COLTO Depredation Workshop #1

March 15th - 18th 2016
Punta Arenas, Chile

BACKGROUND

The aims of the COLTO Working Group on Depredation and the COLTO Depredation Workshop are to investigate Sperm whale and Killer whale depredation on Toothfish longline fisheries, including assessment of the socio-economic and conservation impacts of depredation; the impacts on depredated Toothfish in a fisheries management context; and the development of mitigation solutions. More specifically, the expected outcomes are:

1. to develop a standardized data collection methodology to be implemented in all Toothfish fisheries;
2. to accurately assess the levels and the trends of depredation in Toothfish fisheries;
3. to agree on a consistent method across fisheries to account for depredated fish in stock assessment procedures; and
4. to identify mitigation solutions and strategies to reduce depredation, based on technical, operational (i.e. behaviour of vessels/skippers) and behavioural (i.e. behaviour of marine mammals) studies.

The WG also aims to develop management strategies to prevent depredation from starting, and subsequently spreading, in fishing areas where it has not yet been reported.

WEDNESDAY 16th MARCH 2016 – Workshop Day 1

CURRENT KNOWLEDGE & STATE OF DEPREDATION IN VARIOUS FISHERIES

SESSION 1 - Levels of depredation and trends in Toothfish fisheries.

Each fishery had 10-15 minutes to introduce their fishery and the level of depredation they are experiencing. What has been tried, tested? What is being recorded?

EDUARDO INFANTE Sr– CHILE

- Chile unique in that it has both artisanal (~120 vessels) and industrial fleets (8 vessels)
- Uncertainty between Chilean science bodies (IFOP and SernaPesca) on actual toothfish removals in the early 1990s.
- Industrial vessels used traditional Spanish system until 2006-07, when they to trotlines with Cachaloteras. Successful against Sperm whales (SW), but not Killer whales (KW). Now looking into Orqueras, as KW getting worse.
- Depredation occurring since at least 1997, with early estimates of 2-3% of catch taken by SW and KW. CEPES estimated 10-15% in 2009. Industry believe current levels are more like 30% of the catch.
- Vessels and IFOP observers have been recording whale presence and depredation evidence since 2009. However, nothing has been done with this information and it has not been taken into consideration in the stock assessment and TAC calculation.
- Tried OrcaSaver but found it ineffective. Are developing their own acoustic harassment device, SASDO.
- Avoid areas known to have high whale abundance. Move on when whales arrive.

JANET ROBERTSON – FALKLAND ISLANDS

- Have been using trotlines with cachaloteras since 2007
- Reports of depredation since 2001. Retired CFL Pioneer in 2002 due to not being able to outrun whales.
- KW mainly NE of fishery and periodically. SW all over fishery, consistently.
- Acoustic Deterrent Device (ADD) unsuccessful
- Estimated catch loss 2-3% in 2002-03, but field trip indicated 23%
- Industry recording presence/absence and estimated weight lost. However weight lost is reliant on physical evidence of depredation. This lost weight is taken off TAC. Industry estimates 3.1% catch taken

JOHN BENNETT - SOUTH GEORGIA

- KW can strip almost everything. SW can take up to half (anecdotally)
- Buoy off gear and move away
- Tagged a SW last season

RICHARD BALL – PRINCE EDWARD & MARION ISLANDS

- Spanish longlines until recently. Transitioned to trotlines with cachaloteras from 2008-2013.
- Up to 2010, only one operator had a vessel, and also fished SG, so limited the availability to catch all quota. Now 2 vessels – current TAC 575t.
- Extensive tagging last 5 years. Assessment includes tags.
- KW will take two thirds of fish (anecdotal)
- One KW has been tagged. Hopeful 3 by end of year.
- Have started photo ID with help from France

PAUL TIXIER – FRANCE

- 7 vessels, all autoline
- Depredation occurring since longlining began (1993 at Kerguelen, 1996 at Crozet)
- KW Depredation rate at Kerguelen 0.3% of sets. More depredation to the North of fishery than the South. SW 38.4%
- KW Depredation rate at Crozet 15.5% of sets. SW 29.7%. Both at once 27.8%

RHYS ARANGIO – HEARD ISLAND

- 2 trawl vessels only, until 2003. Transition to longline finalised in 2014.
  Currently 3 longliners, plus 1 dual purpose longliner-trawler. Trialled traps, not commercially viable.
- Increase in longline footprint and season length increases possibility for depredation
- First SW interactions in 2011. Only sightings are from April to July.
- Saw one KW in 2014 and one KW pod in 2015. No depredation
- Have not calculated depredation rate, but whales present on about 2.5% of lines since 2011.
- Move on 50 nm upon sighting. Photo ID started. Mapping movement patterns.

