SC/69A/HIM/17

Sub-committees/working group name: HIM

Chilean experience in the diagnosis, regulation and control of discards an incidental bycatch

Luis Cocas And Jorge Guerra

Chilean experience in the diagnosis, regulation and control of discards an incidental bycatch

Luis Cocas[1] and Jorge Guerra[1]
[1]Undersecretariat for Fisheries and Aquaculture, Government of Chile

Abstract
Within the framework of the implementation of a fisheries management strategy with an ecosystem approach, and following the recommendations of FAO and other fisheries forums, aimed at guaranteeing ocean´s sustainability and food security, Chile has developed since 2012 a process of diagnosis, reduction and control of discards and incidental bycatch in its national fisheries. This process has involved the joint efforts of the regulatory, research and control agencies along with a collaborative work with the fishing users, leading the country to the gradual solution of the problem.

Regarding marine mammals' bycatch specific measures, these have been promulgated in 2021 for industrial purse seine fisheries, artisanal traps, industrial trawling and artisanal gillnets, establishing the mandatory use of devices along with the application of fishing maneuvers to release specimens into the water, handling protocols on board, codes of good practices and reporting in logs, among others. These components are of differentiated application depending on the target fishery, gear, and type of fleet.

Finally and considering the challenges of controlling and registering discards and incidental bycatch at sea, it was recently incorporated the mandatory use of EMS (Image Recording Devices - **DRI** and Electronic Logbook System - **SIBE**) to control compliance, with differentiated application depending on the type of fleet, together with the maintenance and enhancement of human observation programs for scientific purposes.

Introduction

Given the current levels of fishing effort and a general lack of management, discards and incidental bycatch have become global issues that threaten fisheries sustainability. Despite its importance the problem doesn´t show significant progress over time as evidenced by a number of FAO global assessments, with currently about 10% of world catches being discarded (Pérez Roda et al., 2019). The Interaction of fishing with seabirds, marine mammals and sea turtles may also be critical in some places of the world, which on top of other environmental pressures, has led many of these species to critical conditions of conservation. Therefore, managing discards and incidental bycatch is a must for a fishing nation, but first is required the collection of unbiased and independent data on what happens at sea during fishing operations since these issues are invisible at landings points which is where most of the fishing monitoring has focused on the past.

Aware of these conditions, and within the framework of the implementation of a fisheries management strategy with an ecosystem approach, aimed at guaranteeing ocean´s sustainability and food security (as FAO and other fisheries forums have recommended), Chile has developed since 2012 an effective process of diagnosis, reduction and control of discards and incidental bycatch in its national fisheries. This process has involved the joint efforts of the regulatory (SUBPESCA[1]), research (IFOP[2]) and control (SERNAPESCA[3]) agencies along with a collaborative work with the fishing users, the academia and NGOs, leading the country to the gradual solution of the problem.

Furthermore, considering the challenges of controlling and registering discards and incidental bycatch at sea, it was recently incorporated the mandatory use of EMS (Image Recording Devices **DRI** and Electronic Logbook System **SIBE**) to control compliance, with differentiated application depending on the type of fleet, together with the maintenance and enhancement of human observation programs for scientific purposes (**Figure 1**).

[1] Subsecretaría de Pesca y Acuicultura/Undersecretariat for Fisheries and Aquaculture
[2] Instituto de Fomento Pesquero/Fisheries Development Institute
[3] Servicio Nacional de Pesca y Acuicultura/National Fisheries and Aquaculture Service

Methodology

There has been a 20-year evolutionary regulatory framework that has played an essential role in the development of discard and incidental bycatch's management to its current state.

In 2001 the term discard was first introduced in the Chilean legislation under one approach of a general prohibition of discarding fish that did not distinguish between species or sizes. Heavy sanctions to offenders and the lack of an extensive system to monitor compliance with this regulation at sea, made fishers uncooperative and consequently the real extent and causes of discards remained unknown to the fishing authorities. On the other hand, the directed catch on marine mammals, sea turtles and seabirds were already eradicated by 2008 through different laws and regulations (Exempt Decrees N° 225 of 1995, N° 179 of 2008 and N° 4 of 2021 and Law N° 20293 of 2008). However, the problem of involuntary catch or incidental catch during fishing operations, which was the remaining source of mortality for these groups, was not clearly afforded and required its inclusion in the law.

