AUDIT MANUAL - ASC ABALONE STANDARD

Created by the Abalone Aquaculture Dialogue (AAD)

Aquaculture Stewardship Council

Scope: The ASC Abalone Standard applies globally to all locations and scales of abalone aquaculture production systems, whether land based or sea-based. Abalone aquaculture is defined by this Standard as active husbandry of abalone from seed to harvest (or any part thereof) within a defined area and with defined ownership of the abalone being cultured.

PRINCIPLE 1. OBEY THE LAW AND COMPLY WITH ALL APPLICABLE LEGAL REQUIREMENTS AND REGULATIONS WHERE FARMING OPERATION IS LOCATED

1.1. Criteria: All applicable legal requirements and regulations where farming operation is located

		Compliance Criteria (Required Client Actions):	Auditor Evaluation (Required CB Actions):
1.1.1.	**Indicator:** Presence of documents proving compliance with local and national authorities on land and water use (E.g., permits, evidence of lease, concessions and rights to land and/or water use) **Requirement:** Yes	a. Obtain copies of applicable land and water use laws.	A. Verify compliance with applicable land and water use laws.
		b. Obtain original lease agreements, or copies, of land titles on file.	B. Confirm client holds original lease agreements or land titles.
		c. Keep records of inspections for compliance with national and local laws and regulations (only if such inspections are legally required in the country of operation).	C. Verify that inspection records comply with national and local laws and regulations (as applicable).

	Applicability: All	d. Obtain all necessary permits relating to land and water use as required by local and national authorities.	D. Verify the farm has valid permits relating to land and water use.
		e. Provide a detailed map of the farm with at least 4 GPS coordinates to show that farm location does not conflict with national preservation areas.	E. Verify that the farm is represented accuracy using GPS coordinates. If possible, verify spatial information using Google Map, satellite images or similar means.
PRINCIPLE 2. AVOID, REMEDY OR MITIGATE SIGNIFICANT ADVERSE EFFECTS ON HABITATS, BIODIVERSITY, AND ECOLOGICAL PROCESSES			
2.1. Criteria: Critical habitat and species interactions			
		Compliance Criteria (Required Client Actions):	**Auditor Evaluation (Required CB Actions):**
2.1.1.	**Indicator:** Where not otherwise mandated by local law or covered by recognized environmental impact assessment permitting the farming activity, evidence proving no significant adverse effects on threatened or endangered species [1] or the habitat on which they depend.	**Instruction to Clients for Indicator 2.1.1 - Presence of Species Listed as Threatened or Endangered on the IUCN Red List** Determine whether IUCN red list species are present in the region as follows: - go to http://www.iucnredlist.org/ - follow to "other search options" - select "Taxonomy" and select "Animalia" and "Plantae" - indicate appropriate "Location", "Systems", "Habitat", - click on "run search" and record species listed and whether they are threatened by the farming activity. Note: The IUCN Red List uses nine categories for ranking species according to threat, and search results may include species that are not currently threatened. For the purposes of determining whether a farm complies with indicator 2.1.1, species in the following IUCN categories may be excluded from further analyses: "Not evaluated", "Data Deficient", and "Least Concern".	
		a. Perform above analysis. Record all IUCN red list species and farm-related threats.	A. Repeat analysis to verify that client obtained an accurate result. Verify through additional databases and government reports to cross-check whether endangered species exist in the immediate vicinity of the farm.
		b. Provide a map showing location of the farm (see Indicator 1.1.1e) relative to the known distribution of endangered species or critical habitats in the area.	B. Verify that client is aware of these endangered species or critical habitats located near farm.

	Requirement: Yes **Applicability:** All	c. If an IUCN Red List species is identified in region of the farm (including receiving and source waters), document how the farm takes appropriate precautions. If no IUCN Red List species is present this is N/A.	C. Verify that client takes appropriate precautions as required.
Footnote	[1] As defined by national law or as found in the IUCN Red List of Threatened Species.		

Classification of Seabed Type (applicable to Criteria 2.2. and 2.3.):
Sea-based farms are required to perform a "tiered assessment" (see Appendix 1, Section 2) to assess benthic impacts of the culture activity. The first step is to classify each farm according to the type of seafloor that occurs beneath it. Seafloors, and thus farms, must be classified into one of two main types: Depositional, or Non-Depositional. In order to make this classification, all sea-based farms shall conduct an initial visual survey, using video or seabed imaging.

Depositional / Soft Substrate
Criterion 2.2 applies only to sea-based farms on depositional substrate (i.e. sediment bottoms of sand or silt). Indicators 2.2.1., 2.2.2., 2.2.3., and 2.2.4. are evaluated while Indicator 2.3.1. is not evaluated. Farms must measure sulphide (S) concentrations in the sediment to determine compliance and subsequent monitoring frequency (see 2.2.1., 2.2.2.) . Direct measurement of S concentration may be replaced by an analysis of benthic community structure (see 2.2.3.). Farms must determine areas containing biogenic structures of importance to the functioning of the ecosystem (2.2.4.)

Non-Depositional / Hard Substrate
Criterion 2.3 applies only to sea-based farms on non-depositional substrate (i.e. hard or rocky bottoms). Indicator 2.3.1 is evaluated while Indicators 2.2.1, 2.2.2, 2.2.3, and 2.2.4 are not. The initial visual survey must allow for the comparison of control vs. impacted sites in terms of detrital accumulation and surface organisms.

Note: The initial assessment shall be conducted within a 6 month period prior to the first audit. Sediment samples for the assessment of total "free" sulphides must be collected and analysed by a State or Nationally approved laboratory. Methods for the measurement of "free" sulphides in marine sediments is outlined in Appendix 2.

2.2. Criteria: Benthic impacts of sea-based farming on depositional substrate

		Compliance Criteria (Required Client Actions):	**Auditor Evaluation (Required CB Actions):**
		a. If the farm site is a non-depositional area of hard substrates: Monitoring via video or seabed imaging transects shall be conducted every five years (Proceed to 2.3.1)	A. Verify from video or seabed imaging evidence that the aquaculture site is non-depositional.

2.2.1	**Indicator:** Acceptable levels of total 'free' sulphides in surficial sediment (0-2 centimetres from the surface) measured beneath sea-based farm **Requirement:** ≤ 1500 µM, monitoring every five years is required [2]. ≥ 1500 µM and ≤ 3000 µM, monitoring every year is required [2] . **Applicability:** Sea-based Farms on Depositional Substrate	b. <u>If the farm site is a depositional area of soft substrate:</u> An initial assessment of S concentration in sediments shall be conducted according to Appendix 1 & 2. Direct measurement of S concentration may be replaced by an analysis of benthic community structure in areas where this biotic approach is preferred by the client or is already mandated by a regulatory body [3] (see 2.2.3.). The client shall present information detailing the sampling design used and results of the S assessment: - If S concentration is ≤ 1500 µM, monitoring shall be conducted every five years (Proceed to 2.3.1). - If S concentration is ≥ 1500 µM and < 3000 µM, monitoring shall be conducted every year (Proceed to 2.3.1). - If S concentration is ≥ 3000 µM (Proceed to 2.2.2.).	B. Verify documentation of the initial assessment of S concentration as measured by either direct measurement or analysis of benthic community structure. Verify that samples were collected and analysed according to protocols approved by a State or Nationally approved laboratory
Footnote	[2] If a farm increases standing biomass by more than 100 percent from the date of last assessment, the sulphide measurement must be taken and serve as the new baseline.		
2.2.2.	**Indicator:** Unacceptable levels of total 'free' sulphides in surficial sediment measured beneath sea-based farms **Requirement:** ≥ 3000 µM **Applicability:** Sea-based Farms on Depositional Substrate	*For sea-based farms on depositional substrate and not compliant with 2.2.1.* a. If initial assessment of S concentration is ≥ 3000 µM, the farm is not certifiable unless natural background S levels exceed 3000 µM. Management response is required to reduce S levels. Natural background levels are derived from reference sites outside the farm (see Appendices I & 2 for the comparison to control sites). If S concentrations beneath the farm structures are not significantly higher ($p<0.05$) than reference sites, monitoring shall be conducted every year. (Proceed to 2.3.1).	A. Verify documentation of initial assessment of S concentration by either direct measurement or analysis of benthic community structure. Verify comparison to natural background levels if presented.
2.2.3.	**Indicator:** Sulphide analysis may be replaced by direct analysis of benthic community structure (i.e., infaunal surveys) in areas where this biotic approach is preferred by the applicant or is already mandated by a regulatory body [3]. **Requirement:** Yes **Applicability:** Sea-based Farms on Depositional Substrate	*For sea-based farms on depositional substrate that choose to replace direct measurement of S concentration with an analysis of benthic community structure* a. Direct measurement of S concentration may be replaced by an analysis of benthic community structure in areas where this biotic approach is preferred by the client or is already mandated by a regulatory body [3]. If S equivalency is < 3000 µM, proceed to 2.2.1. If S equivalency is ≥ 3000 µM, proceed to 2.2.2..	A. Record whether the farm replaced the sulphide analysis with a direct analysis of benthic community structure. If yes, confirm that the farm's benthic community analysis complies with requirements [3].
Footnote	[3] Biotic indicator decision thresholds need to be assessed to ensure equivalency with the thresholds identified for total 'free' sulphides given in Requirement 2.2.1. There are several papers that have been published linking specific benthic sulphide levels to indices for benthic biodiversity. Please refer to the reference section for examples (e.g., Hargrave et. al. 2008)		
2.2.4	**Indicator:** Allowance for sea-based abalone aquaculture over areas that provide a particularly significant or essential biological or ecological function within the broader ecosystem [4]	*For all sea-based farms on depositional substrate* a. Prepare results from video or seabed imaging survey of the farm.	A. Verify that video or imagery demonstrates that the farm is not located over areas that provide significant biological or ecological function within the broader ecosystem.