JEFF FARVOUR – SOUTH EAST ALASKA (Gulf of Alaska)

- Lots of small boats (most 12-18m). 650 boats fish for variety of species. 320 of those fish for Sablefish in 450-1000m of water. Fresh boats at sea 2-5 days.
- 90% sablefish caught by line

- Annual survey undertaken by NOAA in GoA
- SW depredation in GoA since 1970s
- Depredation occurring since at least 1980. Several factors have led to increased SW depredation: Transition from foreign fishery with large vessels to domestic with smaller vessels in 1980's. SW abundance is increasing. Transition from an Olympic to a 9-month fishery in 1995 with introduction of IFQ management. By 1997 depredation had increased substantially.
- SEASWAP: In the late 1990s, fishermen approached scientists with concerns about SW depredation. In 2003, SEASWAP (South East Alaska Sperm Whale Avoidance Project) was launched, creating a team focused on protecting marine mammal populations while maintaining thriving coastal fisheries. Using logbooks and cameras, fishermen worked with scientists to document SW interactions with fishing gear. Now work collaboratively with a number of organisations.

MEGAN PETERSON – WESTERN ALASKA – Aleutians and Bering Sea

- Bering and Aleutians much smaller fishery than GoA. Was a foreign fishery until 1988
- Fishery TAC generally not caught due to several factors – distance, killer whales, weather
- Less than 100 vessels. About 50% pots
- Mainly KW depredation
- Annual survey (alternate years for Bering Sea and Alutian Islands) depredation on 25% of sets due to survey not being able to move on. Commercial average 6% of sets in logbook over last 10 years. Fishermen think 10-25% now
- Mitigation includes pots, moving on, buoying gear, orca sphere, bang pipes, seal bombs, avoidance measures (chaser skiffs, shorter sets, tandem fishing, hauling quickly, staying in gear while hauling).

SESSION 2 – Research on depredating whale populations

ANELIO AGUAYO – Depredating whale populations off Southern Chile

- Limited knowledge about KW of Southern Chile. Depredation occurs between 53° and 57° S. Natural diet may include South American sealion and fur seal, birds and whales. Possibly same whales depredating on toothfish longliners?
- 119 sightings between 2002 and 2012 in Chilean Patagonia: catalogue with 49 individuals, all ecotype A-like KW
- Moreno et al. (2008), agrees that the "Chilean longline" or cachalotera system diminished significantly the depredation rate for SW and KW. Nevertheless, fishing operators assure that this measure does not work as a mitigation alternative for KW.
- studying the ecology and dynamics of cetaceans interacting with the Patagonian toothfish fisheries in an alliance with the fishing industry has just started, in order to understand the cetacean depredation patterns off Southern Chile

PAUL TIXIER – Demography and population structure of depredating killer and sperm whales off Crozet and Kerguelen Islands

- Two morphotypes depredating in Crozet and Kerguelen (Mainly Crozet): Type "Crozet" = Type-A like KW and "Type D" KW. Long-term monitoring by photo-ID for both types, since 1964 for Crozet, 2003 for Type D
- Type D more likely to depredate at greater depth. Increase of Type D depredation in recent years.
- Type Crozet: 85 individuals, diet including whales, seals, penguins and fish.
- Type Crozet: great variations between groups, subset of 4 groups responsible for >70% of depredation. Broad distribution of interactions and all year round. Other groups spatio-temporally more sporadic.
- Negative effects of depredation on KW interacting with fisheries during the period of illegal fishing: lethal interactions with IUU vessels in Crozet.
- After 2003 and the end of IUU fishing: positive effect of depredation on survival and reproduction of KW.
- SW: Photo-ID monitoring since 2005: 305 individuals identified.
- SW: high site fidelity. Individuals come back to highly localised spots over periods of >7 years. Very few individuals visit both Crozet and Kerguelen.
- SW: Estimate 97 individuals at Kerguelen and 82 at Crozet.

MARTA SOFFKER – Implementing research on depredating whales in South Georgia: satellite tracking, biopsies and long-term monitoring

- South Georgia: both KW and SW. Most depredation by KW but in very localised spots in which >50% of the catch can be taken.
- Depredating KW = Mini Type B Antarctic KW.
- South Georgia tends to be seeing spatio-temporal patterns of depredation = from E to W through the fishing season. Potential for fishers to perhaps reverse catch spots at different time of year?
- Tagging program by Jared Towers: 1 KW and 1 SW tagged in 2015. Depth of dive by KW greater than any other maximum dive ever recorded for KW. Shows movement to North of SG, part of migration?
- Different avenues of learning transfer hypothesized, including "teacher" between groups and mother-calf transmission of depredation behaviour
- Next: isotopes on biopsy samples. Need to examine the diet of the Mini Type B, only penguins? Also fish? What species?