In recognition of these restrictions, the Chilean government reviewed the fisheries law in 2012, and through the law N° 20625/2012, incorporated the concepts of **discards** "*action of returning captured hydrobiological species to the sea"* and **incidental bycatch** "*marine reptiles, seabirds and marine mammals"* along with sanctions to the offenders and modern mechanisms for control. To solve efficiently the problem, the law also incorporated a new step wise approach, which in a first stage considered exceptions to the penalties, conditional on a minimum of two years fishery-based research monitoring programs, by observers on board, to quantify and identify the precise causes of discards and incidental bycatch. The exemption to penalties was included to prevent atypical behavior by crews that could bias the results and to gain the trust of fishermen. However, once the research programs concluded, the exemption of penalties ended (**Figure 2**).

The technical background obtained through the research programs was used to develop, at a later stage, mandatory reduction plans for these practices, tailored for each fishery. The reduction plans include *i)* management and conservation measures along with the technological means (such as the use of devices, excluders, handling protocols, etc.) necessary to reduce discards of both target and non-target species as well as the incidental bycatch of seabirds, marine mammals and sea turtles, *ii)* a program for monitoring and follow-up of the plan's performance, *iii)* an assessment of the measures adopted to reduce discards and incidental bycatch, *iv)* training and dissemination programs, *v)* codes of good practices during fishing operations, and *vi)* incentives for innovation in systems and fishing gear, whose objective is the mitigation or reduction of discards and incidental bycatch.

Having finished several fishery-based research monitoring programs by observers on board as required by law N° 20625/2012, by 2022, 11 discards and incidental bycatch reduction plans have been established, covering 17 fisheries both artisanal and industrial, while other fisheries are still in the research (exceptions ban) phase. Additionally, the lists of species subject to the reduction plans for each fishery and the regime in which they are (prohibited discard, authorized discard, mandatory return to the sea) are updated annually.

In a final stage and considering the challenges for controlling and registering discards and incidental bycatch at sea, the law N°20625/2012 also incorporated the use of Image Recording Devices or cameras onboard (DRI) (**Figure 3**). To implement the DRI, in 2015 a Supreme Decree N° 76/2015 established the requirements for these systems on both industrial and artisanal fleets. This regulation set out the DRI's components, DRI's technical and design requirements, minimum number, and location of cameras by fishery, the characteristics of the collection, processing and confidentiality of images, obligations to vessel owners, the role of SERNAPESCA, requirements for removing, downloading and processing DRI's information, penalties for non-compliance, and requirements for external entities that eventually may get involved in the images review. In Chile, although the law allows the participation of third parties in the images review, currently this task is being performed exclusively by the government, through SERNAPESCA, while is recognized that the experience gained from conducting review internally would guide any future outsourcing process. There are also a set of complementary resolutions from SERNAPESCA, that established the unique technical standard for the DRIs, the procedure for accreditation of DRIs, requirements for the location, height, direction and angle of each camera by fishery, type of vessel and fishing gear, among others. Finally, a resolution from SERNAPESCA N° 5930/2019, established the start date for the entry into force of this control system (DRI), as January 1, 2020.