	Requirement: None **Applicability:** Sea-based Farms on Depositional Substrate	b. Summarize information about sensitive habitats in proximity to farming operations (e.g. using a map of habitat distribution) noting any areas where biogenic structures are located [4].	B. Verify farmer knowledge of sensitive habitat in proximity to farming operations.
Footnote	[4] Areas containing biogenic structures that are not particularly adapted to sedimentation or organic enrichment (e.g., tubeworm mounds, bryozoan mounds, bivalve beds and reefs or sponge gardens that form a structure for other epifauna).		
2.3. Criteria: Benthic impacts of sea-based farming on hard or rocky substrate			
		Compliance Criteria (Required Client Actions):	**Auditor Evaluation (Required CB Actions):**
2.3.1.	**Indicator:** Observable detrimental accumulation of sediment underneath the farm compared to a control site, based on bottom video **Requirement:** None **Applicability:** Sea-based Farms on Hard or Rocky Substrate	**Instruction to Clients for Indicator 2.3.1 - Accumulation of Sediment Beneath Farm** *For sea-based farms on non-depositional substrate (i.e. hard or rocky bottoms)* All sea-based farms on non-depositional substrate (i.e. hard or rocky bottoms) will at least conduct an initial visual survey, using video or seabed imaging (outlined in the box "Classification of Seabed Type Criteria", Criteria 2.2.). If the initial visual survey indicates a hard or rocky substratum beneath the farm, then the client shall also include control areas in the visual survey for the comparison of detrital accumulation (see Appendix I for the design of a "CI" (Control-Impacted) type of sampling) Note: The initial assessment shall be conducted by the client within a 6 month period prior to the first audit. If the client is unable to conduct the initial assessment themselves, then an independent party should be contracted by the client.	
		a. The client shall provide video or seabed imaging to the auditor. A "CI" (Control-Impacted) type of sampling design is required for the assessment of detrital accumulation and impact on surface organisms inhabiting the rocky substrate between control and impacted sites.	A. Verification of video or photographic evidence shows absence of detrimental sediment accumulation on rocky seafloor beneath the farm. Detrimental effect would include the reduction or elimination of the surface organisms inhabiting the rocky substrate beneath the farm, relative to control sites.
2.4. Criteria: Effluents from land-based farming			
		Compliance Criteria (Required Client Actions):	**Auditor Evaluation (Required CB Actions):**
2.4.1.	**Indicator:** Annual median concentration [5] of total ammonia nitrogen in effluent or receiving water beyond mixing zone [6] **Requirement:** <0.6 mg/L **Applicability:** Land-based Farms	**Instruction to Clients for Indicator 2.4.1 and 2.4.2 - Monitoring Release of Total Ammonia Nitrogen and Total Suspended Solids** Clients are required to provide quarterly measurements of total ammonia nitrogen and total suspended solids in effluents for ≥ 1 year before the 1st audit. For guidelines regarding procedures, calibration techniques, and instrument/reagent specifications used, refer to Appendices 3 and 4 for total ammonia nitrogen and total suspended solids, respectively.	
		a. Conduct at least 4 quarterly measurements of total ammonia nitrogen before first audit and document results. Samples shall be collected and analysed by a State or Nationally approved laboratory. Annual median concentration will be assessed against the standard of <0.6 mg/L.	A. Verify that documented evidence of annual median concentration of total ammonia nitrogen in the effluent or receiving water does not exceed the threshold level and that water samples were collected and analysed by a State or Nationally approved laboratory.
		b. Obtain documentation regarding the procedures, calibration techniques, and instrument/reagent specifications used by the laboratory. These shall be in compliance with Table B of the California Ocean Plan and shall conform to the requirements of USA federal regulations (40 CFR PART 136) or equivalent national regulations.	B. Verify that all procedures, calibration techniques, and instrument/reagent specifications used are in compliance.

Footnote	[5] Based on quarterly samples.		
Footnote	[6] The mixing zone as defined by the local regulatory authority, or if that does not exist, then the zone of initial dilution as defined in the California Ocean Plan (SWRCB, 2009). The California Ocean Plan defines initial dilution as the process that results in the rapid and irreversible turbulent mixing of wastewater with ocean water around the point of discharge. If the concentrations of ammonia and suspended solids in the effluent comply with the recommended standard, effluent sampling is all that is required. Otherwise, a dilution study is necessary to estimate concentrations at the edge of a mixing zone, under conditions of minimal dilution. A dilution factor should then be applied to the effluent concentration to estimate concentration at the edge of the mixing zone. Where a mixing zone has been defined by a local authority, the defined mixing zone will apply. Otherwise the mixing zone should be the zone of initial dilution as defined in the California Ocean Plan (SWRCB, 2009).		
2.4.2	**Indicator:** Annual median concentration [5] of total suspended solids in effluent compared to influent measured in the outflow or in the receiving water beyond zone of initial dilution [6] **Requirement:** <5 mg/L **Applicability:** Land-based Farms	*See instructions for Indicator 2.4.1.*	
		a. Conduct at least 4 quarterly measurements of total suspended solids before first audit. Samples shall be collected by a State or Nationally approved laboratory. Annual median concentration will be assessed against the standard of <5 mg/L.	A. Verify documented evidence that annual median concentration of total suspended solids in the effluent does not exceed the threshold level and that water samples were collected and analysed according to protocols approved by a State or Nationally approved laboratory. (See also Appendix 4)
		b. Document the procedures, calibration techniques, and instrument/reagent specifications used by the laboratory. These shall be in compliance with national regulations, or if none available, the requirements of CCME (Canadian Council of Ministers of the Environment, 2002). Canadian Water Quality Guidelines for the Protection of Aquatic Life: Total Particulate Matter 1999. Updated 2002, or equivalent national regulations.	B. Verify that all procedures, calibration techniques, and instrument/reagent specifications comply with national guidelines, or if none available, the requirements of CCME (Canadian Council of Ministers of the Environment). (2002). Canadian Water Quality Guidelines for the Protection of Aquatic Life: Total Particulate Matter 1999. Updated 2002, or equivalent national regulations.
2.4.3	**Indicator:** Evidence that all chemicals used on the farm that are discharged to effluent are recorded and quantified **Requirement:** Yes **Applicability:** Land-based Farms	a. Maintain records of all chemicals used on the farm that are discharged to effluent. Records include invoices, history of application (dates applied, quantities used, reason for use).	A. Verify that client maintains documentation showing the recording and quantifying of all chemicals used on the farm that are discharged to effluent.
2.5 Criteria: Chemical and hydrocarbon waste			
		Compliance Criteria (Required Client Actions):	**Auditor Evaluation (Required CB Actions):**
2.5.1.	**Indicator:** Evidence of proper disposal of chemical and hydrocarbon waste **Requirement:** Yes **Applicability:** All	a. Prepare a prevention and response plan describing how the farm deals with potential spills of chemical and hydrocarbon waste.	A. Verify that the farm has sufficiently documented prevention and response plans for dealing with potential spills of chemical and hydrocarbon waste.
		b. Maintain documentation regarding the training history of appropriate employees in the proper disposal of waste and in the prevention and management of chemical and hydrocarbon spills as described in the above plan (2.5.1.a).	B. Verify that the farm has sufficiently documented the training of all employees in current prevention and response plans to manage chemical and hydrocarbon spills.
		c. Maintain documentation of equipment or structures that have come into contact with spilled chemicals and have been subsequently cleaned.	C. Verify that the farm has sufficiently documented equipment or structures that have come into contact with spilled chemicals and the actions taken to clean the affected areas.
2.6. Criteria: Biological waste (E.g., shells, dead animals and sludge)			
		Compliance Criteria (Required Client Actions):	**Auditor Evaluation (Required CB Actions):**
	Indicator: Evidence of proper disposal of biological waste	a. Prepare a plan that details how the farm ensures proper disposal of all biological waste.	A. Verify that the farm has a plan for the proper disposal of biological waste.

2.6.1.	**Indicator:** Evidence of proper disposal of biological waste **Requirement:** Yes **Applicability:** All	b. Maintain records to show how the farm disposes of dead abalone and other forms of biological waste.	B. Verify from farm records that disposals follow the farm's plan.
		-	C. During the on-site inspection, confirm the farm's plan is effectively implemented. Evidence will include interviews with farm workers who confirm that disposals followed the plan.
PRINCIPLE 3. AVOID AND MITIGATE DETRIMENTAL EFFECTS ON THE HEALTH AND GENETIC DIVERSITY OF WILD POPULATIONS			
3.1. Criteria: Escapes			
		Compliance Criteria (Required Client Actions):	**Auditor Evaluation (Required CB Actions):**
3.1.1.	**Indicator:** Documented protocol and evidence of best management practices to minimize escapes **Requirement:** Yes **Applicability:** All	a. Prepare written protocols that describe how the farm will follow best management practices to minimize escapes.	A. Verify that the farm's protocols are sufficient to minimize escapes base don risk.
		b. Maintain a record of all escapes outside of the main culture area. For each escape incident, identify the date and location, probable cause, and actions taken by the farm to prevent similar escapes in the future.	B. Verify that the farm maintains a record of escapes.
		c. For escape incidents, record actions taken by the farm to recover or destroy the escaped individuals.	C. Verify that farm documents confirm that any escapees were recovered or destroyed.
		d. Ensure that all containment structures (e.g. mesh at outlets) are properly maintained.	D. During on-site audit, inspect containment measures (e.g. mesh at outlets) to verify that structures are in place and well maintained.
		-	E. During the audit verify there is no evidence of significant escapes in channels, drains or settlement ponds.
3.2. Criteria: Genetic management			
		Compliance Criteria (Required Client Actions):	**Auditor Evaluation (Required CB Actions):**
3.2.1.	**Indicator:** Sea-based farm seed originates from native wild brood stock (not selectively bred animals) in situations where the wild population is threatened or endangered **Requirement:** Yes **Applicability:** Sea-based Farms	**Instruction to Clients for Indicator 3.2.1 - Genetic management** Clients must demonstrate that, in areas where the wild population is threatened or endangered (see Indicator 2.1.1), all seed must originate from native wild brood stock and not from selectively-bred animals. Clients are required to document the sources of all culture stock. **Note:** Where wild populations are not threatened and there is healthy local recruitment, genetic risk posed by selectively-bred animals is minimal and Requirement 3.2.1. need not be rigorously applied.	
		a. Maintain documentation showing the origin of culture stock with names, addresses, contact person(s) and delivery dates of each purchase.	A. If culture stock is purchased, verify that farm documents show the origin of culture stock with names, addresses and contact person(s) of suppliers.
		-	B. If the wild population is threatened or endangered, review farm documents to confirm that all seed entering a sea-based farm originates from native wild brood stock (not from selectively-bred animals).

Instruction to Clients for Criteria 3.3 - Translocated Brood stock and Seed
Quarantine: A principle requirement for all acquired brood stock and seed (farm to farm, 3.3.1.; wild to farm, 3.3.2) is that they undergo a period of quarantine following translocation, for at least 8 weeks, in order to ensure that they are free of disease and parasites prior to being mixed with other farm animals. For wild to farm translocations (3.3.2.) there is an additional requirement of cohabitation with farmed "sentinel" abalone during quarantine to prevent the introduction of disease to the farmed stock.

Monitoring and identification of disease:
Appendix 5 outlines the required protocol for identification, surveillance and response to diseases and mortality events. All farms are required to monitor the health of cultured abalone through regular inspection (Appendix 5. Section 3.) in order to identify and react to disease or mortality events (Appendix 5. Section 5.). All farms must be able to identify the key infectious diseases of concern for the abalone in their area. This requires both the training of staff in the identification of visible symptoms and the use of labs that are State or Nationally approved and have diagnostic procedures for detecting the presence or absence of these diseases (4.1.1., Appendix 5. Section 2.).

Maintenance of records:
In addition to maintaining records as to the origin of the brood stock (3.2.1.), clients must maintain detailed records of all translocations to the farm and within the farm to ensure that the requirements of quarantine have been met. In addition, all health inspection details shall be recorded. Documentation shall include:
1) Origin of culture stock with names, addresses, contact person(s) and delivery dates of each purchase.
2) All translocations within the culture facility including dates of introduction and time spent in quarantine (minimum 8 weeks).
3) Record of staff training in the recognition and response to disease events.
4) Record of all mortality events and actions taken.