JAN STRALEY – SEASWAP: Understanding whale movements and acoustics to reduce interactions

- Scientists, fishermen and managers working together to understand depredation and minimise interactions
- Avoidance as a means for reducing depredation

- SEASWAP into phase 3: design and test deterrents with fishermen
- Acoustics play a big part – found that engine cycling is distinctive and LOUD: an acoustic cue for whales
- SW use clicks, creaks and clangs to navigate and forage. Have used these noises to assess depredate rates
- Tagging SW to monitor movements

SESSION 3 – Mitigation by developing knowledge on whales and acting on fishing practice

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MARTA SOFFKER – Review of strategies to mitigate depredation in CCAMLR waters

- Review of Acoustic Deterrent Devices (ADD) and Acoustic Harassment Devices (AHD): Complex to test their efficacy, or whether they damage hearing of whales or not
- Scientific evidence? The few available studies show limited efficacy: habituation of the whales.
- Effects on target species: Unclear if AHDs harm hearing system of whales in the wild; temporary hearing threshold shift observed in various odontocete species; negative response behaviours of captive animals observed
- Effects on non-target species: concerns about AHD repelling target fish, limited effects on diving birds, possible effects on pinnipeds.

JAN STRALEY – Is Depredation increasing in the Gulf of Alaksa

- Differences in diet of SW between Bering Sea (squid) and Gulf of Alaska (Fish). Depredation by SW occurs primarily in GOA
- Spread of depredation in GOA investigated through a diffusion curve analysis (DCA) and Wave of Advance analysis. Both models provide evidence for social transmission.
- Learning mechanisms = imitation, emulation, observational conditioning
- Social transmission or independent among multiple individuals (individual learning*?)*

PAUL TIXIER – Combining research on fishing practice and whale ecology to mitigate depredation

- Combining extensive fishing and photo-identification datasets to mitigate depredation
- Technological approach: at-sea testing of the Orcasaver in the Crozet EEZ – Acoustic Harassment Device – clear habituation after successive exposures.
- Behavioural approach: behaviour of vessels: analyses of 3 operational variables:
  - length of longline sets: shorter lines (< 5km) have better CPUE, prevent whales from depredating large numbers of hooks
  - hauling speed: high speed (> 60 hooks per minute) may reduce the number of fish removed by whales;

- distance travelled: vessels moving further than 75 – 100 km from previous fishing ground with depredation are less likely to have whales again on the next fishing ground.

- Behavioural approach: behaviour of whales: seasonality and distribution:
  - Periods of low depredation: link with the ecology and biology of whales. Low SW depredation in winter months, male SW may migrate to sub-tropical tropical waters for reproduction. KW of Crozet: lower depredation in Spring, period of high natural resource abundance?
  - Spatial patterns of depredation: hotspots vs. areas of low interaction with KW. Problem: correlation between the presence of whales and the productivity of the area = co-occurrence

DIRK WELSFORD – Depredation: What are the questions we need to answer?

- What depredates toothfish? Where, when, how much? Does it matter for fishery efficiency? Does it matter for the predators? Does it matter for stock status?
- What depredates toothfish? = The first question to address depredation:
  - Squid, sea lice, lampreys, Porbeagle sharks, Sleeper sharks, fur seals, killer whale, sperm whale, elephant seal

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SESSION 4 – issue – Mitigation by developing technological systems to reduce depredation: Toothfish and other fisheries

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EDUARDO INFANTE JR - Depredation and the attempt to dissuade it in Chile

- Cachalotera: only fishing technique used since 2006-2007 – decrease of SW depredation but total depredation remained constant. Increase of KW depredation?
- Orcasaver: failure – hard to operate, unsolved electrical issues, habituation of KW
- 2013: Globalpesca hired a consultant office (INTEP): need to increase knowledge on Chilean KW
- SASDO (Orca deterrent acoustic submarine system): work in progress, first attempts failed
- Orqueras: plastic star shaped protection over fish in development, harder than nets. Hopefully work better against KW

JAHN HOEL (MUSTAD) – OrcaSaver – product development timeline

- 2005: start of development of Orcasaver
- 2006-2007: first version produced and tested: technical challenges and not enough power

- 2008-2009: 2 units produced and tested: more power, 1st positive feedbacks but technical improvements still needed
- 2010: 11 units with 195-197 dB on 6-7 kHz: more technical failures and increased costs
- 2011-2012: electrical feedback problems
- 2013: Technological issues fixed but biological results dropped
- 2014-2015: Expanded to 5-8kHz with up and down sweeps, signal overlapping, short pukses at high dB levels
- Need to broaden the frequency range for more efficacy, mixing possibilities, etc.