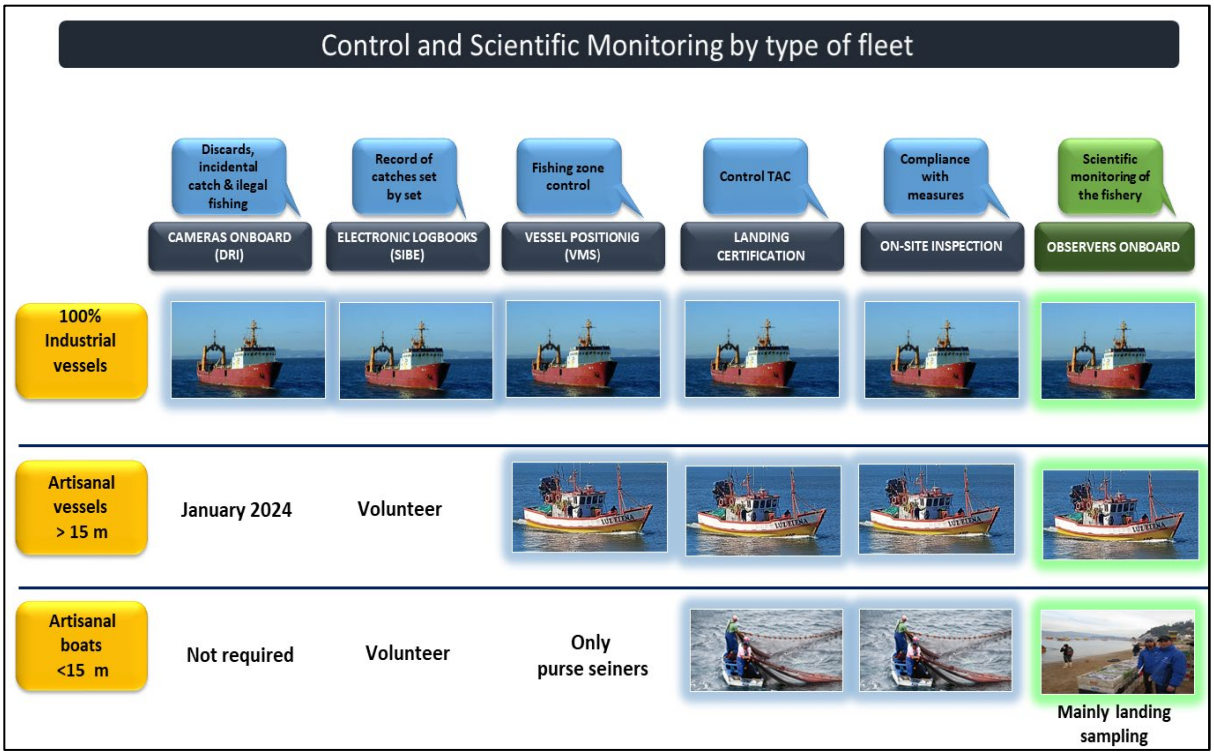

Figure 1. Monitoring tools differentiated by type/size of fleet/vessels to control compliance with fishing regulation (highlighted in blue) and to collect fishery dependent data for scientific purposes (highlighted in green), implemented in Chilean fisheries.