3.3. Criteria: Translocated brood stock and seed

		Compliance Criteria (Required Client Actions):	Auditor Evaluation (Required CB Actions):
3.3.1.	**Indicator**: For farm-to-farm translocations: batch certification using diagnostic tests capable of detecting all diseases and parasites/pests of concern [7] followed by minimum eight week isolation (not mixed with other animals on the farm). [8] **Requirement**: Required **Applicability**: All	a. Maintain records for origin of brood stock (see 3.2.1.a).	A. Verify that farm keeps records/permits indicating the origin of cultured stock.
		b. Maintain documentation of all translocations.	B. Verify in documentation that acquired stocks have been kept in isolation (quarantine) for at least 8 weeks prior to mixing with other farm animals.
		c. Maintain separate quarantine facilities in operable condition.	C. Inspect quarantine facilities during on-site audit to verify they are in operable condition.
		d. Maintain documentation of stock inspections and any actions taken regarding mortality events.	D. Verify correct treatment of mortality events in quarantined stocks according to the protocol in Appendix 5. [8]

Footnote	[7] Notifiable diseases present in the country of origin, plus diseases that have been the primary cause of abalone mortality in the country of origin, plus organisms that may be transferred with the abalone and are regarded as pests.		
Footnote	[8] If a mortality event occurs in the translocated stock during the eight-week period, then the procedures prescribed in Appendix 5 shall be followed. The stock will remain in isolation for a minimum of a further eight weeks following the cessation of the mortality event, unless there is an obvious non-infectious cause.		
3.3.2.	**Indicator:** For wild to farm translocations: an eight week minimum biosecure quarantine (treated effluent) with cohabitation and disease surveillance [9] **Requirement:** Required **Applicability:** All	**Instruction to Clients for Indicators 3.3.2 - Wild to Farm Translocation of Brood stock and Seed** See general "Instruction for Criteria 3.3." above. In addition to the general requirement of quarantine for all translocations, translocated wild abalone must go through cohabitation with farmed "sentinel" abalone during quarantine. Farms must ensure that sentinel abalone are clearly distinguishable from wild abalone (e.g. through marking) during the cohabitation.	
		a. Maintain documentation of all translocations including the additions of sentinels	A. Verify in documentation that acquired stocks have been kept in isolation (quarantine) for at least 8 weeks prior to mixing with other farm animals. Verify that farm stock has been added to quarantined wild stock grow out units as sentinels for disease and that methods and responses detailed in Appendix 5 have been followed.
		b. Maintain separate quarantine facilities in operable condition.	B. Inspect quarantine facilities during on-site audit to verify they are in operable condition.
		c. Maintain documentation of stock inspections and any actions taken regarding mortality events.	C. Verify correct treatment of mortality events in quarantined stocks according to the protocol in Appendix 5.
Footnote	[9] Farmed stock added to the quarantined wild stock grow out units as sentinels for disease. Methods to be followed and responses required are detailed in Section 7 of Appendix 5.		
3.4 .Criteria: Exotics			
		Compliance Criteria (Required Client Actions):	**Auditor Evaluation (Required CB Actions):**
3.4.1.	**Indicator:** Evidence of responsible [10] introduction of non-native abalone species **Requirement:** Required **Applicability:** All	a. If the farm works with the culture of non-native abalone species, permits must be obtained verifying compliance with ICES codes [10].	A. Verify accuracy and validity of documents
Footnote	[10] At a minimum, includes permits based on a credible risk or environmental assessment procedure and environmental management plan (e.g., ICES Code of Practice on the Introductions and Transfers of Marine Organisms) and certification to ICES requirements regarding parasites and pathogens.		
3.5 Criteria: Transgenic abalone			
		Compliance Criteria (Required Client Actions):	**Auditor Evaluation (Required CB Actions):**
3.5.1	**Indicator:** Allowance for farming of transgenic [11] abalone **Requirement:** None **Applicability:** All	a. Obtain documentation from the supplier confirming that culture stock is not transgenic (see 3.2.1a).	A. If the farm purchases culture stock verify that farm records for cultured stock (see 3.2.1A) clearly indicate that the stock is not transgenic.
		b. Prepare a declaration stating that the farm does not culture transgenic abalone.	B. Verify that farm makes declaration.

		-	C. If there is suspicion of transgenic abalone being cultured, genetic validation is required. Auditors shall take samples from ≥ 3 individuals from suspected stock and ship these for genetic mapping by an ISO 17025 certified laboratory to determine gene sequence and unknown sequences.
Footnote	[11] Introduced genes from other species.		
PRINCIPLE 4. MANAGE DISEASE AND PESTS IN AN ENVIRONMENTALLY RESPONSIBLE MANNER			
4.1. Criteria: Disease and pest management practices			
		Compliance Criteria (Required Client Actions):	**Auditor Evaluation (Required CB Actions):**
4.1.1.	**Indicator:** Evidence of compliance with a documented protocol for health surveillance and disease response (minimum requirements are found in Appendix 5). **Requirement:** Yes **Applicability:** All	**Instruction to Clients for Indicator 4.1.1 - Evidence of compliance with a documented protocol for health surveillance and disease response** Appendix 5 outlines the protocols required for identification, surveillance and response to diseases and mortality events. As detailed in the "Instruction to Clients for Criteria 3.3.", Clients are required to maintain documentation of inspections and actions taken following mortality events. Farms must also demonstrate that staff have been trained in the identification of visible symptoms and subsequent actions required. <u>Stock inspection</u> (from Appendix 5, Sections 3 & 5): 1. Every grow out unit is inspected at least once every 10 days to help ensure that any mortality event or abnormal behaviour of the abalone is quickly investigated. The frequency of stock inspection on an abalone farm varies with feed type, grow out unit design, weather and management strategies. 2. In the case of a mortality event (as defined in Appendix 5 Section 5), or if abnormal behaviour is observed, then the details must be recorded (see log details below) and the procedures outlined in Appendix 5 Section 5 must be followed. 3. A log shall be kept where details of each inspection are recoded. Information includes: - date of inspection - grow out unit number - abnormal behaviour - mortality (number of moribund abalone, cause of event, action taken, and conclusion) 4. Each farm will compile over time records of grow out abalone mortality rates by year class and season. These will be used as a reference point in Appendix 5 Section 7 and will help the farm identify trends that could relate to diseases.	
		a. Maintain documentation of stock inspections and any actions taken regarding mortality events.	A. Verify that the farm's documentation, practices and facilities to determine compliance with a health protocol meeting the requirements laid out in Appendix 5.
		b. Maintain documentation of staff training in the identification of visible symptoms of disease and appropriate actions to be taken.	B. Verify that the farm maintains a record of staff training in the identification of disease. Conduct interviews with relevant staff to confirm abilities to identify abalone diseases from visible symptoms.
4.1.2	**Indicator:** Evidence that all equipment and clothing from other abalone farms or seafood processors are disinfected before being bought onto a farm	a. Prepare procedure on disinfection of all equipment and clothing brought to the farm from other abalone farms or seafood processors.	A. Verify that the procedures used to disinfect equipment/clothing from other abalone farms/ seafood processors are appropriate.

4.1.2.	**Requirement:** Yes **Applicability:** All	b. Maintain record of all disinfections of equipment and clothing brought to the farm from other abalone farms or seafood processors.	B. Verify that the farm maintains records of disinfection and confirm that procedures are effective.
4.1.3.	**Indicator:** Evidence that access to farmed abalone by birds and other animal vectors is minimized (E.g., indoor grow out units, fencing, netting and deterrents) **Requirement:** Yes **Applicability:** All	a. Farms must show how they minimize access of birds and other animal vectors of disease (E.g., indoor grow out units, fencing, netting and deterrents). Maintain a list of all exclusion measures implemented on the farm.	A. During the on site audit, Inspect the farm's exclusion measures to verify effective implementation.
4.1.4.	**Indicator:** Allowance for the prophylactic use of antibiotics **Requirement:** None **Applicability:** All	a. Maintain records for all purchases of antibiotics (invoices).	A. Verify from purchase records the calculated total amount of antibiotics procured by client. Inspect storage area to verify quantities on site.
		b. Maintain a log of all health related events. For each event, record the type of treatment and duration.	B. Verify from the log that the farm's application of antibiotic corresponds to health-related events.
		c. Maintain a register all chemical and antibiotics treatments in the prior 12-month period.	C. Verify that the farm accurately records the total amount of antibiotics used. Confirm that the records do not suggest prophylactic use.
4.1.5.	**Indicator:** Where farms use fresh seaweed, it must be locally sourced**.** **Requirement:** Yes **Applicability:** All	a. Maintain records of the origin of all seaweed used for abalone feed with names, addresses, and contact person(s) of each purchase.	A. Verify that farm maintains adequate records for all purchases of seaweed used for abalone feed.
		-	B. Verify from records that fresh seaweed brought onto the farm is locally sourced.
PRINCIPLE 5. USE RESOURCES EFFICIENTLY			
5.1. Criteria: Use of wild seaweed and kelp			

		Compliance Criteria (Required Client Actions):	Auditor Evaluation (Required CB Actions):
5.1.1.	**Indicator:** Wild seaweed used for abalone feed is obtained from a regulated or recognized, well-managed resource **Requirement:** Yes **Applicability:** All	a. If wild seaweed is used for abalone feed, obtain a declaration from the supplier stating that the seaweed is from a regulated or recognized well-managed resource.	A. Verify compliance (if applicable). Cross-check supplier declarations against purchase records (see 4.1.5a)
Criteria 5.2: Manufactured feed			
		Compliance Criteria (Required Client Actions):	**Auditor Evaluation (Required CB Actions):**
5.2.1.	**Indicator:** Forage Fish Equivalency Ratio (FFER) for abalone fed manufactured feed **Requirement:** <1 [12] **Applicability:** All	**Instruction to Clients for Indicator 5.2.1. - Calculation of Forage Fish Equivalency Ratio (FFER)** In order to calculate the Forage Fish Equivalency ratio (FFER), follow the method in Appendix 6. 1. Calculate the Economic Feed Conversion Ratio (eFCR): the quantity of feed used to produce the quantity of fish harvested. eFCR = Feed, kg or mt / Net aquaculture production exclusive of mortalities, kg or mt (wet weight) 2. Calculate the FFER for both fish meal (FFERm) and fish oil (FFERo) FFERm = (% fish meal in feed from forage fisheries) x (eFCR) / 22.2 FFERo = (%fish oil in feed from forage fisheries) x (eFCR) / 5.0 3. Take the higher value between FFERm and FFERo FFER = maximum(FFERm, FFERo) **Notes:** - Fish meal and fish oil that are produced from trimmings can be excluded from the calculation as long as the origin of the trimmings do not come from any species that are classified as Critically Endangered or Endangered in the IUCN Red List (The International Union for the Conservation of Nature and Natural Resources, reference can be found at http://www.iucnredlist.org/static/introduction). - The standard for FFER will be reduced to 0.8 effective October 15, 2013.	
		a. Provide records of the total quantity of abalone produced (kg or mt wet weight) during the last ≥12 months prior to the audit.	A. Verify from documented evidence that the calculated FFER is <1 according to the methodology in Appendix 6.
		b. Provide records of the quantity and type of feeds used during the last ≥12 months prior to the audit.	-
		c. Provide records from feed suppliers stating the forage fish content (fish oil or meal, as a percentage) in each type of feed used. If farm produces their own feed records must be kept on forage fish content.	-
Footnote	[12] The standard for FFER will be reduced to 0.8 within three years of the publication date of the standards.		
5.2.2.	**Indicator:** >95% of fish meal and fish oil component in feed originates from fisheries deemed sustainable by an ISEAL compliant certification scheme for sustainable forage fisheries **Requirement:** Yes, within five years of commercial availability	**Instruction to Clients for Indicator 5.2.2 - Percentage of Certified Fish Meal and Fish Oil in Feed** In order to ensure that the fish meal and fish oil components in feed original from sustainable fisheries, certified feed manufacturers should provide an authoritative signature of the ISEAL compliant certification scheme on their letterhead. Clients shall maintain these and any other documentation provided by the feed manufacturer in order for the auditor to assess compliance. Note: Regarding the language of the Standard that farms must be compliant "within five years of commercial availability in the farming region" - means being commercially available in the region (UN regions) by at least two independent suppliers and indicated in grey literature (date of becoming available).	