PABLO PARRA HENRIQUEZ (FISKEVEGN) – Mitigation by developing technological systems to reduce depredation – what has been so far

- Operational adaptations: hauling velocity increased – need for better understanding of hydrodynamics of line hauling.
    - Concerns = hydrodynamic issues and gear losses, HSE issues
- Catch protection system: SAGO prototype
- Fiskevegn is in favour for of detailed exploration of containment / catch protection solutions. Efforts on hydrodynamics. Need to come to terms there is no silver bullet. Need a variety of approaches

JAN STRALEY – Can we be as clever as a Sperm whale? …Using gizmos and gadgets

- SEASWAP: Work on acoustics
- Acoustic cue = engine cycling: engine in neutral (0-2 kHz) - propeller cavitation (0-10 kHz)
- Acoustic decoy = can we delay whales' arrival at the fishing haul by attracting them elsewhere? Designed to attract the whales away from the true haul.
- VHF communication allows captains to remotely activate playback from up to 10nm away.
- Tested in summer 2013: 14 successful trials
- Decrease of number of whales at haul with increased distance between decoy and fishing set.
- Increased delay in arriving at the haul with distance between decoy and haul.
- Limits: whales must be known to be present, fishing vessel is alone, device is heavy

OPEN DISCUSSION BASED ON DAY 1 – Chaired by Eduardo Infante

- John Bennet:
    - would rather turn OrcaSaver on before the whales get there. Once they show up its too late.
    - Has also tried hauling faster, with two single ended lines frozen together with a frozen ice core which defrosts once the gear is fishing. Whales confused with a single hanging end. Not usual line dynamic.

- Curious to know if orcas can hear OrcaSaver at 4-5nm away

- KW depredation generally increasing over recent years – it is populations increasing, or just learning?

- In Chile: Quick change in KW depredation in short period of time. Should be looking at environmental changes or other stock conditions that may explain the reason for the increased reliance on TOP. Isotopes could explain this.

- Predictability of fishing. Early years of a fishery, more prospecting, harder for whales to pin known vessel locations down.

- SG daily hooks have dropped from 21000/day to 15000 due to moving around avoiding whales

- The Ross Sea has TOA eating KWs present but they don't depredate. Reason possibly that fishery doesn't overlap with KW distribution

THURSDAY 17th MARCH 2016 – Workshop Day 2 – Chair: Paul Tixier

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IMPROVING AND STANDARDISING DATA COLLECTION AND ASSESSMENT OF DEPREDATION LEVELS

SESSION 5 - Creation of consistent approaches in data collection, stock assessment, and management of depredation implications.

NICOLAS GASCO – Long term monitoring of fish stock and whale depredation in French fisheries by fishery observers

- Data collection in the French EEZs of Crozet and Kerguelen by fishery observers:
  - For each longline set: lat and long, depth, number of hooks, catch for each species
  - Presence/absence of whales: need to make sure that depredation is happening, so during hauling, observers can record presence/absence/non-observed (if there is a doubt about their presence because of weather, light conditions or effort of observation). Cues for a true depredation event are: whales follow the boat, birds aggregate around them to grab pieces of fish, they repeat dives around the line.
  - Abundance: estimate of minimum and maximum number of whales are provided by the observer
  - Time of arrival = time elapsed between first hook and first appearance of whales
  - Photo-identification (all observers equipped with camera gear): 2 protocols:
    - i) time available and weather ok: 30 min, pictures of all individuals for catalogue update,

- ii) no time or poor conditions: 5-10min per line, pictures of some individuals to have the information about which group of whales is present.

JAN STRALEY – Communication network and avoidance as a means of reducing depredation in South East Alaska

- Are they the same whales each year ? Do they associate ? Can their location/timing be predicted ?
- Avoidance through real-time communication network
- Analyising association indexes for pairs of SW show males have long term associations.

