal during fishing likely due to the extra connectors. This system will be further developed by the skipper and is expected to reach an operational level soon.

Due to the above-mentioned difficulties to obtain a stable video-feed onboard HM 424 Westbank, DTU Aqua tested the system onboard Havfisken in the deep-water shrimp fishery.

5.3 Onboard Havfisken (deep-water shrimp fishery)

The system onboard Havfisken differed from the system onboard HM 424 Westbank by only having a single SubCon connector along the cable.

Images of similar quality as in the *Nephrops* directed fishery were obtained, allowing to collect quantitative information on gear performance and catch composition (Figure 18, Figure 19).

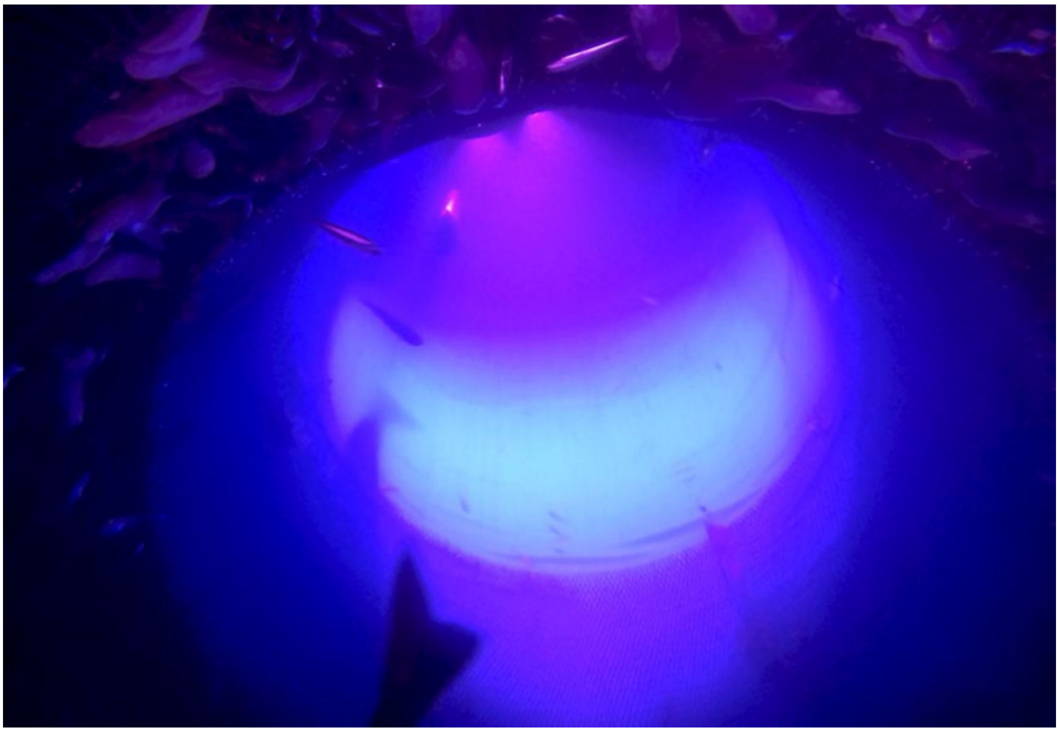


Figure 18. Forward view into the observation section in the deepwater shrimp trawl at about 250m of depth. Notice the two lights from the camera inside the observation section.

Figure 19. The camera system in combination with the developed sediment suppressing system delivers a stable feed of high quality in the deep-shrimp fishery.

Operating the trawl camera system in the observation scene without a sediment suppressing system proved possible in the shrimp fishery as the mobilized sediment did not reach the extension of the trawl during the experiential fishing. This is likely due to the high headline (+10m) trawl used in the fishery for deep-water shrimp, lifting the extension and thus allowing the mobilized sediment to pass underneath.

5.4 Fishers' feedback

Feedbacks from both skippers and local fisherman's organization were positive, and they will both continue using the system onboard (Figure 20).

Fordele og ulemper

Claus Hjørne Pedersen, der er formand for Strandby Fiskeriforening, og som selv har et fartøj, der fisker efter jomfruhummere, var med på turen.

Han så især et stort potentiale i muligheden for at få et overblik over, hvor det præcist er, man har fanget jomfruhummerne under et slæb.

Til gengæld mener han, det er vigtigt, at man får udviklet systemet, så man undgår at skulle bøvle med et stort kabel ned til kameraet.

Han konstaterede også, at systemet ikke er helt billigt. Det koster cirka 360.000 kroner foruden udgifter til kabel og flere andre ting, som skal til for at få systemet til at fungere. I alt vurderes udgifterne at løbe op i cirka en halv million kroner.

Claus Hjørne vurderede derfor også, at det nok især er store og mellemstore fartøjer, der vil overveje at investere i et trawlkamera.