	in the farming region **Applicability:** All	a. Maintain receipts for all feed purchases from the last ≥12 months prior to audit.	A. Verify that all the farm's feed suppliers (in 5.2.2a) have made declarations (5.2.2b)

		b. Obtain declaration from each feed supplier stating that fish meal and fish oil components in feed originates from fisheries deemed sustainable by an ISEAL compliant certification scheme for sustainable forage fisheries.	B. Verify from documentation that >95 % of fish meal and oil used in the manufactured feed is certified by an ISEAL compliant certification scheme within 5 years of commercial availability.
5.3. Criteria: Solid waste disposal			
		Compliance Criteria (Required Client Actions):	**Auditor Evaluation (Required CB Actions):**
5.3.1.	**Indicator:** Evidence proper disposal of waste and presence of recycling programs **Requirement:** Yes **Applicability:** All	a. Prepare a policy stating the farm's commitment to proper and responsible treatment of non-biological waste from production. It must explain how the farm's policy is consistent with best practice in the area of operation.	A. Verification that a waste treatment policy exists and that best practise examples in the area are used in this policy.
		b. Provide a description of the most common production waste materials and how the farm ensures these waste materials are properly disposed of. Indicate which waste materials are recycled.	B. During the on-site inspection look for evidence of proper waste disposal and recycling of waste materials
5.4. Criteria: Energy efficiency			
		Compliance Criteria (Required Client Actions):	**Auditor Evaluation (Required CB Actions):**
5.4.1.	**Indicator:** Evidence of energy use monitoring relative to production and on-going effort to improve efficiency **Requirement:** Yes **Applicability:** All	a. Maintain records (e.g. receipts) of fuel and electricity used by the farm. A minimum of 12 months of continuous records are required before the first audit.	A. Verify the farm maintains records.
		b. Compute the annual energy consumption for the last 12 months. Energy usage is itemized and summed in kilojoules. Conversions of energy components to kilojoules of energy can be found at: http://tonto.eia.doe.gov/energyexplained/index.cfm?page=about_energy_conversion_calculator.	B. Verify the accuracy of the calculated annual energy consumption.
		c. Using results from 5.4.1.b and the total weight (metric tons) of abalone produced over the last 12 months (calculated in 5.2.1.a.), determine the farm's energy consumption relative to production.	C. Verify the accuracy of the calculated energy consumption relative to production.
		d. Document any efforts made by the farm to improve energy efficiency	D. Confirm the effectiveness of the farm's efforts to improve energy efficiency (as applicable).
5.4.2.	**Indicator:** Evidence of energy audit or in-house assessment if independent auditors are not nationally available **Requirement:** Yes **Applicability:** All	a. Conduct an energy audit within the 12 months prior to first audit. An in-house audit is acceptable if no independent auditors are available nationally.	A. Verify documentation of the energy audit.
5.4.3.	**Indicator:** Records of total quantities of freshwater used on farm **Requirement:** Yes	a. Maintain continuous records (e.g. receipts) of freshwater use on the farm. A minimum of 12 months of continuous records are required before the first audit.	A. Verify the farm keeps continuous records of water consumption.
		b. Calculate the total quantity of freshwater used on the farm on an annual basis.	B. Verify the accuracy of the calculation of total annual quantity of freshwater used.

	Applicability: All	c. Document any attempts made to reduce the farm's water consumption.	C. Confirm the effectiveness of the farm's efforts to reduce water consumption (as applicable).

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Social requirements of this Standard shall be audited by an individual who is a lead auditor in conformity with SAAS Procedure 200 section 3.1. (See ASC Farm Certification and Accreditation Requirements)

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PRINCIPLE 6. BE A GOOD NEIGHBOR AND CONSCIENTIOUS COASTAL CITIZEN

6.1. Criteria: Community relations and interaction

		Compliance Criteria (Required Client Actions):	
6.1.1.	**Indicator:** Rights of access to public resources are maintained **Requirement:** Yes **Applicability:** All	a. Maintain free access to public resources. Provide map showing farm operations and property in relation to public areas and resources	A. Verify through site inspection that access to public resources is maintained
		b. Minimize the use of lights and bright colored buoys in comparison to those required for navigational safety	B. Verify that lights and bright colored buoys are minimized in comparison to those required for navigational safety
6.1.2.	**Indicator:** Evidence of compliance with all applicable navigational rules and regulations **Requirement:** Yes **Applicability:** Sea-based Farms	a. Provide a copy of local navigational rules and regulations. Document that staff have been appropriately informed and trained in compliance with local navigational rules and regulations.	A. Verify through site inspection that farm complies with local navigation rules and regulations. Workers must prove competence in these rules and regulations.
		b. Post a copy of local navigational rules and regulations on farm site.	B. Verify that navigational rules are posted on farm site
6.1.3.	**Indicator:** Documented complaints response protocol that includes, at a minimum, a registry of complaints and appropriate responses **Requirement:** Yes	a. Maintain a publicly available document that outlines the farm's external complaint response protocol, including a record of all past complaints and appropriate responses taken.	A. Verify the documented conflict resolution policy
		-	B. Verify that records of complaints, related actions and resolution maintained are publicly available

	Applicability: All	-	C. Verify from the record that past complaints, when brought to farm attention, were dealt with swiftly.

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Social requirements of this Standard shall be audited by an individual who is a lead auditor in conformity with SAAS Procedure 200 section 3.1. (See ASC Farm Certification and Accreditation Requirements)

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PRINCIPLE 7. DEVELOP AND OPERATE FARMS IN A SOCIALLY AND CULTURALLY RESPONSIBLE MANNER		
7.1. Criteria: Child labour		
		Compliance Criteria (Required Client Actions):
7.1.1.	**Indicator:** Incidences of child [13] labour [14] **Requirement:** 0 **Applicability:** All	a. Minimum age of permanent workers is 15 or higher (per national legal minimum age).
		b. System exists to monitor hours and conditions of young workers and light work by children.
		c. Young workers from 15 to 18 years of age [as defined in footnote 15]: have no conflicts between work and schooling; do not spend more than 10 hours/day on transportation time, school and work; and do not perform hazardous work [as defined in footnote 16].
		d. Children under 15 perform only light work. Light work & school not to exceed 7 hours/day.
		e. Equal treatment for children of migrant workers.
Footnote	[13] A “child” is defined as any person less than 15 years of age. A higher age would apply if the minimum age law stipulates a higher age for work or mandatory schooling. If, however, the local minimum age law is set at 14, in accordance with developing country exceptions under International Labour Organization (ILO) Convention 138, the lower age will apply.	
Footnote	[14] “Child labour” is defined as any work by a child younger than the age specified in the definition of a child, except for light work as provided for by ILO Convention 138, Article 7.	
Footnote	[15] A “young worker” is defined as any worker between the age of child, as defined above, and under the age of 18.	

Footnote	[16] “Hazardous work” is defined as work that, by its nature or circumstances in which it is carried out, is likely to harm the health or safety of workers.	
7.2. Criteria: Forced, bonded, compulsory labour		
		Compliance Criteria (Required Client Actions):
7.2.1.	**Indicator:** Incidences of forced [17], bonded [18], or compulsory labour **Requirement:** 0 **Applicability:** All	a. Contracts clearly stated and understood by employees, no ‘pay to work’ schemes through labour contractors or training credit programs.
		b. Employees free to leave workplace and manage their own time.
		c. Employer does not withhold employee’s original identity papers.
		d. Employer shall not withhold any part of workers’ salaries, benefits, property or documents in order to oblige them to continue working for employer.
		e. Employees not obligated to stay in job to repay debt.
Footnote	[17] “Forced labour” is all work or service that is extracted from any person under the menace of any penalty for which said person has not offered himself or herself voluntarily or for which such work or service is demanded as a repayment of debt. “Penalty” can imply monetary sanctions and physical punishment, such as loss of rights and privileges or restriction of movement (or withholding of identity documents).	
Footnote	[18] “Bonded labour” is when a person is forced by the employer or creditor to work to repay a financial debt to the crediting agency.	
7.3. Criteria: Discrimination		
		Compliance Criteria (Required Client Actions):
7.3.1.	**Indicator:** Incidences of discrimination [19] **Requirement:** 0 **Applicability:** All	a. Written anti-discrimination policies in place, stating that the company does not engage/support in discrimination in hiring, remuneration, access to training, promotion, termination or retirement based on race, caste, national origin, religion, disability, gender, sexual orientation, union membership, political affiliation, age or any other condition that may give rise to discrimination
		b. Worker testimony supports that the company does not interfere with the rights of personnel to observe tenets or practices, or to meet needs related to race, caste, national origin, religion, disability, gender, sexual orientation, union membership, political affiliation or any other condition that may give rise to discrimination. Records indicate objective mechanisms for employee reviews and the offering of promotion and training opportunities

Footnote	[19] “Discrimination” is any distinction, exclusion or preference, which has the effect of nullifying or impairing equality of opportunity or treatment. Not all distinction, exclusion or preference constitutes discrimination. For instance, a merit or performance-based pay increase or bonus is not by itself discriminatory. Positive discrimination in favour of people from certain underrepresented groups may be legal in some countries.	
7.4. Criteria: Health and safety		
		Compliance Criteria (Required Client Actions):
7.4.1.	**Indicator:** All health and safety related accidents and violations are recorded and corrective action is taken when necessary **Requirement:** Yes **Applicability:** All	a. Documentation is generated with regards to occupational health and safety violations.
		b. Corrective action plans are implemented in response to accidents that have occurred. This should include: analysis of the root causes, address the root causes, remediate and prevent future accidents of similar nature.
7.4.2.	**Indicator:** Occupational health and safety training is available for all employees **Requirement:** Yes **Applicability:** All	a. Minimization of hazards/risks in the working environment, including documented systemic procedures and policies to prevent workplace hazards and their risks, shall exist and the information shall be available to employees.
		b. Emergency response procedures shall exist and be known by employees.
		c. Health and safety training for all employees is available, including training on potential hazards and risk minimization.
		d. Potentially dangerous chemicals are stored properly and as prescribed.

7.4.3.	**Indicator:** Employer responsibility and proof of insurance (accident or injury) for employee medical costs in a job-related accident or injury, unless otherwise covered **Requirement:** Yes **Applicability:** All	a. Documentation maintained by management confirms that all personnel are provided sufficient insurance to cover costs related to occupational accidents or injuries. Equal insurance coverage must include temporary, migrant or foreign workers.
7.5 Criteria: Fair and decent wages		
		Compliance Criteria (Required Client Actions):
7.5.1.	**Indicator:** Payment of fair and decent wages **Requirement:** Yes **Applicability:** All	a. Employers/Managers understand and have policies to ensure the principle of equal pay for equal work.
		b. Employers ensure wages paid for a standard working week (no more than 48 hours) always meet, at least, legal/industry minimum standards.
		c. Labour conflict resolution policy in place to track conflicts and complaints raised, and responses to conflicts and complaints.
		d. Ratio of lowest wage rate to basic needs wage always exceeds 100%.
7.6. Criteria: Freedom of association and collective bargaining		
		Compliance Criteria (Required Client Actions):
7.6.1.	**Indicator:** Employees have access to freedom of association and collective bargaining **Requirement:** Yes **Applicability:** All	a. Workers have the freedom to form and join any trade union, free of any form of interference from employers or competing organizations set up or backed by the employer. The ILO specifically prohibits "acts which are designed to promote the establishment of worker organizations or to support worker organizations under the control of employers or employers' organizations".
		b. Local trade union, or where none exists a reputable civil-society organization, confirms no outstanding cases against the employer for violations of employees' freedom of association and collective bargaining rights.
		c. Trade union representatives have access to their members in the workplace at reasonable times on the premises.
		d. Explicit communications from the employer about their commitment to freedom of association and collective bargaining rights of all.
		e. If trade unions exist, they are able to access/inform all workers directly (posters, pamphlets, visits).
7.7. Criteria: Non-abusive disciplinary practices		
		Compliance Criteria (Required Client Actions):
7.7.1.	**Indicator:** Incidences of abusive disciplinary practices occurring on the farm **Requirement:** 0	a. There is never any use of or support for (e.g. subcontractors using) corporal punishment, mental or physical coercion, or verbal abuse.
		b. Fines or wage deductions shall not be acceptable as a method for disciplining workers (indicated by policy statements, as well as evidence from worker testimony).