MEGAN PETERSON – Data collection and federal perspective in the Bering Sea/Aleutians fisheries

- 3 primary sources of data from the federal perspective: longline survey (100% monitored), commercial fishery (partial observer coverage), logbook data (vessels >60ft)
- data collected = presence of whales and evidence of damaged gear or fish
- historically, logbooks did not track depredation – changed rules to track evidence of depredation: Number of marine mammals, number of fish damaged
- Sablefish stock assessment: trawl survey/longline survey/commercial fishery (unaccounted for sablefish mortality due to whales)
- SW: CPUE decreased by 7 – 20%; KW: CPUE decreased by 54 – 72%
- Bering Sea most impacted by KW, some years 50% of sets depredated – dropped from the stock assessment
- Stations depredated by SW are included in the stock assessment – reduced accuracy – In longline survey, catch inflated by 14% according to estimated CPUE reduction – in commercial fishery, sablefish removals due to SW and KW depredation added to fixed gear (6500mt 1995 – 2014)

DIRK WELSFORD – Collecting data on depredation in toothfish fisheries

- Where, when and how often depredation occurs?
- Data stream and utility:
  - presence only: distribution maps, trends
  - presence/absence: distribution maps, correlation with environmental or operational data
  - numbers sighted: distribution maps, correlation with environmental or operational data
  - sighting/resighting: population size, turnover, demographic structure, movement
- HIMI: on average <3% of longlines
- What data: at least presence absence data, all the time, everywhere
- Once patterns analysed, data collection can become more focussed

OPEN DISCUSSION – chaired by Dirk Welsford

- Chile struggling to get science and industry on same page. Some industry funded scientists not getting recognition from govt. Need to all get on same page to move forward. International review? Collaboration?

- What is the best information to collect and what can that information tell you?

- Alaska has server based whale ID between fisheries

- Whale sighting into C2 reports?

- Need for standardisation in data collection. Example of seabird bycatch, the problem was solved after combining efforts from the different fisheries to implement efficient measures to reduce/suppress seabird bycatch.

SESSION 6 - Improving depredation assessment and incorporation in stock assessment and management.

ANDREAS WINTER – Assessing depredation in a small fishery

- Single quota, single vessel: limited data for comparisons among longline sets
- Whale interaction data since 2002 (observers) – presence/absence data recorded during seabird observation periods + damaged fish
- No interaction longline set = no fish reported damaged. Whale interaction longline set = at least 1 fish damaged or destroyed (heads, lips, gills)
- 2004-2015: 1948 observed sets, 296 with whale interaction
- Method 1: CPUE of sets compared by proximity (within 2 days, 6km) – not statistically different
- Method 2: predictive model: GLM (including gear method – Spanish or umbrella), using no interaction sets only and all sets. For longline sets that actually had whale interaction: predicted N (all sets) > predicted N (no interaction)
- Sets attended by whales have more toothfish: co-occurrence, especially SW
- Toothfish catch weight: predicted kg (all sets) < predicted kg (no interaction): Toothfish catch weight is significantly reduced on longline sets attended by whales;
  despite the contrasting bias of higher numbers of toothfish in the presence of whales.
  Both KW and SW retrieve larger fish
- Depredation also increases with soak time
- Small fishery, model differencing can provide a means to estimate depredation

NICOLAS GASCO – Indirect methods to assess losses due depredation

- Using only damaged fish is not reliable: likely to underestimate depredation

- CPUE method = comparisons of CPUE between sets hauled in same spatial 0.2°x0.2° cell = 5% average in Kerguelen, 30% average in Crozet
- Grenadier method (Gasco method): comparing proportion of grenadier vs. toothfish in presence and absence of depredation
- The two methods provided similar depredation estimates

MARTA SOFFKER – Calculating depredation and incorporation into stock assessment

- Background to stock assessment: accounts natural vs. fishing mortality of fish;
    - depredation is included in fishing mortality.
    - Not including depredation = likely to underestimate fish mortality = biased stock assessment = higher uncertainty = greater risks to stock
- Critical data to collect = biological, environmental and fishing data
- Cryptic depredation = additional possible mortality; very hard to assess
- SGSSI: depredation is accounted since 2009, estimation model was reviewed in 2013.
- Depredation at SGSSI estimated with GLM, average = 5%; provided annually, catches corrected in stock assessment input data.
- Other CCAMLR depredated areas have also recently begun to estimate and include depredation: through safety margins, bycatch methods and modelling (Crozet 2014, Ob&Lena 2015)

DIRK WELSFORD – Thoughts on if/how depredation should be incorporated into stock assessment

- Harvest strategy = ensure enough fish survive to breed (MSY)
- Ecosystem based harvest strategy = ensure enough fish survive to breed, enough fish to support predators, enough fish to eat prey species
- Stock assessment – index of abundance with surveys, tag recapture, CPUE time series
- CPUE based assessments can over-estimate depredation
- Facilitated depredation could be included as part of the natural mortality
- Opportunistic depredation could be modelled as a separate fleet with its own catch, selectivity, etc.

