Supplementary Table S1

Source types, contributions to the review, and limits of inference for the 71 references supporting the synthesis of longline mechanization, automation, electronic monitoring, and artificial intelligence.

This table describes the evidence used in the qualitative synthesis. Source type is not a risk-of-bias score or a numerical technology-readiness level. Scientific studies were examined for methodological description, data or sample information, validation procedures, and reported outcomes. Institutional sources were assessed for issuing body, methodological transparency, traceability, and operational evidence. Patents and commercial documents were used only for disclosed mechanisms, configurations, or availability and not as independent evidence of performance.

Reference	Type	Contribution to the review	Limits of inference
[1]	Journal	North Atlantic trials compare bird-scaring lines, underwater setting and a line shooter.	Mitigation effects depend on the tested method; no universal line-shooter benefit.
[2]	Technical	ICCAT manual describes pelagic longline components, configurations and operations.	An operational description, not an independent comparison of automation performance; setter/shooter terminology overlaps.
[3]	Technical	FAO technical webpage describes industrial tuna longlining and its target fisheries.	Descriptive source; not an independent performance evaluation.
[4]	Technical	FAO review and technical guidelines describe seabird interactions in pelagic and demersal longlining.	Technical synthesis; does not establish universally low environmental impact.
[5]	Technical	ILVO compares selected North Sea gears with respect to fuel use and seabed impacts.	Regional gear comparison cannot establish that all longlining is environmentally preferable to trawling.
[6]	Journal	Measured pelagic-longline depth differs from catenary predictions because of shoaling.	Nominal gear geometry does not guarantee achieved fishing depth.
[7]	Journal	Southwestern Atlantic trials found fewer pelagic stingrays with 18/0 circle hooks than with 9/0 J-hooks.	Effects concern the tested hook configurations and species; not an overall sustainability test.

[8]	Journal	Larger bait improved size selectivity for most tested species but reduced haddock catch by weight by 57%; larger hooks reduced capture efficiency with minor size-selectivity effects.	Six Icelandic trials; effects depend on species and the tested hook and bait sizes.
[9]	Journal	An Azorean trial finds circle-hook trade-offs involving loggerhead turtles, swordfish and blue sharks.	A reduction in turtle bycatch does not imply that all catch or bycatch outcomes improve.
[10]	Technical	UNU training-project report describes bait-size work and longline mechanization.	Technical project report; the cover identifies Final Project 2005 despite experimental dates in 2006.
[11]	Journal	Electric inverter-controlled hauling saves 24% energy relative to the tested hydraulic drive at 800 N and 0.6 m/s.	A component test at defined load and speed, not a 24% fleet fuel reduction.
[12]	Journal	Autoliner trials evaluate setter use with integrated-weight line; overall sinking did not become faster.	Earlier sinking near the stern is distinct from a higher overall sink rate.
[13]	Journal	Pelagic trials assess line-shooter use and mainline tension; loose setting had slower initial sinking under the tested conditions.	Results depend on turbulence and gear configuration.
[14]	Journal	Shaped 5 kg steel weights could match or exceed the tested 8 kg rock-weight shallow sink rate in Spanish-system toothfish gear.	External weights differ from integrated-weight mainline; final published pages are 93–106.
[15]	Journal	Historical review relates gear and operational changes to fishing power and catchability.	Historical synthesis, not a controlled whole-system automation trial.
[16]	Journal	Scottish demersal-vessel applications supported scientific uses of REM for discard estimation and activity mapping; analyst capacity and further methodological development remained constraints.	Scientific applications in other settings are not direct validation of every longline monitoring objective.

[17]	Journal	Agreement was higher for retained than discarded catches; longline logbooks reported more protected-species interactions than EM for groups other than seabirds.	Both reporting practice and EM visibility affect agreement; discrepancies do not invariably indicate logbook under-reporting.
[18]	Journal	Global synthesis documents EM trials, operational programs and implementation constraints.	Counts of 100 trials and 12 programs are historical review results, not a 2026 census.
[19]	Journal	Interviews with Chinese tuna-longline managers and skippers identified confidentiality and cost concerns; the authors prioritized EM standards, procedures, and data fields.	Implementation and governance evidence, not camera accuracy validation.
[20]	Journal	AIS-based longline fishing-status classification reports SVM accuracy of 95.74%.	Dataset-specific status inference from AIS; aggregate accuracy does not establish cross-fleet transfer or direct observation of catches.
[21]	Journal	Longline video pipeline evaluates detection, tracking, event counting and species classification.	Fish mAP 87.0%, event AP 81.0%, event recall 74.5% and event species accuracy 89.05% have different units.
[22]	Journal	Faster R-CNN detects bird-scaring lines in footage from three tuna longliners, with precision 0.87.	Image presence does not establish continuous correct deployment or reduced mortality.
[23]	Journal	The review found inadequate evidence to quantify cetacean depredation losses and population-level consequences, and identified research priorities for mitigation.	Bycatch and depredation synthesis, not a review primarily about stock-assessment indicators.
[24]	Journal	The review reported mixed outcomes for acoustic and physical mitigation of odontocete interactions and called for further testing and multiple complementary strategies.	Mitigation review; findings do not validate the complete automated workflow.