	Applicability: All	c. Procedures exist for situations in which disciplinary action is required, and they establish the use of progressive verbal and written warnings. Aim should always be to improve the worker before letting him/her go. (Indicated by policy statements as well as evidence from worker testimony).
7.8. Criteria: Working hours		
		Compliance Criteria (Required Client Actions):
7.8.1.	**Indicator:** Incidences, violations or abuse of working hours and overtime laws or expectations **Requirement:** None **Applicability:** All	a. No deductions in pay for disciplinary actions.
		b. Wage and benefits are clearly articulated to employees and rendered to employees in a convenient manner; e.g. no need to travel to collect benefits, no promissory notes, coupons or merchandise; payment in cash or check.
		c. Labour-only contracting or false apprenticeship schemes are not accepted, including: revolving/consecutive labour contracts used to deny benefit accrual.
		d. Clear, transparent mechanism for wage setting known to employees.
		e. Employer shall comply with applicable laws and industry standards related to working hours. “Normal workweek” can be defined by law but shall not on a regular basis (constantly or majority of the time) exceed 48 hours. Only if allowed by law, variations (to the 48-hour regular work week) based on seasonality may apply.
		f. All overtime shall be paid at a premium and should not exceed 12 hours per week.

		g. Overtime work shall always be voluntary.

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APPENDIX I: Experimental design for assessment of benthic impacts of abalone culture

1.0 Rationale

Before-After-Control-Impact (BACI) and Gradient Analysis (GA) models may be used for detecting environmental change or disturbance in benthic variables affected by abalone culture. The recommended experimental designs are consistent with the tiered assessment approach described in Section 2.1.1 for non-depositional areas of hard substrates using bottom video/imaging methods or measurements of total 'free' sulphide (S) or other indicators of organic enrichment in depositional areas where bottom samples can be collected. Changes in benthic habitat characteristics are assessed by comparing observations at a series of stations outside of a farmed area either along transects or randomly placed as groups of sampling sites to assess temporal and spatial differences in measured variables. The design selected determines station locations, numbers and sampling frequency. The before-after (BA) test compares observations within a farmed area before and after the farm is established. Alternatively, non-farm (control) and farm (impact) areas can be compared (CI design) to determine if abalone culture has changed temporal variations in selected variables. If both BA and CI data from multiple sites are available, the BACI model detects environmental change associated with disturbance. Regression analysis is used to test for spatial trends in a GA model where changes in variables occur with increasing distance from a farm.

2.0 Tiered Assessment

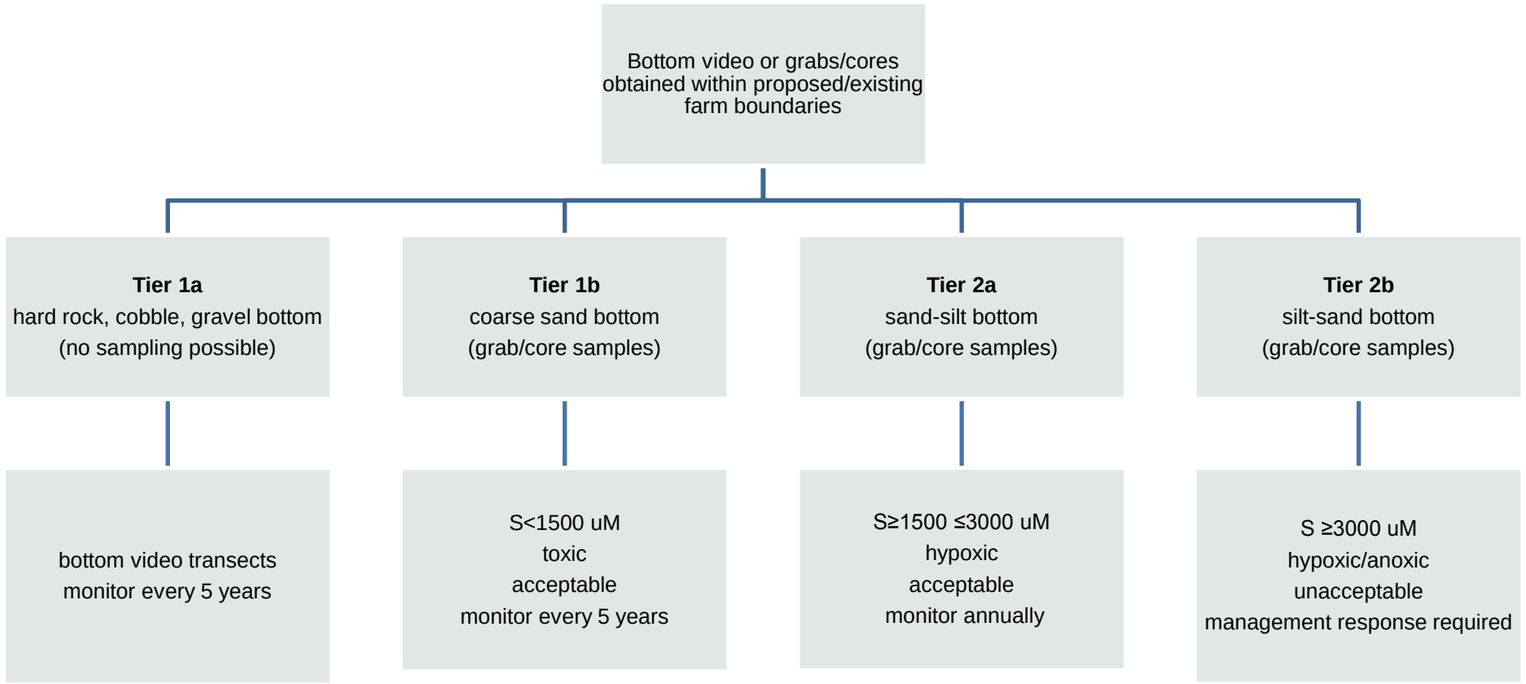

Fig. 1 Tiered assessment approach for assessing effects of abalone culture on benthic habitat conditions

A tiered assessment approach is recommended for assessing effects of abalone culture on benthic habitat conditions (Fig. 1). Collection of bottom video or other images along transects once every 5 years (Tier 1a assessment) is recommended for monitoring high energy, low risk areas where hard bottom prevents sample collection. Sampling in lower energy areas with depositional conditions represented by sand or mud bottom types may be carried out once every 5 years, annually or more frequently depending on the level of risk determined by mean or median S concentrations (Tier 1b and 2a and 2b assessments).

3.0 Sampling Designs

3.1 Before-After Observations with and without a Control

Green (1979) described a simple approach for detecting environmental changes associated with human activity by making observations at one location before and after the activity has occurred. Underwood (1991, 1992), Smith et al. (1993) and Underwood (1994) presented a more complete experimental sampling design with observations at multiple sites in impacted and control areas (BACI) to determine if changes in measured variables are due to environmental disturbance and to account for natural variations.

A full application of the BACI method requires collection of replicate samples in time and space over different temporal scales at multiple sampling sites to determine if an 'event' has changed one or more measured variables. Observations are compared before and after the start of the activity potentially causing the disturbance. Multiple sites selected at random within impacted and control areas can be sampled with observations at the same locations before and after the activity has begun. Ideally sampling should occur at random times but seasonal effects can be minimized if sampling occurs at a fixed time during the year.

The approach has been used following the establishment of mussel culture to assess temporal variations in benthic macrofauna communities (Lasiak et al. 2006) and geochemical indicators for sediment organic enrichment (Cranford et al. 2009).

3.2. Control-Impact Observations

Often data from the before period is not available. If this is the case a control-impact (CI) model can be used to compare sites within and outside of farm boundaries in locations assumed to be unaffected by disturbance. A decision must be made to select sampling locations within impacted and control areas on a random or stratified basis. If a randomized design is used control sites must be a sufficient distance from the impacted area to represent natural 'background' variability (i.e. be unaffected by the events within the farm). The appropriate distance may be determined by sampling along transects with distance and directions determined by the velocity and direction of major currents (discussed below). The appropriate upstream or downstream locations for control sites relative to an abalone culture area will vary with specific hydrographic conditions. In some studies benthic effects were only measureable directly under culture arrays (Grant et al. 1995, Crawford et al. 2003). However, modelling studies of the distribution of biodeposits from mussel aquaculture have shown that depending on current speed and water depth enhanced settling of particulate matter from cultures could occur up to distances of 30 to 90 m from a farm (Weise et al. 2009). The CI approach was used in an embayment-wide study in a shallow inlet with intensive mussel culture to show effects of organic enrichment in farm vs. non-farm areas (Hargrave et al. 2008).

3.3. Gradient Observations

The BACI designs allow area-by-area (e.g. farm vs. non-farm) comparisons to detect environmental changes against a background of natural variability when there are defined boundaries for the impacted area. GA using sampling along transects provides an alternative design for assessing effects of bivalve aquaculture where boundaries between impacted and control areas may be poorly defined or variable between sites. Sampling along transects may be more sensitive for detecting spatial differences than a CI design if the disturbance is directional (Ellis and Schneider 1997). Sampling stations along transects should be located along the axis of the major current with either uniform spacing or at variable distances to reflect expected diminished effects with increasing distance from culture arrays. Crawford et al. (2003) provided an example of observations along transects to evaluate benthic effects of shellfish farms.

4.0 Station Locations and Numbers

Since the power of statistical tests increases with sample size (Sokal and Rohlf 1995) numbers of observations should be as large as practically possible with equal numbers of observations at all locations being compared. As a compromise between monitoring costs and statistical power to detect differences between sites, triplicate samples at ten sites along transects or within farm and non-farm locations are recommended. Replication (3 samples x 5 sites, n=15) for each group of stations to be compared is required to account for variations in benthic conditions common in shallow coastal areas where abalone aquaculture occurs.