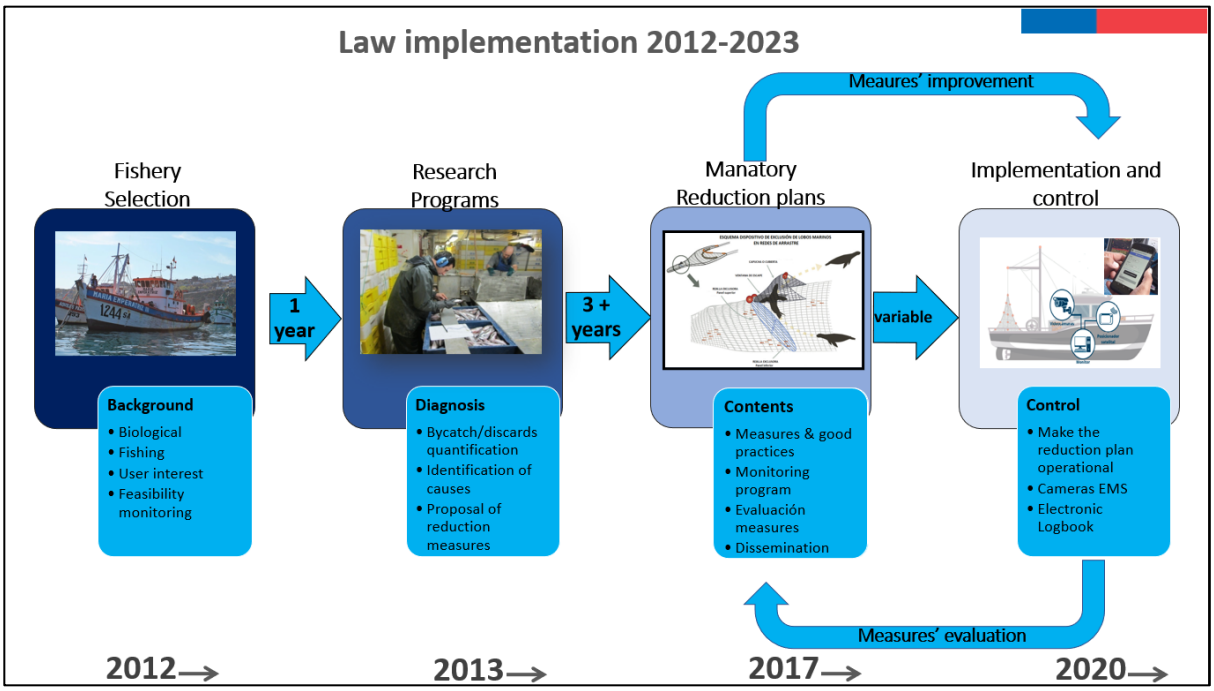

Figure 2. Stepwise approach implemented in Chile to diagnose, reduce, and control discards and bycatch in fisheries.

In addition, among other related modifications to the Fisheries Law in 2013, through Law N° 20657/2013 (Article 63 letter a), it was incorporated the obligation for vessel owners to report all their catches and landings in logbooks of electronic type in industrial fleets and paper logbooks in artisanal fleets (**Figure 3**). Consequently, through the Supreme Decree N° 129/2013, the specific regulation that sets the requirements for the delivery of fishing information to SERNAPESCA by the vessel owners, was established. In the case of the industrial fleets, the

information must include the identification of the vessel owner, the dates and port of departure and landing, fishing gear used and also for each fishing set; the amounts of catch by species or groups of species, the geographical position, the date and time of setting and hauling of each fishing set, the amounts discarded by species or groups of species and the incidental bycatch of marine mammals, seabirds and sea turtles, if any. Thus the electronic logbooks, mandated by the Law, were formally established for the first time in 2015 by Resolution N° 114/2015, and were later replaced in 2020 by an electronic logbook provided by World Wildlife Fund Inc. (WWF) and officialized through Resolution N° 267/2020. This last resolution establishes the Electronic Logbook System (SIBE) currently in use and determines the opportunity and conditions for the delivery of fishing information through this tool. Additionally, it establishes the components of the SIBE (SIBE web and SIBE mobile), its characteristics, the minimum conditions that the mobile devices in which the SIBE will be used, the conditions for downloading and installing the application, the profiles of the different users of the system, their responsibilities, and the procedures when there are failures, among others. In relation to the artisanal fishing fleets, the fishing information must be delivered in paper logs, although they can voluntarily use SIBE, for which pilot projects are being developed.

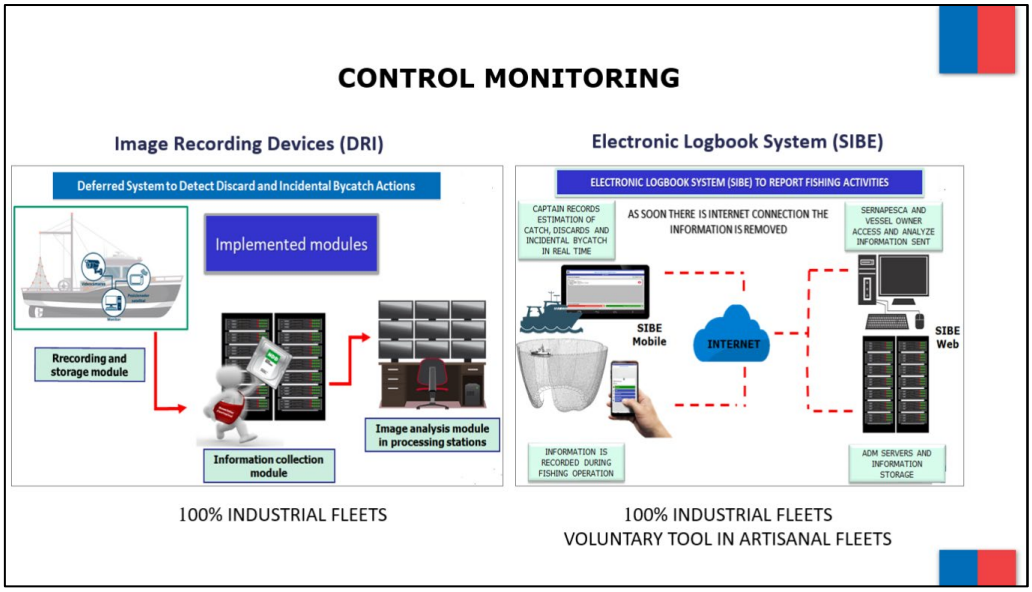

Figure 3. Image Recording Devices (**DRI**) to detect discard and incidental bycatch at sea and Electronic Logbook System (**SIBE**) to report fishing activities (including discards and incidental bycatch) in Chilean fisheries.(Source: SERNAPESCA.