Det bliver ikke vanskeligt gang, og jeg kan sagtens det sammen med mine Men jeg vil gerne prøve, t kan virke uden presen-. Måske vi kunne flytte et længere ud? Og lege standen til lyset, foreslår Westbank, hvilket inge- Dr. Max Abildgaard fra MARIDAN noterer.

kan man også vende et for at se, hvordan opfører sig i trawlposen. som Henrik Christensen bruge i designet af nye ber:

mange mindre juste- som man kunne tilføje dre.

Lørdag 5. september 2020 / fiskeritidende 17

Peter Husth
FN 462 Jeanne
Strandby

Mindre held og mere effektivt

- Lige nu er det nok 50 procent erfaring og 50 procent held. Men på den her måde, kan vi jo blive klogere og finde ud af, hvad der virker.

Sådan siger Peter Husth, der er skipper på FN 462 Jeanne, og som godt kan se fidusen i, hvis han fra styrehuset kan se fangsten. Når han tager på jomfruhummerfiskeri, så kører det efter helt bestemte rutiner, men måske er de ikke de rigtige. Måske er det slet ikke nødvendigt at fiske så længe, som de gør i dag? Det er svært at afgøre, fordi de jo ikke præcis ved, hvad der foregår.

- Vi sejler afsted og slæber i 5-6-7 timer. Men jeg er ikke sikker på, at det nødvendigvis er det rigtige. Jeg tror ikke, at vi fanger noget hele tiden, men at hummerne kommer i ryk. Hvis jeg fra styrehuset kan se, hvad der sker nede i trawlet, så er jeg sikker på, at vi kan få et mere effektivt fiskeri. Hvis jeg kunne se, at vi efter et par timer slet ikke havde fanget noget, ville jeg overveje, om vi skulle sejle videre og finde en anden plads, forklarer fiskeren.

Der er altså mange muligheder, hvis skipper kan få syn for sagen – og udviklingspotentiale, hvis man kombinerer billederne med lys, smarte redskaber mm.

- Det kunne jo være smart, hvis der var noget lys, som skræmte torsken, så den ikke svømmede ind, opfordrer Peter Husth forskerne til at overveje og undersøge.

Peter Husth er klar, og det er FN 462 Jeanne også, som allerede da hun blev bygget for et par år siden, tænkte den nye teknologi ind i spil og hydraulik. Ledningerne ligger klar!

Figure 20: The industry perspective, extracts from interviews published in FiskeriTidende.

6. Stable and clear live feed towards automatic detection (WP5)

The camera system gave a stable and high-quality live video feed from the trawl to the wheelhouse in real-time for both fisheries (Figure 21). Images obtained are at quality where gear performance can be controlled for, and species can be easily identified.

Figure 21. Examples of quality of image output – here in the *Nephrops* fishery from the recorded videos onboard Havfisken.

Commercially important species, as well as bycatch- and charismatic species, can be recognized by the human eye in real-time during the fishing operation. However, the skipper might not want/be able to just sit and watch the catch passing by, and automatic detection and counting is therefore relevant.

In both fisheries, the obtained image quality was high and will in the future enable automatic detection and tracking. Processed information on catch levels and average sizes of individuals entering the catch can thereby be established. Such information is expected to deliver a strong decision tool for the single fisher in the process of catching the target species in the correct size range while largely avoiding the remaining species (Figure 21). DTU Aqua is currently developing automatic species detection and tracking in the EMFF project AutoCatch.

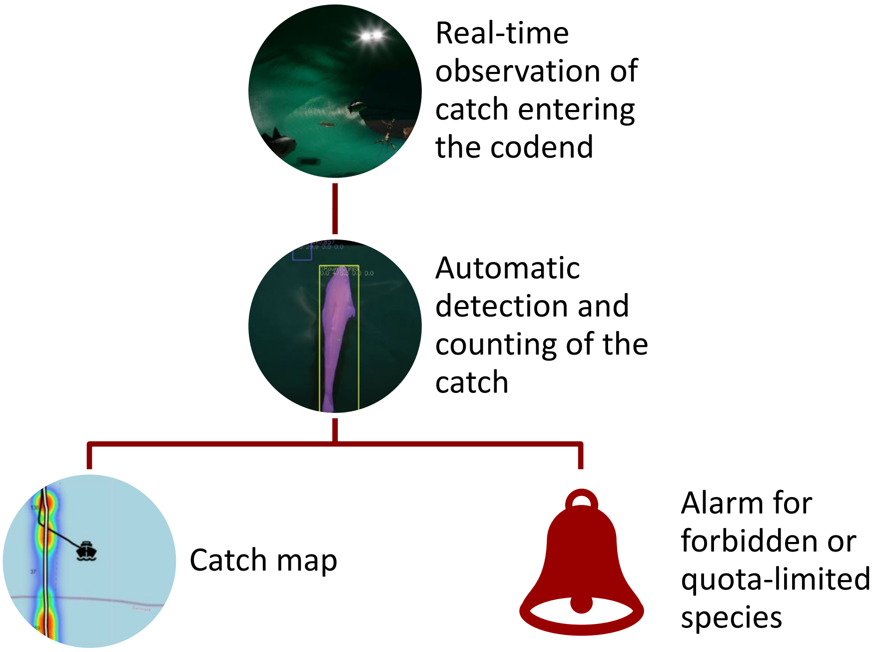


Figure 22. Real-time information as a strong decision tool during fishing.