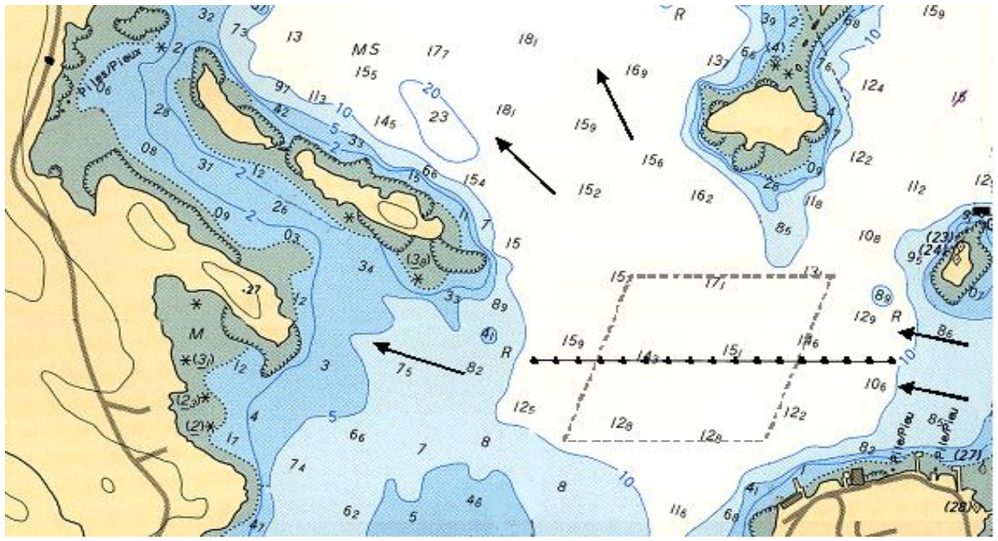

Fig. 2 Example of gradient sampling approach for Tier 1a assessment of benthic effects of abalone aquaculture (Fig. 1). The video transect (solid line) or photographic transect (solid dots) is aligned along the axis of the major current (arrows) and runs through the farm boundaries (dotted lines).

Tier 1a assessments of non-depositional or hard bottoms using bottom imaging should be conducted using the GA approach with transects extending from inside to outside of a proposed or existing farm area. The orientation of transects should as far as possible follow depth contours to minimize depth and sediment type variations. Bottom imaging with GPS navigation would be obtained continuously (video) or at random or regular intervals (still images) along the entire length of a transect running through and outside farm boundaries in both directions. Image analysis can then be applied to examine gradients in benthic conditions along the transect.

Bottom samples for the preliminary site assessment and subsequent Tier 1b, 2a and 2b monitoring programs may be collected using the GA approach sampling in either upstream or downstream directions by collecting samples at known distances from the farm boundary (Fig 3). Station spacing can be uniform or increase with distance from the edge of a farm with triplicate surface (0-2 cm) sediment samples collected at each of the five sites along a transect.

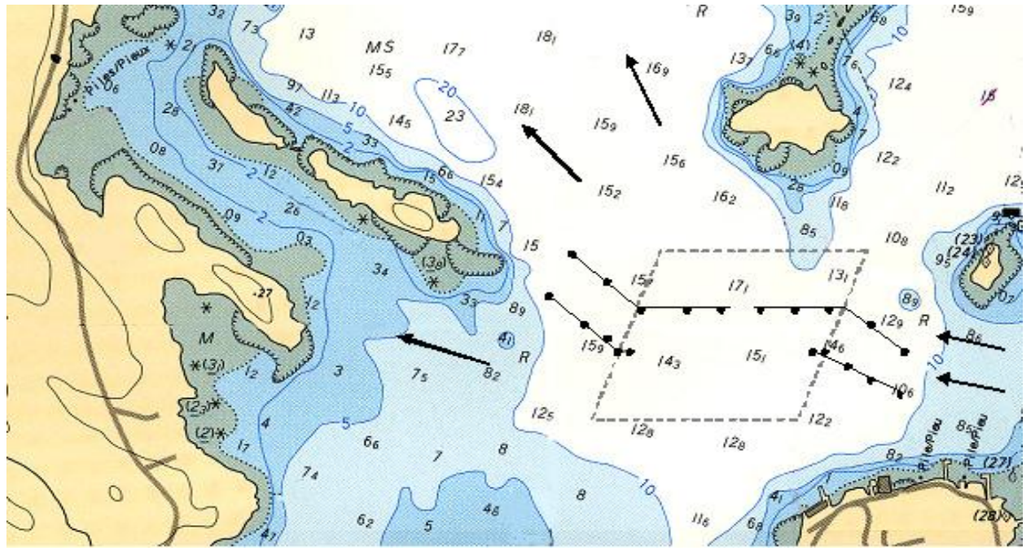

Fig. 3 Four examples of gradient sampling approach for Tier 1b, 2a and 2b assessment of benthic effects of bivalve aquaculture (Fig. 1). The bottom sampling sites (solid dots) are aligned along the axis of the major current (arrows) and run through the farm boundaries (dotted lines). Samples for total 'free' sulphide measurements would be collected in triplicate from five stations along a single transect either upstream or downstream from the farm. Station spacing could be uniform or increase with distance from the farm edge. Transects inside and outside the boundaries of the culture area should have generally similar depths and sediment types.

Bottom samples for the preliminary site assessment and subsequent Tier 1b, 2a and 2b monitoring programs may also be collected using a random control-impact sampling approach (CI and BACI) by collecting samples in either upstream or downstream directions at known distances from the farm boundary. Triplicate surface (0-2 cm) sediment samples can be collected from five randomly located stations within farm and non-farm areas (Fig. 4). Control sites are located in an area assumed not to be influenced by the cultured stock (e.g. a sufficient distance from farm boundaries to be unaffected by increased sedimentation of bio-deposits). Depths and bottom substrates in the farm and non-farm areas should be similar to avoid confounding effects of depth and sediment type on S concentrations.

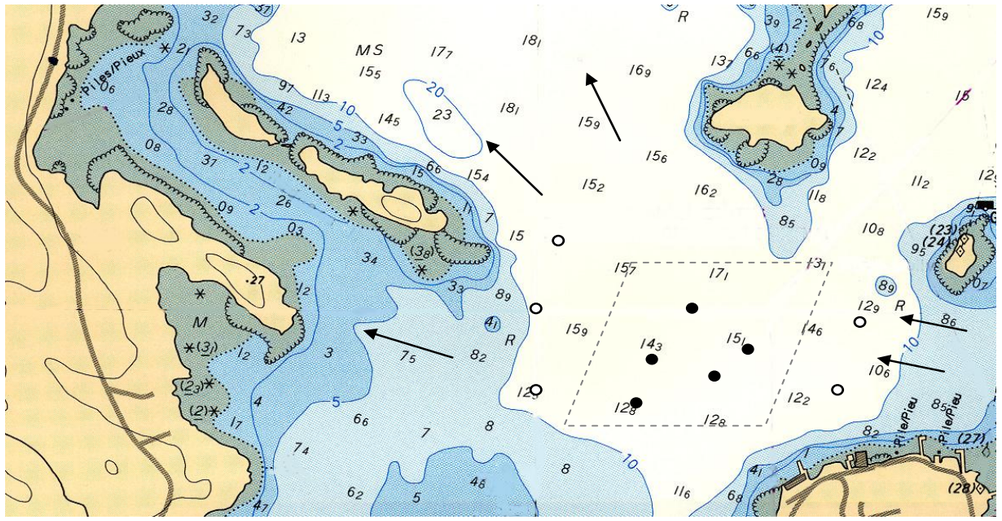

Fig. 4 Example of random sample station locations for Tier 1b, 2a and 2B assessments of benthic effects of abalone aquaculture. Total 'free' sulphide measurements would be made on triplicate samples of surface (0-2 cm) sediment collected at five stations with generally similar depths and sediment types located randomly within (solid dots) and outside (open circles) of the farm boundary.

5.0 Statistical Analyses

Gradient Sampling Approach: Data from samples at five or more locations along each transect can be compared using linear and non-linear regression methods to test for significant gradients with distance and goodness-of-fit. Common statistical packages allow p values to be calculated with assumptions that independent residuals have equal variance. Bartlett's test can be used to test for equal variance across groups of samples.

Random Sampling Approach: A one-sample one-tailed t-test can be used to determine if the mean S concentration within a group of stations where bottom samples can be collected exceeds threshold S concentrations (1500 and 3000 µM) to determine if a Tier 1b, 2a or 2b assessment is required. The precision of the test depends on the number of observations, assumes random sampling with independent observations and a normal distribution. This may not be the case when sample size is small (n=15). The null hypothesis (mean S concentration at the culture site is equal to mean values at control sites) is rejected when $p<0.05$.
A Wilcoxon signed-rank test can be used to compare median values between samples in the same location are compared before and after culture activities have begun. The non-parametric test is recommended due to the small numbers of samples being compared. The null hypothesis is that the distribution functions of median values of two related sample groups are the same (before-after observations have a median difference of zero).

When sample size is small ($n<20$) a Mann-Whitney U test can be used to determine if median values between two groups of samples are significantly different. The test determines if samples from two independent groups have identical distribution functions and median values. There is no requirement for a normal distribution. Time can be used as the grouping variable in a BA comparison to test the null hypothesis that the temporal change in median S concentrations in two groups of stations is the same. The test can also be applied in a CI design to compare median values of S within farm and non-farm areas using site as the grouping variable. The null hypothesis is that observations do not differ significantly between the two areas. If BA and CI comparisons are available with multiple sampling times and locations in control and farm sites before and after culture operations begin, a BACI can be performed using an ANOVA model with site, time and site x time interaction. An ANOVA, however, requires confirmation that the data are normally distributed and the statistical power is reduced when sample size is small.

APPENDIX 2: Methods for Redox (EhNHE) and 'free' Sulphide Measurements in Marine Sediments

1.0 Collection of sediment samples

1. At sites <20 m depth divers can be used to push open ended acrylic core tubes into the sediment to maintain the sediment-water interface as undisturbed as possible. A gentle twisting motion prevents sediment compaction and keeps the sediment surface inside level with that outside the core during insertion.
2. Upper and lower ends of a core are closed with rubber stoppers or plastic caps to prevent water leakage.
3. At deeper depths grabs (e.g. Van Veen, 0.25 m2) can be taken. If sediment does not completely fill the grab a reasonably undisturbed sample of the upper sediment layers can be obtained.
4. Holes of sufficient diameter to allow insertion of a cut-off syringe are drilled at 2 cm distances in a spiral fashion down the length of a core tube and covered with duct tape to allow sediment subsamples to be withdrawn from different depths.
5. After retrieval of a core, kept upright and handled gently to minimize disturbance of the sediment surface, a sharp blade is used to cut into the duct tape (X) over each hole starting at the top.
6. Sampling in a sequential down-core fashion prevents disturbance of deeper layers when more shallow depths are sampled first.
7. A 5-ml cut-off plastic syringe is used as a subcorer filled by slowly withdrawing the fully inserted plunger as the body of the syringe is pushed horizontally into the core.
8. A mixed sample from surface sediment in a grab can be obtained in the same way by inserting the syringe obliquely to 2 cm depth. The plunger is partially withdrawn as the open-end of the syringe barrel is slowly pushed into the sediment. The procedure is repeated until the barrel is fully withdrawn and the syringe filled with mixed sediment from the 0-2 cm layer with no air bubbles.
9. Syringes must be closed with tight fitting (air-tight) plastic caps and stored on ice or refrigerated (5 ºC).
10. Analyses for redox potentials (EhNHE) and dissolved ('free') sulphides (HS-, H2S, S=) (S) should be carried out within 4 to 6 hr but samples may be stored for up to 72 hr if refrigerated or held on ice without being frozen.