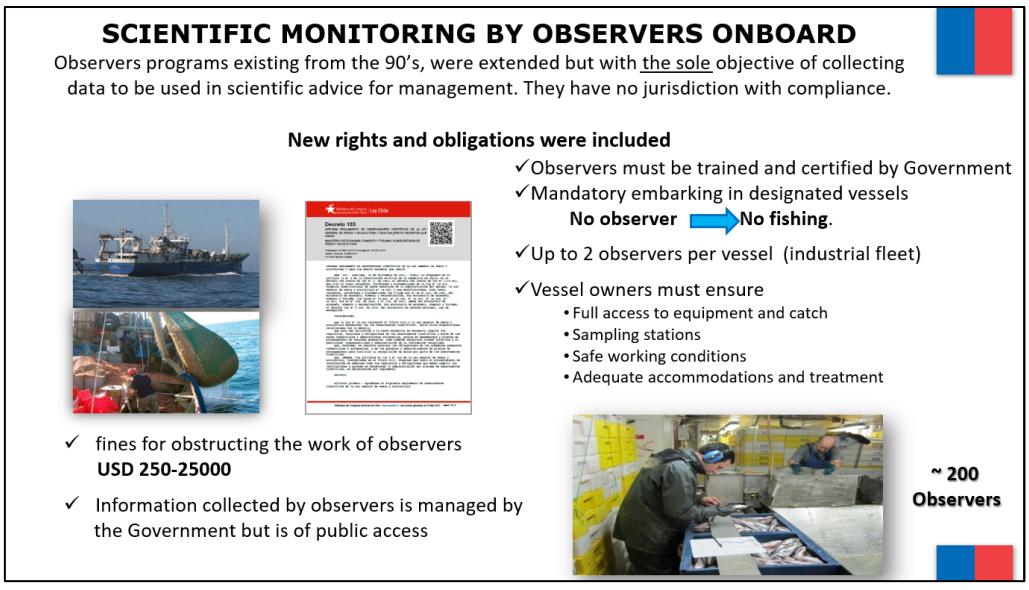

Figure 4. General overview of the scientific observer program in Chile to monitor fishing activities.

It is important to note that the human fisheries observer programs, carried out since 1990, were extended with the law N° 20625/2012, but have continued with the sole objective of collecting biological and fisheries data to be used exclusively in scientific advice for management, without any jurisdiction with compliance (**Figure 4**).

Measures to reduce marine mammals´ incidental bycatch

Regarding specific measures to reduce the capture and incidental mortality of marine mammals during fishing operations, based on the results obtained by the research programs through observers onboard carried out by IFOP added to the information provided by SERNAPESCA through the EMS systems (DRI and SIBE), in 2021 several measures were promulgated for industrial purse seine fisheries, artisanal traps, industrial trawling and artisanal gillnets through exempt resolutions No. 2667 of 2021, No. 2827 of 2021, No. 3120 of 2021 and No. 3122 of 2021 in which the mandatory use of devices is established along with the application of fishing maneuvers to release specimens into the water, handling protocols on board, codes of good practices and incidental bycatch reporting in logs, among others (**Figure 4**). These components were of differentiated application depending on the target fishery, gear, and type of fleet (**Table 1**). It is important to note that the measures were designed in consultation with experts and presented to the respective Management Committees or users (owners, captains, and crews) of the fisheries involved for their adjustment and validation. Likewise, different aspects were considered in its design that would allow adequate control through the electronic monitoring systems. Finally, it should be noted that in consideration of the structural changes, acquisition of materials, and changes in fishing operation or behavior that its implementation implicates, an exemption period was granted for its application that ranges from 6 to 24 months depending on the fishery.