[25]	Journal	Review links feeding behavior, bait characteristics and alternative-bait development.	Bait attraction and retention do not directly measure machine attachment success.
[26]	Journal	A meta-analysis of 40 publications and 59 experiments found lower sea-turtle and swordfish retention with circle hooks; fish bait reduced turtle retention but increased at-haulback mortality for blue shark and shortfin mako.	Heterogeneous fishery and gear effects cannot be reduced to a universal benefit.
[27]	Journal	The review identified potential mismatches between climate-driven species distributions and existing spatial/temporal management, recommending species-specific climate responses in assessments.	Regional environmental-management context, not automation-performance evidence.
[28]	Technical	Technical description explains the linked autoline hook, snood, backbone, hauler and magazine cycle.	Operational description does not quantify independent whole-system labor or safety gains.
[29]	Commercial	Mustad 2026 catalogue describes hydraulic, coastal and electric configurations and modules.	Manufacturer-reported availability and specifications require configuration-specific interpretation.
[30]	Technical	Historical test-machine report, reproduced in an ACAP meeting document, describes mechanized throwing of already-baited hooks.	Bait throwing is distinct from bait attachment; operating examples and economic projections are not contemporary fleet-wide measurements.
[31]	Patent	Gill's Automatic Fishline Baiting Machine patent documents an early mechanical baiting concept and disclosed configuration.	Patent disclosure supports design history, not independently measured productivity, reliability, or commercial deployment.
[32]	Patent	Korean patent application describes guided hooks and automatic bait insertion during setting.	Published application establishes a proposed mechanism, not independent reliability testing.

[33]	Journal	Four of six alternative baits significantly reduced hake catch efficiency by 32–90% relative to whole sardine; the 2.12% reduction for chopped herring was not significant.	Biological catch-performance test, not an automatic baiter test.
[34]	Journal	Underwater-device deployment places branch lines deeper than hand throwing at 100 m astern.	Variable sinking behavior; the depth comparison alone does not measure seabird mortality.
[35]	Technical	Report develops two bottom-longline setter designs over 13 trips on three snapper vessels, with roughly 7–10 m deployment.	Fragile-bait losses and tension-related catch trade-offs remain; prototypes are not mature fleet deployment.
[36]	Journal	Numerical hook-motion analysis is compared with observations; width-to-length ratio above 0.6 makes separation harder in the model.	Model-conditioned result; not a universally optimized hook geometry.
[37]	Journal	Korean summary reports splitting rates of 94.2% for pollock-type hooks and 96.2% for flounder-type hooks at 24 m/min and 482 gauss.	The flounder is identified as Paralichthys olivaceus, although the English abstract calls it “halibut”. Results depend on hook geometry, speed and magnetic field.
[38]	Commercial	Martak product document identifies a Catch Linetech hook separator.	Commercial description; no independent standardized throughput comparison.
[39]	Commercial	Martak product document identifies Automatic Magazine Storage.	Product-page wording overlaps with separator descriptions; do not infer independent quantified performance.
[40]	Patent	Chinese patent describes hairtail-longline separation components and a manual inspection station.	Semi-automatic arrangement, not demonstrated unattended operation.
[41]	Patent	Korean patent describes hook-transfer, line-transfer and magazine-based arranging components.	Grant date 30 October 2024 differs from B1 publication date 1 November 2024.
[42]	Journal	Case study describes hydraulic deck equipment on combination vessel F.V. Sagar Harita.	Adjacent engineering evidence; not validation of an integrated longline system.

[43]	Journal	Norwegian autoliner comparison uses 99 two-hour observation series and reports gains of 2.3% cod, 6.2% haddock and 8.8% Greenland halibut.	The tested hauling-well method, not all autoline architectures, supports these gains.
[44]	Journal	Peruvian gillnet study finds over 90% detection for nine of twelve elasmobranch taxa, 50% for turtles and 80% for cetaceans.	Adjacent fishery; taxon-dependent detection is not a direct longline estimate.
[45]	Technical	NOAA technical evaluation examines video observation of seabird-avoidance devices and mortality in Pacific halibut longlining.	Task-specific visibility and review performance, not replacement of all observer functions.
[46]	Journal	Table 1 records discard species for 92/215 (42.8%), length for 2/215 (0.9%), at-vessel condition for 121/215 (56.3%), and release condition for 103/215 (47.9%).	Pooled proportions calculated from counts, not classification accuracy or per-set model estimates. The abstract reports approximately 43%, 1%, 57% and 48%.
[47]	Journal	Review examines improvements to EM functionality, camera views, handling and accuracy.	Synthesis supports design considerations, not universal proof of a single architecture.
[48]	Journal	Bottom-longline reef-fish study adds underwater imagery across 68 retrievals on eight trips to improve shark observations.	Vessel-specific visibility evidence; not a general source for GPS, storage or mandatory AIS integration.
[49]	Journal	Western Pacific longline EM reveals some retained-catch underreporting of up to threefold and omitted discards in logbooks.	Under-reporting varies by fishery, vessel, and catch category; EM is not an error-free census.
[50]	Journal	Video reviewers recorded fewer fish in 7 of 17 categories in 2002; agreement improved after camera changes in 2004, when observers recorded fewer individuals in some categories.	Study comparisons have no error-free reference; camera arrangement and species distinguishability affect agreement.