2.0 Redox (EhNHE) potentials

2.1 Materials

1. An ion specific electrode (ISE) meter (e.g. Orion 4-Star pH/ISE, model #1215001) or any mV meter with a connector suitable for attachment of the redox electrode.
2. An oxidation reduction potential (ORP) Pt electrode combined with an internal reference electrode (e.g. Orion 96-78BNWP) with a cable and appropriate connector for attachment to the ISE meter. The electrode should have a thin Pt disc (rather than a pin), be refillable (not gel-filled) with an epoxy body (to avoid breakage).
3. A 4 M KCl filling solution (e.g. Orion solution #900011, KCl saturated with Ag/AgCl) is recommended for redox electrodes used in marine sediments.
4. Redox reference solutions may be purchased from some ISE electrode manufacturers or standards such as Zobells solutions can be prepared from reagents (see below). Calibration should be conducted at intervals recommended by the manufacturer.
5. Cleaning strips can be used for polishing Pt electrodes (available for Orion ISE electrodes) or a fine powdered detergent can be used as an abrasive.

2.2 Zobell Eh standard solutions

1. Zobell Standard A: weigh 2.11 g of K4Fe(CN)6 •3H2O (potassium hexacyanoferrate (II) trihydrate) and 0.825 g of K3Fe(CN)6 (potassium hexacyanoferrate (III)) into a 50 ml volumetric flask, add ~25 ml of distilled water to dissolve the solids and dilute to 50 ml.

2. Zobell Standard B: weigh 0.21 g K4Fe(CN)6 •3H2O, 0.825 g K3Fe(CN)6 and 1.695 g of KF•2H2O (potassium fluoride dehydrate) into a 50 ml volumetric flask, add ~25 ml of distilled water to dissolve the solids and dilute to 50 ml.

3. Freshly made ZoBell's solutions must be aged for at least 24 h before use. Solutions are stable at room temperature for several months when stored in air-tight glass-stopper flasks.

2.3 Assessing Pt electrode performance

1. Pt electrodes stored dry must be activated by adding the filling solution at least 24 hr before determining performance in redox standards.
2. A prepared electrode should stabilize rapidly (<30 sec) due to the strong oxidation-reduction coupled reaction in a standard solution.
3. With a 4 M KCL filling solution Zobell solution A should have a potential of +234 ± 9 mV and solution B +300 ± 9 mV at 20 ºC.
4. After a day's use the Pt tip of the electrode should be cleaned with a detergent or abrasive strip followed by rinsing with distilled water. For long term storage (more than a week) the filling solution can be removed and the probe stored dry.

2.4 EhNHE measurements

1. Samples in 5 ml syringes allow two 2 ml sub-samples of sediment to be analysed, either as duplicates or with the second sample used for other analyses (e.g. water content, grain size, organic matter).
2. Prior to analysis 2 ml of sediment is pushed from a syringe into a small (50 ml) beaker. Syringe markings can be used to determine the extruded volume.
3. Temperature measurements of the subsample should be made immediately and the Pt electrode placed in the sample to ensure full contact between the Pt tip and wet sediment.
4. mV readings should stabilize within 1-2 min. If redox conditions are not controlled by single oxidation-reduction reactions, as in oxic sediments, there is often a slow, continuous drift of electrode potentials (Whitfield 1969). An arbitrary time (3-4 min) can be chosen to record mV readings if they do not stabilize in less than this time. Potentials in reduced sediments usually stabilize more rapidly due to redox conditions being controlled primarily by the reversible half-cell reaction [HS-aq. ↔ So rhomb + H+aq. + 2e-] (Berner 1963).
5. Measured mV potentials are corrected to be relative to the normal hydrogen electrode (EhNHE) by addition of a potential characteristic for the filling solution used and the sample temperature. (Table 1)

Table 1 Reference electrode potentials (mV) relative to the normal hydrogen electrode at different temperatures and filling solution concentrations to be added to Pt electrode potential to determine EhNHE. From Wildish et al. (1999).

Temperature (°C)	1.5 M KCL Orion #900001	4 M (saturated) KCL Orion #900011
5	254	219
10	251	214
15	249	209
20	244	204
25	241	199
30	238	194

3.0 'Free' sulphides

3.1 Materials

1. A portable ISE meter (e.g.Orion 4-Star pH/ISE, model #1215001) or any mV meter with a connector suitable for the AgS electrode.
2. An Orion Ag+/S= combination electrode (Orion #96-16BNWP) or similar electrode with a thin disc of Ag (rather than a pin) at the electrode tip. The electrode should be refillable with an epoxy body and have a suitable connector to allow attachment to the ISE meter.
3. If the Orion 96-16 Sure-flow combination electrode is used, Optimum ResultsTM A solution (Orion #900061) is recommended as the filling solution for precise S= measurements with optimum temperature and response time (Thermo Electron Corp. 2003).

3.2 Sulphide anti-oxidant buffer (SAOB) solution

1. SAOB solution can be purchased (e.g. from Orion as Sulphide Anti-oxidant Buffer (SAOB II) Reagent Pack #941609) or prepared from separate reagents.
2. 20.0 g of NaOH and 17.9 g EDTA buffer (ethylenediaminetetraacetic acid disodium salt dehydrate) are placed in a 250 ml volumetric flask and diluted to volume with distilled water.
3. Allow the solution to cool to room temperature before use. The solution is stable for up to 7 days if stored in a refrigerator.
4. Just before standards or samples are to be analysed 8.75 g of L-ascorbic acid is added to the 250 ml of the SAOB solution. The mixture is unstable and must be used within 3 hr.
5. The SAOB with ascorbic acid is added to standards and wet sediment samples in a 1:1 volume ratio.

3.3 Sulfide standards

1. A stock solution of 0.1 M Na2S is prepared by weighing 2.402 g Na2S•9H2O into a 100 ml volumetric flask and diluting to 100 ml with de-oxygenated (N2–bubbled) distilled water. Large crystals should be ground to a fine consistency using a mortar and pestle. Use rubber gloves and weigh the reagent on a balance in a fume-hood.
2. Although solutions of Na2S•9H2O are unstable and easily oxidized on exposure to air (Barica 1973), the concentrated 0.1 M stock solution can be stored refrigerated in a dark, air-tight bottle for up to 48 hours.
3. A decreasing concentration series is prepared by transferring 10 ml of the concentrated stock solution into a volumetric flask and diluting to 100 ml with 90 ml of de-oxygenated distilled water.
4. The procedure is repeated sequentially using 10 ml aliquots of each standard and 90 ml of de-oxygenated water (e.g. 10 ml of 10,000 µM S= standard solution is transferred to a volumetric flask and diluted to 100 ml to prepare 1000 µM S=).
5. Diluted standards are unstable and must be used for calibration of an electrode as soon as possible.

3.4 Ag+/S= electrode calibration

1. A dry Ag+/S= combination electrode must be activated by adding the filling solution at least 24 hr before use.
2. A set of standards (e.g. 100, 1000, 10000, 100000 µM S=) is prepared to span the range expected in samples.
3. Standards should be at the same temperature as samples.
4. The Ag+/S= combination electrode tip should be gently cleaned using an abrasive strip or detergent solution before each calibration.
5. Calibration of the Ag+/S= combination electrode should be carried out working from the lowest to highest concentration in a standard series.
6. Standards are diluted 1:1 with equal volumes of SAOB (with ascorbic acid added) (e.g. 2 ml standard + 2 ml SAOB).
7. The ISE meter should be used in the direct measurement mode to record mV potentials after they stabilize (usually <2 min).
8. The theoretical slope constant for the inverse linear relation between log10 S= and mV potential is approximately -28 mV (Thermo Electron Corp. 2003).
9. The slope of the calibration curve is slightly temperature sensitive with theoretical values between -28.1 and -29.1 at 10 and 20 ºC, respectively. In practice slope coefficients vary (-26 to -34) depending on electrode characteristics.
10. Electrodes should be calibrated at least once a day or during a day before and after analysis of a set of samples.

3.5 Sulfide measurements

1. Electrochemical potentials are temperature sensitive and standards and samples should be the same temperature (±1 °C).
2. SAOB is added to the sediment (1:1 volume) immediately following redox measurements.
3. The Ag+/S= electrode is positioned such that the tip is fully immersed in the SAOB-sediment mixture.
4. Alkaline conditions (pH>12) created by SAOB will dissolve solid phase metal-sulphide complexes causing S= concentrations to increase over time as particulate phase sulphides (FeS and pyrite) are solubilized. The effect can be minimized by recording potentials as soon as possible when drift has stabilized (1-2 min).
5. The stable mV reading is used in the calibration curve regression to calculate µM S=.
6. Ag+/S= electrodes can be wiped clean and rinsed with distilled water between the analysis of successive samples.
7. The reference electrode filling solution should be drained and the chamber rinsed with distilled water if the electrode is to be stored for more than one week.

APPENDIX 3: Measurements of Ammonia in Effluents

Procedures, calibration techniques, and instrument/reagent specifications used to determine compliance with Table B of the California Ocean Plan (www.waterboards.ca.gov/water_issues/programs/ocean) shall conform to the requirements of USA federal regulations (40 CFR PART 136) or equivalent national regulations. All methods shall be specified in a farm procedures manual

Laboratories analysing monitoring data shall be certified by National or State governments, and must include quality assurance / quality control data with their reports.

National, State or Regional Bodies may specify test methods which are more sensitive than those specified in 40 CFR PART 136.

APPENDIX 4: Measurement of Total Suspended Solids

Turbidity is a measure of the lack of clarity or transparency of water caused by biotic and abiotic suspended or dissolved substances. The higher the concentration of these substances in water, the more turbid the water becomes. Technically, when passing light through a water sample, turbidity is an expression of the optical properties of substances that causes light to be scattered and absorbed rather than transmitted in straight lines through the sample (Wetzel 1975). The most reliable method for determining turbidity is nephelometry (light scattering by suspended particles), which is measured by means of a turbidity meter giving nephelometric turbidity units (NTUs). Environmental samples vary within the normal range of 1 to 1000 NTUs (Chapman 1992).

The type and concentration of suspended matter controls the turbidity and transparency of the water. Suspended matter consists of silt, clay, fine particles of organic and inorganic matter, soluble organic compounds, plankton, and other microscopic organisms. Suspended matter is measured in the laboratory by both filterable and nonfilterable residues of a water sample. Undissolved particles make up the nonfilterable residues, these varying in size from approximately 10 nm to 0.1 mm in diameter, although it is usually accepted that the suspended solids are the fraction that will not pass through a 0.45-µm pore diameter glass fibre filter (Caux et al. 1997). For the purpose of deriving water quality guidelines, the nonfilterable residues, containing both biotic and abiotic components, will be referred to as total suspended sediments.

APPENDIX 5: Farmed Abalone Health Surveillance and Disease Response Protocol

1. Objectives of the Protocol

This protocol sets out minimum requirements for health surveillance and disease response in abalone farming. It is intended to be applicable to both land- and sea-based farms.

2. Identification of key diseases of concern

All farms must identify the key infectious diseases of concern for the abalone in their area and ensure that the following protocol incorporates measures for their detection. Thus the laboratories used for pathology work must have diagnostic procedures that would detect these diseases (if present) or confirm absence of these diseases (if absent). Where listed diseases have externally visible symptoms, farm staff should be trained to recognize these and report them to management. It is acknowledged that from time to time new diseases emerge—this protocol is designed to ensure early detection of a new disease through regular observation of stock and mortalities (Section 3) and health surveillance (Section 4).

3. Observation of stock and recording of mortalities

All farms should observe stock on a regular basis to help ensure that any mortality event or abnormal behaviour of the abalone is quickly investigated. The frequency of stock inspection on an abalone farm varies with feed type, grow out unit design, weather and management strategies. Every grow out unit on the farm must be inspected at least once every 10 days in sufficient detail to detect abnormal behaviour or abnormal mortality of abalone. If the number of mortalities in any grow out unit exceeds the trigger level for a mortality event (as defined in Section 5) or if abnormal behaviour is observed, then the details must be recorded and the procedures outlined in Section 5 must be followed. Each farm will compile over time records of grow out abalone mortality rates by year class and season. These will be used as a reference point in Section 7 and will help the farm identify trends that could relate to diseases.