IMPLEMENTING STRATEGIES TO REDUCE DEPREDATION: AVOIDANCE vs. TECHNOLOGICAL DEVELOPMENT

Session 7 - Costs and benefits of changing fishing practice: identification of best strategies

MEGAN PETERSON – The entangled economics of Killer whale depredation in Western Alaska

- Implications of depredation = decrease CPUE, Increase operating costs, increased uncertainty in stock assessment, increased risk entanglement / altered foraging strategies
- Estimating the costs of Two potential responses to depredation :
    - 1) fishing through the whales: GAM to estimate decrease of CPUE and Linear model to estimate additional fuel consumption;
    - 2) depredation avoidance: fishermen collected data, estimating direct effort input and opportunity costs
- New approach: high value longline fisheries – fishermen will fish longer to catch entire quota: CPUE goes down. With reduced CPUE → effort inputs must increase to catch the same amount of quota
- Costs of fishing through the whales: fuel consumption per set x CPUE reduction per set (area, target) x $/gallon = $433 per set
- Costs of avoidance = distance travelled, hours waited, etc. additional fuel + additional crew food + opportunity costs = $564 per set
- Conclusions: fishing through the whales is costly, and doesn't account for additional costs (crew food, opportunity costs, # sets per day, whales reinforced/ spreads behaviour). Depredation avoidance preferred long-term solution

JAN STRALEY – Real time monitoring and communication network

- Photo-identification data with 120 identified depredating whales, but 11-12 account for most sightings due to their prevalence near vessels.
- Sperm whale avoidance network: combination of tracking data and information sharing amongst captains. In-reach devices, cell phones, and satellite phones as equipment. Participants reported their location and presence or absence of whales twice daily to the shore-based coordinator. Participants then received twice daily reports of whale activity (Tagged whale locations were given as exact locations, participant reports were anonymous and generalized by region to protect confidentiality)
- Communication network results: 117 field reports from 28 vessels over the season; 13 visual reports of sperm whales in Chatham from 10 vessels; 91% of participating vessels successfully avoided depredation
- Plans for the future : satellite tagging of SW before during the 2016 Chatham opening ; expanding the communication network to offshore ; towed array sonar project

SESSION 8 - Directions for future technological development

JAHN HOEL, MUSTAD –New Orca Saver and SoundBeam: testing, expectations and launch

- The main advantage of the new Orca Saver is its potential to "play" an unlimited range of signals, as long as these signals do not exceed a frequency range between **10 and 30 kHz**. This results in a nearly unlimited freedom in programming and/or modifying signals.
- The first OrcaSaver prototype was produced for a early 2015 trial in Chile. Although technically performing flawlessly, the trial could not take place due to several reasons.
- Planned sea trial schedules:
  - March-April-May: 2 new OS products tested in Alaska – with SoundBeam
  - April-May: 1 new product in use in the South.
  - March-April: proto-type product in use on 230V vessel
- After receiving expected positive feedback, commercial phase starts in Q3 2016.
- Due to long production lead time, maximum capacity for 2016 is 8 products. Products will only be produced upon order.

- Line controller: Controls and displays line tension/force and hauling speed. Start and stop hauling aggregate. Fish counter sensor can be added. Catch information is stored in the database.

PABLO HENRIQUEZ, FISKEVEGN – Directions for future technological developments – the next steps

- Currently modelling hydrodynamic forces in deep water tornado trolling and deep-sea longline fishing, with and without Catch Protection device (CPD)
- Modelling and tank trials simulating deep-sea longline fishing are on-going
- Design iterations followed by field tests in deep-sea conditions are pending
- Proper understanding of forces from gravitation, accelerations and hydrodynamic processes is needed, with and without deployed containment solutions.
- Operational approaches: FISKEVEGN now incorporates noise reduction criteria in the new generation of longline systems. This is already in the phase of engineering and prototypes.
- If rapid hauling is going to be part of the operational strategy - development of longlines and mechanical equipment has to adapt to this.
- Fiskevegn's tests of new prototypes show that next-generation longline systems will have an over-capacity for rapid hauling and setting.
- The main constraints instead lie in:
  - Health and safety issues for crew due to increased accident risks
  - Time and working conditions for proper handling of longlines and hooks
  - Increased risks for loss of gear, with catch on them
  - Incomplete understanding of the hydrodynamics of longline hauling
  - Development of longline gear that can keep up with increased physical strains