[51]	Journal	Longline event-segment extraction reports temporal precision 100/99.93/99.98% and temporal recall 62.92/65.61/62.32% on three trips.	The abstract's nearly complete event retrieval is not the same as temporal coverage; units must be explicit.
[52]	Journal	Calibrated handheld tuna deck photographs yield estimation error 4.5 ± 4.4%.	Mean ± standard deviation; photographs are not an end-to-end EM video pipeline.
[53]	Journal	Cod morphometric proof of concept uses seven selected measurements and 127 occlusion scenarios for length prediction.	Anatomical relationships do not themselves validate automated longline video detection.
[54]	Journal	A gear-mounted autonomous camera successfully recorded demersal-gear interactions with benthic habitats during commercial Southern Ocean operations.	Habitat-observation hardware, not direct validation of deck catch classification.
[55]	Conference	Hierarchical longline-video species classification is compared with flat classification.	The retained preprint and the published 2021 conference chapter address the same hierarchical-classification study; the manuscript cites the final chapter.
[56]	Journal	Review covers machine-learning applications from genomics to ecosystems.	Broad fisheries synthesis; not evidence that every application operates on longliners.
[57]	Journal	Review considers fisheries AI tasks, data and decision-making requirements.	Broad review and research context, not a longline field trial.
[58]	Journal	Perspective discusses cross-sector collaboration for fisheries AI.	Organizational argument, not experimental model-performance evidence.
[59]	Journal	Auction-image analysis estimates European hake box-level mean length with RMS deviation 1.9 cm over means of 20–40 cm.	Box-level landings estimate, not individual fish-length error in hauling video.

[60]	Journal	Auction images and box weight supported dolphinfish count and mean fork-length estimation; validation against measured fish in 83 boxes gave a box-mean length RMSD of 2.4 cm.	Landings application; transfer to hauling video requires separate validation.
[61]	Journal	Systematic smart-fishery review examines technology and sustainability research agendas.	Synthesis identifies open questions; smart technology alone does not demonstrate sustainability.
[62]	Journal	Critical review covers smart-fisheries and aquaculture AI, machine learning and IoT.	Broad and heterogeneous applications, not integrated longline deployment evidence.
[63]	Journal	Commercial-vessel camera and AI deployment study discusses operational obstacles and data conditions.	Practical deployment experience does not establish universal cross-vessel transferability.
[64]	Journal	Trustworthy-AI framework addresses scientific robustness, governance and socioeconomic viability.	Evaluation principles, not an operationally tested autonomous longline system.
[65]	Journal	I-EMR paper proposes integration of EM, reporting and vessel monitoring.	Explicit conceptual design without empirical validation.
[66]	Journal	AIS fusion identifies gillnet, purse-seine and trawl classes; mean accuracy 92.23%, F1 92.18%.	Gear-type classification in adjacent fisheries, not longline setting/hauling-stage detection.
[67]	Journal	Remote-sensing and spatiotemporal features support bigeye-tuna habitat prediction.	Habitat inference is distinct from verified catch and operational compliance.
[68]	Journal	Five-year Eastern Tuna and Billfish Fishery EM/logbook comparison evaluates reporting performance.	Agreement varies by retained/discarded category, taxonomic grouping and vessel.
[69]	Journal	Review describes digital twins across marine industries.	Cross-sector context; does not establish a working longline digital twin.

[70]	Journal	In an East China Sea data-informed simulation, adding digital-twin integration to a PPO agent improved its composite reward by 31.9% relative to PPO without that integration; this is a simulation metric rather than measured stock recovery.	Simulation is not prospective field validation; final citation is Scientific Reports 16, 25618 (2026).
[71]	Journal	FMRAG image-benchmark experiments reported improvements in species identification and biomass estimation relative to baseline multimodal models and text-only retrieval methods.	Benchmark performance does not validate regulatory decisions or autonomous vessel control.

Source composition: 54 journal publications, one peer-reviewed conference chapter, nine technical or institutional sources, four patents, and three commercial documents (71 sources in total). Together, the journal publications and conference chapter constitute the 55 scientific sources reported in the manuscript. Full bibliographic details are given in the manuscript reference list.