○

7. Future perspectives

Fisheries and in particular trawl fisheries are challenged with increasing management ambitions in relation to bycatch, CO2 emissions, ecosystem effects of fishing and other parameters. The industry will need more efficient and precise technologies and decision tools to improve on these parameters. The real-time camera system developed in EU Horizon 2020 SmartFish have proven able to provide such detailed real-time information on the ongoing catching process.

Within the TechnoFish project, this technology is for the first time transferred to commercial fishing vessels and lifted to a fully operational level where the skippers can use the system actively during fishing activities similar to other sensors and technologies used onboard. The camera system is today commercially available through the Danish company Atlas Maridan. The basis for a more technology-based trawl fishery, with real-time catch monitoring is therefore established within the current project.

Stable and clear live feed providing real-time monitoring of catch rates of different species and sizes, allow the skipper to make informed decisions during the fishing operation. With the possibility to change fishing tactics during fishing, the fisher can improve both the ecological and the economical sustainability in the fisheries which will result in the following directly measurable effects for Danish fishing with trawls (Figure 23):

1. Optimizing the allocation of fishing effort.
2. Optimizing economic and ecological sustainability in Danish trawl fisheries.
3. Minimizing unintended effects of fishing, for example impact on the seabed and catching of unwanted species. In addition, a reduced CO2 emission is expected as the quota can be captured with less effort.
4. Detailed quantitative documentation of the capture process.

Overall, such real-time information availability during the catching process is expected to significantly improve the economic and biological sustainability of Danish fisheries. In addition, it is expected to be instrumental in ensuring a successful implementation of the landing obligation.
The establishment of a real-time camera system with images from the trawl during the entire fishing process is expected to be fundamental to the development of a new generation of fishing gear that delivers more intelligent and better documented fishing with a significantly higher use of technologies.

The real-time camera system developed in the project is expected to achieve uptake in both national and international fisheries, particularly in well-controlled fisheries with ambitious management initiatives. Based on positive feedbacks following the dissemination activities of the project, towards not only the fishing industry but also managers and other researchers, a gradual up-take of the real-time monitoring system is expected in both national and international fishing with trawls.

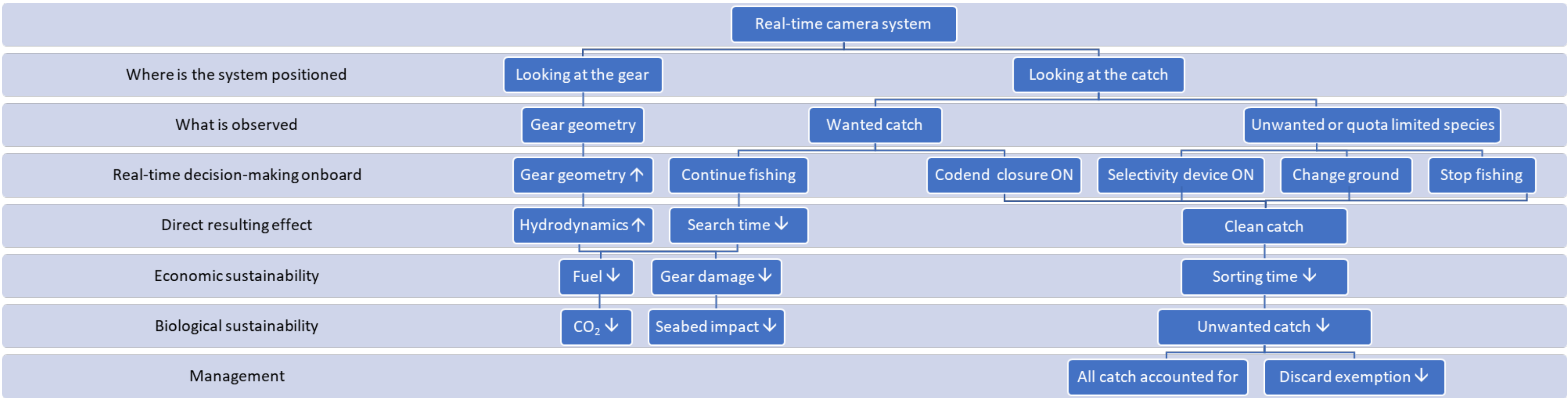


Figure 23. The real-time information during the catching process is expected to significantly improve the economic and biological sustainability of Danish fisheries and ensure a successful implementation of the landing obligation. ↓ reduced, ↑ improved

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