The results obtained to date show variable levels of implementation, however, stand out significant reductions in marine mammals' bycatch in those where the measures are fully implemented. By 2024 there will be longer time data series and it will be possible to show specific results by fishery regarding estimates of bycatch, catch and mortality rates and the trends observed since the implementation of the measures.

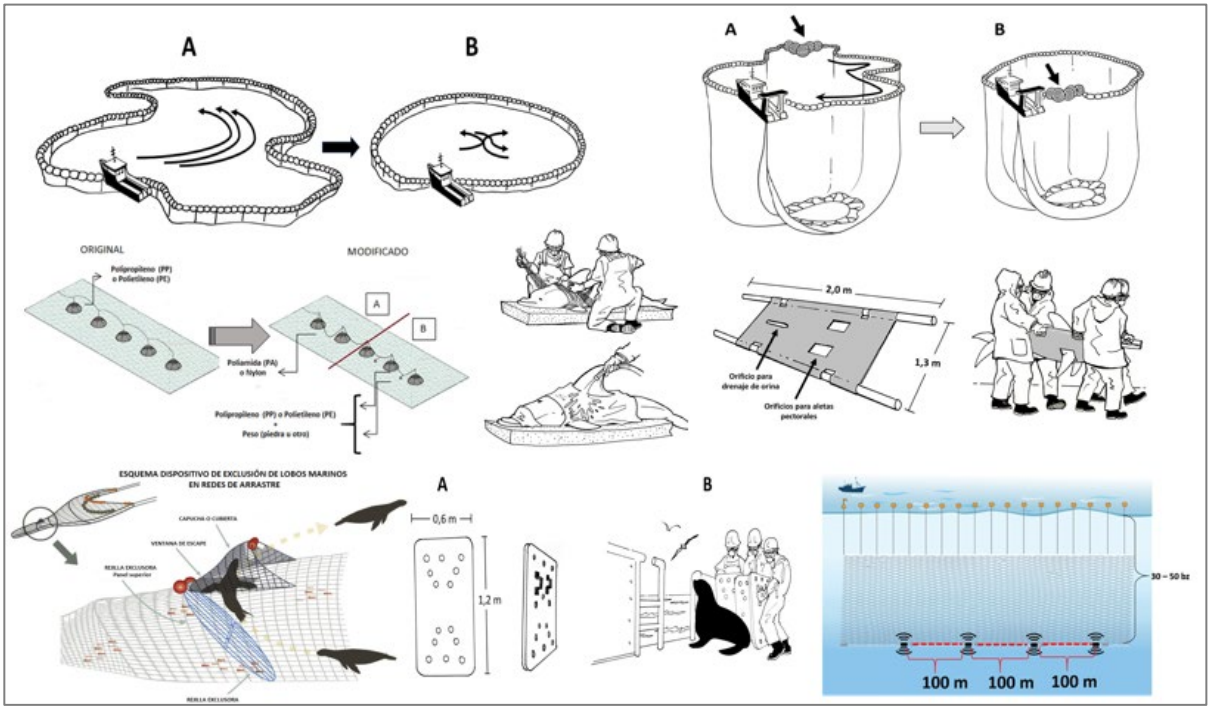

Figure 4. Summary of the measures, devices, and actions to reduce the incidental capture of marine mammals in Chilean fisheries enacted as of April 2023. Details may be reviewed in specific regulations (links provided in references)