- Increased loss of fish that is ripped off fast-moving or rapidly accelerating gears by inertia or hydrodynamic drag – losses that need to be quantified

PAUL TIXIER – ORCADEPRED, Fish protection devices and experimental trials

- The objective of OrcaDepred is to investigate and propose operational and technological solutions to the depredation issue.
- Task 1 = natural feeding and interaction behaviours of KW and SW: photo-ID, satellite tracking and diving behaviour, acoustic vertical antenna, experimental line (pressure, light and accelerometer sensors). One of the questions is to know when depredation is taking place (hauling only or hauling+soaking)
- Task 2 = assessment of direct and indirect economic losses due to depredation
- Task 3 = vessel acoustic features and/or fishing practices: The objective of OrcaDepred is to investigate and propose operational and technological solutions to the depredation issue.
- Task 4 = technological approach to suppress depredation, new fishing methods, experimental fish protection devices on the line

JEFF FARVOUR –Next steps for SEASWAP – refining and developing tools and strategies

- Successes: decoy and avoidance
- Current and pending deterrents: bubbler, decoys, towed array, pods, acoustic jammer, real-time acoustic alerts, reporting network
- Bubbler: set on the line, produces bubbles during hauling. Have had trouble at depth
- Decoy: delaying whales arrival by attracting them elsewhere
- Towed array: detect animals in real time, localize on the fishing grounds
- Pods: metal chain fish protecting device
- Cameras: evolution, gopros

OPEN DISCUSSION – Chaired by Richard Ball - other potential options

- COLTO Fellowship – scientist full time across all toothfish fisheries for a couple for years. Agreed methodology, COLTO stamped, suite of tools.
- Importance of further developing fishermen/boat owners/scientists collaboration

FRIDAY 18th MARCH 2016 – Workshop Day 3 – Chair: Paul Tixier

Open discussions and identification of milestones

SESSION 9 - Summary of priorities, key milestones, and recommended actions

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CHAIRED BY PAUL TIXIER BASED ON WHAT HAS HAPPENED SO FAR IN THE WORKSHOP, AND THEN WHAT NEEDS TO BE DONE BOTH LOCALLY AND GLOBALLY OVER THE NEXT 2 YEARS.

Mitigation options

- Research – presence/absence, photo ID, tracking/diving data, biopsy, acoustics
- Technological systems – acoustic harassment devices, fish protection devices, gear mods, decoys, bubbler, towed array
- Fishing practices – avoidance (comms network, displacement, seasonality, spatial patterns), operational factors (hauling speed, short lines), vessel/skipper effects

What next?

RESEARCH AGREED TO UNDERTAKE

What?	Where?	Who?	When?
Distribute Guidelines on collecting presence/absence data using a standardised method	All toothfish fisheries	Paul, Nico, Marta to arrange guidelines. Rhys to distribute to COLTO Members and Scientists	By end April 2016
Collect presence/absence data using a standardised method	All toothfish fisheries	COLTO Member vessels / observers	ASAP. Definitely 2016 season
Quantify level of depredation using data from industrial fleet over the last 5 years	Chile	Chilean industry / science / government	By end of 2016
Distribute Guidelines on using acoustic data	All toothfish fisheries	SEASWAP to arrange guidelines. Rhys to distribute to COLTO Members and Scientists	By end April 2016
Use acoustic data to test for bias in observer reports of depredation	Falklands and Chile	GlobalPesca and CFL	By end of 2017
Distribute Guidelines on using photo	All toothfish	Nico to arrange	By end April

identification. Translated as necessary	fisheries	guidelines. Rhys to distribute to COLTO Members and Scientists	2016
Collect whale photos for the purpose of identification	All toothfish fisheries	COLTO Member vessels / observers	ASAP. Definitely 2016 season
Develop photo ID database for each fishery	All toothfish fisheries	COLTO Members to work with their Governments	By end of 2016 season
Develop photo ID matching software and global toothfish catalogue	All toothfish fisheries	COLTO Members to work with their Governments	2018-2020
Tagging/tracking of whales	Some fisheries already doing this	South Georgia, France, South Africa	Continue, and report back at next workshop
Collect biopsies for food web interactions	Some fisheries already doing this	South Georgia, France, ???	Continue, and report back at next workshop