4. Routine health surveillance

As a minimum, all farms will routinely submit at least twice per year 66 abalone to an auditor-approved service provider experienced in aquatic animal pathology. One of these samples will be taken during a period of high stress (e.g., high seawater temperature at sites with stressfully warm summers, or immediately after spawning at cool water sites) as identified by past experience, and the second sample approximately six months later. Sampling and fixation procedures should be as advised by the pathology laboratory. The pathology laboratory or veterinarian will provide a written report to the farm as a permanent record of the surveillance results. The report should explain the significance of the results.

5. Nonroutine sampling and mortality event investigation

A. Farms may experience a mortality event. A mortality event is defined here as follows:
• More than 1 percent of the abalone in a grow out unit or brood stock tank have died since the grow out unit was last inspected.
• The total number of abalone dead in the grow out unit or brood stock tank is greater than 50 abalone. (This is to exclude triggering by a small number of deaths in a grow out unit holding a very low number of abalone. Mortality >1 percent but less than 50 abalone is covered in Section 6.)
• It is the first time the population has experienced this level of mortality over the previous 10 days (to avoid repeated triggering from the same grow out unit during the same mortality event).
If a mortality event occurs, or abnormal abalone behaviour is observed, the event must be investigated and a satisfactory explanation for the mortality event provided and logged. Relevant details to be recorded in the log are date, abalone behaviour, grow out unit number, cause of event, action taken and conclusion.
B. If there is an obvious non-infectious cause of abalone dying (e.g., equipment failure), then farms are required to correct the problem and continue to monitor the affected population daily for at least 10 days. If mortalities do not decrease within 10 days of the problem being fixed, then farms must follow the procedure outlined in C below. The event should be recorded, detailing the problem that led to increased mortalities, the remedial action taken and the subsequent response of the abalone population.
C. If there is no obvious non-infectious cause of abalone dying, or if mortality continues to increase, then farms must take the following actions:
• Isolate the affected grow out unit(s).
• Submit moribund abalone (at least five if available) from the affected grow out unit(s) for pathological analysis to an auditor-approved laboratory experienced in aquatic animal pathology.
• Submit apparently unaffected abalone (at least five) from the same production unit and from a completely unaffected unit matched as closely as possible with respect to size, age, parentage, etc.
• Seek advice from an aquatic health expert.
• Continue to monitor and record the behaviour and mortality of the abalone population daily.
• If the level of mortalities continues to increase or if similar mortalities occur in other grow out units/cages on the farm, the farm must immediately consult with their aquatic health expert to decide a course of action and notify the competent authority (as defined by OIE, 2009).
• In cases where the aquatic health expert's determination is that the disease cannot be effectively mitigated or treated, the animals in the affected production unit(s) must be culled and the unit(s) disinfected.
• A report on the mortality event shall be filed detailing the course of events. The report shall include the results of the pathology testing, a record of any instructions from the farm's veterinarian or relevant authorities, and the farm's response to these.

6. Lower-level unexplained mortality

If an inspection finds that mortality in a grow out unit exceeds 1 percent but is less than 50 abalone and there is no obvious non-infectious cause, then the number of dead abalone in that grow out unit will be counted daily and the dead abalone removed. Counts will continue for at least 10 days, and longer if required to demonstrate that mortality has declined to levels typical for that farm in that season (as documented in Section 3 above). If cumulative mortality exceeds a further 2 percent within 10 days, then the event will be treated as a mortality event and the procedures in Section 5C followed.

7. Testing of wild abalone translocated onto a farm

Abalone translocated from the wild to a farm represent a high risk of disease introduction for abalone farms and so are required to be held in a biosecure quarantine facility with effluent treatment for at least eight weeks before being moved elsewhere on the farm. It is often not an option to sacrifice wild abalone to screen for diseases. To help detect any diseases present in the wild abalone, farmed "sentinel" abalone must be placed in the grow out units containing the wild stock for the duration of the quarantine period (minimum eight weeks) and monitored as follows.

• A batch of at least 50 farmed abalone >30 millimetre shell length will be placed in the grow out units with each batch of translocated wild abalone. Both the wild and farmed abalone will be inspected for abnormal behaviour or mortality at least once every 10 days.

• If more than two of the farmed sentinel abalone in a grow out unit have died or become moribund since that grow out unit was last inspected, then this shall be regarded as a mortality event and the procedures in sections 5B and C followed.

• Before the wild stock is released from quarantine, at least 10 abalone should be submitted for pathological analysis and found free of significant infectious diseases. These abalone should include in order of priority (1) any moribund wild abalone, (2) any moribund farmed sentinel abalone, and (3) a selection of farmed abalone including any that show signs of ill health. During the quarantine period farm staff must attempt to identify moribund abalone and preserve them for pathology testing.

APPENDIX 6: Feed Resource Calculations and Methodologies

1. Forage Fish Equivalency Ratio (FFER) calculation

Forage Fish Equivalency Ratio (FFER): the quantity of wild fish used per quantity of cultured fish produced. This measure can be weighted for fish meal or fish oil, whichever component creates a larger burden of wild fish in feed. In the case of abalone at current status, the fish meal will be the determining factor for the FFER in most cases. The dependency on wild forage fish resources should be calculated for both fish meal and fish oil using the formulas noted below. In this standard, it is the highest number (dependency) that is relevant and that must be used. These formulas calculate the dependency of a single site on wild forage fish resources, independent of any other farm.

$$\text{FFERm} = \frac{(\%\text{ fish meal in feed from forage fisheries}) \times (\text{eFCR})}{22.2}$$

$$\text{FFERo} = \frac{(\%\text{fish oil in feed from forage fisheries}) \times (\text{eFCR})}{5.0}$$

Where

• The percentages of fish meal and fish oil exclude meal and oil derived from fishery by-products. Only fish meal and fish oil that is derived directly from a pelagic fishery (e.g., anchoveta) is to be included in the calculation of the FFER. Meal and oil derived from fishery by-products (trimmings, offal) should not be included, because the FFER is intended to be a calculation of direct dependency on wild fisheries.

• The amount of fish meal in the diet is calculated back to live fish weight by using a yield of 22.2 percent. This is an assumed average yield. If a different yield is used, documentation must be provided.

• The amount of fish oil in the diet is calculated back to live fish weight by using a yield of 5 percent. This is an assumed average yield. If a different yield is used, documentation must be provided.

• Economic Feed Conversion Ratio (eFCR): the quantity of feed used to produce the quantity of fish harvested.

$$\text{eFCR} = \frac{\text{Feed, kg or mt}}{\text{Net aquacultural production, kg or mt (wet weight)}}$$

APPENDIX 7: Guidance for the Social Component of the ASC Abalone Standard

The requirements related to labour issues and work conditions on the farm were created with input from Social Accountability International (SAI), a recognized leader on labour issues. SAI also recommended the following guidance to accompany the social component of the ASC Abalone Standard.

1. Child labour

Guidance

• Child workers under the age of 15 perform only light work (see definition below) as long as it does not exceed two hours per day on a school day or holiday and the total number of hours spent on light work and on school should not exceed seven hours/day.

• For employees aged 15-18 (young workers), work should not conflict with schooling (combination of daily transportation, school time and work time should not exceed 10 hours). Hazardous work is not performed by those below age 18 (including heavy lifting disproportionate to their size, operating heavy machinery, working night shift, exposure to any toxic chemicals).

Definitions

Light work: (ILO Convention 138, Article 7.1) Light work is work that is 1) not likely to be harmful to a child's health or development and 2) not likely to prejudice a child's attendance at school, limit a child's participation in vocational orientation or training programs, or diminish a child's capacity to benefit from instruction received.

2. Forced, bonded or compulsory labour

Guidance

• Employers should never be permitted to withhold original identity documents.
• Contracts should be clearly stated and understood by employees and never lead to an employee being indebted (such as employees paying for training programs).
• Employees should be free to leave the workplace when not working and to manage their own nonwork time.
(Note: Extra care should be given to migrants and contractor/subcontractor situations.)

3. Discrimination

Guidance

• Company shall not engage in or support discrimination in hiring, remuneration, access to training, promotion, termination or retirement based on caste, national origin, religion, disability, gender, sexual orientation, union membership, political affiliation or age.
• Company shall not interfere with employee rights to exercise or observe tenets or practices or to meet needs related to race, caste, national origin, religion, disability, gender, sexual orientation, union membership or political affiliation.

4. Health and safety

Guidance

• Minimization of hazards/risks in the working environment, including documented procedures and policies to prevent workplace accidents/injuries. Emergency response procedures should exist and be known by employees.
• Documentation of occupational health and safety violations.
• Access to clean lavatories, potable water and sanitary facilities. Dormitories must be clean and safe and meet the basic needs of employees.
• Insurance, if not otherwise provided, to cover employees who suffer accident or injury in the work environment. Special consideration must be given to migrant or foreign workers who may fall outside of local or national laws and legislation.
• Corrective action plan for accidents that have occurred.

5. Fair and decent wages

Guidance

• No deductions for disciplinary actions; wages and benefits must be clearly articulated to employees; wages and benefits must be rendered in a manner convenient to employees (no travel, no promissory notes, coupons or products/merchandise to replace cash/check or electronic methods).
• No labour-only contracting relationships or false apprenticeship schemes (See below.).

Definitions

Labour-only contracting arrangement: practice of hiring workers without establishing a formal employment relationship, for the purpose of avoiding payment of regular wages or the provision of legally required benefits, such as health and safety protection.
False apprenticeship scheme: practice of hiring workers under apprenticeship terms without stipulating terms of the apprenticeship/wages under contract. It is a “false” apprenticeship if purpose is to underpay people, avoid legal obligations or employ children.

6. Freedom of association and collective bargaining

Guidance

• Employers should respect the right of all personnel to form and join trade unions of their choice and to bargain collectively.
• When such situations are restricted under law, employers should facilitate parallel means of independent and free association and bargaining and ensure that they are not the subject of discrimination. (When rights are restricted, the company needs to make clear to workers that they are willing to engage workers in collective dialogue through a representative structure and that they are willing to provide workers with the opportunity to engage in such dialogue.)

7. Nonabusive disciplinary practices

Guidance

• Absolutely no engagement in or support of corporal punishment, mental or physical coercion, or verbal abuse. Fines or wage deductions are also not an acceptable method of disciplining workers.

8. Working hours

Guidance

• Auditors shall be aware of working hours and overtime requirements in local legislation. They can check time sheets and payroll and verify through worker interviews that workers are working legally allowed hours. Pay slips and pay records can confirm whether overtime hours are being paid at a premium. To verify that overtime is not the norm, interviews can be conducted and production records checked, as well as time sheets or other records of working hours, for at least one year before. Some exceptions can be made for overtime not being voluntary, if there is a collective bargaining agreement in place that allows it.

• Employer shall comply with applicable laws and industry standards related to working hours. “Normal workweek” can be defined by law but shall not on a regular basis (constantly or majority of the time) exceed 48 hours. Variations based on seasonality may apply.

• All overtime shall be paid at a premium and should not exceed 12 hours per week. Overtime work shall be voluntary. Exceptions to this last requirement can be made in cases where it is legal and in which there is a collective bargaining agreement in place that addresses this, in order to meet short-term business demands.