General contents of the bycatch reduction measure	Type of fishing gear			
	Purse seine	**Trawl net**	**Gillnet**	**Crab traps**
Release maneuvers in the water	**Yes**	**No**	**No**	**No**
Device usage in gear/Type	**No/ does not apply**	**Yes/Excluders pinnipeds**	**Yes/Pingers**	**Yes/Weighed lines**
Mandatory safety elements for the crew	**Yes**	**Yes**	**No/ just Recommended**	**No/Does not apply**
• Blankets for protection and transfer	Yes	Does not apply	Recommended	Does not apply
• Dolphin mat	Yes	Does not apply	Recommended	Does not apply
• Dolphin stretcher	Yes	Does not apply	Recommended	Does not apply
• Net cutting knives	Yes	Yes	Recommended	Does not apply
• Approaching shields	Yes	Yes	Recommended	Does not apply
• Cage or container for pinnipeds	Yes	Yes	Recommended	Does not apply
• Gloves and masks	Yes	Yes	Recommended	Does not apply
• Safety glasses	Yes	Yes	Recommended	Does not apply
• Boots or safety shoes	Yes	Yes	Recommended	Does not apply
• Waterproof suit and helmet	Yes	Yes	Recommended	Does not apply
Crew Training	Recommended	Recommended	Recommended	Not mentioned
Bycatch report in logs/electronic or paper	Yes/electronic	Yes/electronic	Yes/paper	Yes/paper
Compliance control by cameras (EMS)	Yes	Yes	In 2024 boats ≥ 15m	In 2024 boats ≥ 15m
Time granted to implement measures	9 months	6 months	24 months	20 months

Table 1. Summary table of the measures and actions to reduce the incidental capture of marine mammals in Chilean fisheries enacted as of April 2023.

Results and Discussion

During the process of implementation of the law N°20625/2012, that addressed discards and incidental bycatch, and established the use of new monitoring systems (DRI and SIBE) to control these practices, there has been a close collaboration and feedback between the different agencies involved with fisheries management in Chile. This approach permitted to change and adapt fishing regulations, reducing incidental bycatch and preventing discards of regulatory origin, while increasing compliance. Likewise, the establishment of some measures, such as the use of devices to reduce incidental bycatch of marine mammals or seabirds, has been designed in such a way that they can be efficiently monitored and controlled by the EMS and the analyst teams. In other cases, improvements have been made once the measures have been implemented, like the addition of cameras to detect specific issues in some fisheries or the requirement of specific handling protocols by crews, functional to the DRI. In this way, the EMS information has contributed to the management agencies' understanding of behavior patterns of the fleets with regard to discards and incidental bycatch and to identify individuals associated with non-compliance. These conditions have supported a significant improvement in undesirable practices at sea in a way that was not previously possible. Feedback loops, including communication between hardware installers and video reviewers, or data users communicating back to fishers (i.e. ensuring proper catch handling and data quality) have been key elements to the success of the program. In addition, feedback to the industry about the program implementation, including access to data and videos, has improved fisher's knowledge and acceptance of the EMS program, increased transparency, and improved fisher's efficiency. It is also important to note that providing feedback to fishers has allowed to identify weaknesses or deficiencies of the systems that have been improved.

Remaining challenges include species identification under some fisheries' operating conditions and catch (and discard) identification and quantification using DRI imagery for quota deductions. Until now it has been a general deduction of discards in the establishment of TAC, in fisheries where discarding occurs, but the goal is to move towards an individual deduction, which requires an accurate quantification of discards for each vessel. An additional challenge relates to use DRI for controlling other fishing regulations and illegal fishing as required by a 2019´s review of the fisheries law (that extended the DRI´s scope), being by far the biggest challenge the incorporation of the artisanal fleets to this scheme by 2024, according to law requirements, which is any artisanal boat bigger than 15m in total length (more than 600 boats meet this condition).

Building on the knowledge acquired during the first three years of the EMS program in the industrial fleet, new approaches to sampling imagery for review are being explored, such as the development of fleet-specific criteria and a risk-based process for sample selection. The program will continue to cover 100% of industrial vessels and their fishing activity, while review technologies (using machine learning and artificial intelligence) will be trialed

in pilot projects starting in 2022 in the artisanal fleet, supported by The Nature Conservancy TNC (**Figure 6**). Work underway also includes integrating various electronic monitoring and reporting tools. While the program currently uses hard drives for storage, transitioning to wireless transmission over 5G networks and cloud storage are foreseen as future steps, as well as implementing prereview within the DRI system onboard vessels and improving image quality to support a broader range of monitoring objectives. On the other hand, the recent implementation of technologies (DRI and SIBE) to collect, register, manage and analyze fishing data associated with the control of catches, discards and incidental bycatch, has provided a set of possible solutions to update and modernize the fisheries data systems and significantly expand the collection and analysis of information, also for management and research, creating an opportunity to coordinate and enhance the work of the three national fisheries management agencies (SUBPESCA, SERNAPESCA and IFOP) around the maximization of the use of the information that can be obtained from the new technological monitoring tools.