AGREED FISHING PRACTICES TO TRIAL / IMPLEMENT

What?	Where?	Who?	When?
Communication network	*HIMI, South Georgia, Chile*	*Local industry*	*2016 and 2017 seasons*
Develop and distribute hauling speed trial guidelines	All toothfish fisheries	*Paul to develop trial guidelines. Rhys to distribute*	*By end April*
Hauling speed trials	*Chile, South Georgia, South Africa, Australia*	*Local industry*	*2016 and 2017 seasons*
Develop best practice whale move on guidelines	*All toothfish fisheries*	*Paul*	*By end April*
Recommend vessels to adhere to move practices	*All toothfish fisheries*	*Local industry*	*2016 season onwards*
Visual vs Acoustic Triggers	*South Georgia, France, Alaska*	*Local industry*	*2016 and 2017 seasons*

TECHNOLOGICAL SYSTEMS TO TRIAL

What?	Where?	Who?	When?
Acoustic Harassment – Old OrcaSaver: continue testing deterrent effect	*South Georgia*	*Sanford Ltd supported by Marta*	*2016 season*
Acoustic Harassment – New OrcaSaver: to look into acoustic behavioural response with proper experimental design	*Alaska, Crozet (maybe)*	*SEASWAP, Mustad, France (maybe)*	*2016 and 2017 seasons*
Fish Protection Devices – cachalotera	*Chile*	*Local industry,*	*2016 and*

and orquera		*Mustad, Fiskevegn*	*2017 seasons*
Acoustic detection	*South Georgia*	*Sanford Ltd supported by Marta*	*2018-2019*
Towed Array	*Alaska*	*SEASWAP*	*2016 season*
Bubbler	*Alaska*	*SEASWAP*	*2016 season*

It was agreed that the outcomes of the workshop would be to produce:

1. Peer reviewed paper – a global review on depredation in high latitude fisheries
2. CCAMLR paper summarising the workshop
3. COLTO Guidelines on:

i) Data collection

ii) Using Acoustic data

iii) Photo identification

iv) Hauling speed trials

v) Whale move on practices

SESSION 10 - Closing session

OPEN FLOOR – Chaired by Richard Ball - thoughts on the workshop by each of the attendees

Janet – delayed MSC audit to come here. Much clearer on how to go forward. Face to face great, thanks to COLTO

Eduardo Sr – great opportunity to exchange opinions. Looking forward to optional tour. Sincere thanks for coming.

Tim – thanks to all. New LL as quiet as possible. No clutch, electric drive.

Dirk – collaboration great. Science on its own is sterile. Thanks to Paul (who currently is unemployed). COLTO should utilise Paul as a paid Science rep. Dirk no problem in overseeing a COLTO scientist. Great model to show to other fisheries over the world.

Dario Rivas (subpesca) – thanks to COLTO for organising and invitation

JB – really enjoyed meeting. Similar to Southern Seabirds. Looking forward to solving problems together.

Megan – thanks for invitation. Fascinating. Sure that this will benefit all.

Marta – Fascinating. To have the Alaskans very eye opening.

Jahn – Fascinating, thanks to organisers and hosts and attendees for openness.

Jeff – pleasure. Wasn't sure about coming but so glad he came. Collaboration so effective. Looks forward to working together moving forward.

Eduardo Jr – echo everyone elses sentiments.

Attendees:

Bron Sibree	Austral Fisheries
Rhys Arangio	Austral Fisheries/COLTO
Warwick Beauchamp	Beauline
Marta Soffker	CEFAS
Andres Franco	CEPES
Alejandro Zuleta	CEPES
Pedro Rubilar	CEPES
Jorge Acevedo	CEQUA
Tim Cotter	CFL
Janet Robertson	CFL
Joost Pompert	CFL-Falklands Fisheries Dept
Andreas Winter	CFL-Falklands Fisheries Dept
Paul Tixier	COLTO WG Chair
Alan Mackern	Estremar
Pablo Henriquez	Fiskevegn
Eduardo Infante Jr	Global Pesca
Eduardo Infante Sr	Global Pesca
Michael Della Grotta	Kendell Seafood
Edward Hughes	Kendell Seafood
Allen Gammons	Kendell Seafood
Jahn Noel	Mustad
Megan Peterson	NOAA
Roberto Jirón	Pesca Cisne
John Bennet	Sanford
Richard Ball	ORAFCO
Jan Straley	SEASWAP
Jeff Farvour	SEASWAP
Darío Rivas	SUBPESCA
Patricio Arana	Pontificia Universidad Catolica de Valparaiso
Dirk Welsford	AAD
Ignacio Arocena	San Isidro
Carlos de Andraca	San Isidro
Takaya Namba	TAFCO
Anelio Aguayo	INACH
Nicolas Gasco	MNHN