The rapidly changing characteristics of the fishery and its environment are forcing the need for higher spatial and temporal resolution of fishery data to account for growing uncertainty and enable management agencies to manage adaptively. In this way, the most precise collection of data is required, as well as its processing, analysis and preparation of faster and more advanced reports that derive in the design of more efficient mechanisms to share the results that allow responses to be given in times close to the real time. In this context, starting in 2022, the use of EMS for scientific purposes and their integration with traditional fishery-dependent data collection programs to support fishery monitoring and management has begun to be explored through the development of a specific research projects.

Figure 6. EMS pilot project supported by TNC and implemented in 2022 in the artisanal Chilean seabass fishery.

The experience gained by Chile in the diagnosis, reduction and control of discards and incidental bycatch recommends the gradual implementation of these processes, under transparent framework policies, where the visions of the different stakeholders are considered and the realities of each country are taken into account; technical, human capacities economic and cultural.

In the decision-making process, it has been highlighted the importance of working with relevant stakeholders, authorities, users, and civil society. This experience has shown that any solution must be subject to further analysis in terms of its effectiveness in solving the problem, as well as its ease of implementation by users, for whom it will always be a new process to which they must adapt. Conceiving these norms and control systems under an adaptive scheme, will facilitate the implementation of improvements and acceptance by users.

Finally, is also recommended exploring the use of tools like EMS to improve the monitoring´s coverage of the fishing fleets. However, it is recognized that the use of these technological systems for purposes other than control,

such as obtaining scientific information and collecting fishery-dependent data, still requires intense work on the design of current monitoring programs, the exploration of the use of complementary technologies such as computer vision (CV) or machine learning (ML), and its integration with traditional human observer programs in use.

Results and Discussion

The authors acknowledge the great contribution and work of **Rubén Toro** and **Carolina Vásquez** from the National Fisheries and Aquaculture Service of Chile in the implementation of the Image Recording Devices DRI and SIBE Electronic Logbook Systems SIBE, respectively. Their contribution in background for the preparation of this document is also acknowledged.

References

- Law N° 20625 of 2012: https://www.bcn.cl/leychile/navegar?idNorma=1044210
- Law N° 20657 of 2013: https://www.bcn.cl/leychile/navegar?idNorma=1048776
- Law N° 21132 of 2019: https://www.bcn.cl/leychile/navegar?idNorma=1128370&idParte=9995985&idVersion=2019-01-31
- Pérez Roda, M.A. (ed.), Gilman, E., Huntington, T., Kennelly, S.J., Suuronen, P., Chaloupka, M. and Medley, P.2019. A third assessment of global marine fisheries discards. FAO Fisheries and Aquaculture Technical Paper No. 633. Rome, FAO. 78 pp.
- Supreme Decree N° 76 of 2015 https://www.bcn.cl/leychile/navegar?idNorma=1100026
- Supreme Decree N° 129 of 2013 https://www.bcn.cl/leychile/navegar?idNorma=1057443&idParte=9393593&idVersion=2022-02-24
- Resolution N° 267 of 2020 (SIBE) from the National Fisheries and Aquaculture Service http://www.sernapesca.cl/sites/default/files/res.ex_.267-2020_0.pdf
- Resolution N° 5930 of 2019 (DRI) from the National Fisheries and Aquaculture Service https://www.subpesca.cl/portal/615/articles-106392_documento.pdf
- Resolution N° 2667 of 2021 https://www.subpesca.cl/portal/615/articles-112315_documento.pdf
- Resolution N° 2827 of 2021 https://www.subpesca.cl/portal/615/articles-112527_documento.pdf
- Resolution N° 3120 of 2021 https://www.subpesca.cl/portal/615/articles-112894_documento.pdf
- Resolution N° 3122 of 2021 https://www.subpesca.cl/portal/615/articles-112897_documento.pdf
- Exempt Decree Nº 225 of 1995 https://www.subpesca.cl/portal/616/articles-6623_documento.pdf
- Exempt Decree Nº179 of 2008 https://bcn.cl/3crer
- Exempt Decree Nº 4 of 2021 https://bcn.cl/2qkn6
- Law N° 20293 of 2008 https://bcn.cl/2neff