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Science Advisory Report 2010/078

UPDATED FRAMEWORK FOR THE PINK AND SPINY SCALLOP (*CHLAMYS RUBIDA* AND *C. HASTATA*) DIVE FISHERY IN BRITISH COLUMBIA

Pink scallop (*Chlamys rubida*)

Spiny scallop (*Chlamys hastata*)

Photos: Maria Surry

Figure 1. Dive fisheries for pink and spiny scallops are limited to Pacific Fishery Management Areas (PFMAs) 13–20 and 29. Exploratory fisheries since 2006/07 have taken place in PFMA 18-1 (Mayne Island) and PFMA 29-5 (Valdes Island).

Context:

Pink and spiny scallops (Chlamys rubida *and* C. hastata) *were harvested commercially in British Columbia from 1982 until 1999 when the fishery was closed due to concerns regarding the sustainability and viability of the fishery given the lack of biologically based management controls and the paucity of biological and time series data. In 2000, the fishery was reopened under scientific license as an experimental fishery to facilitate the gathering of information on scallop stocks for the development of appropriate assessment and management strategies. Redevelopment of the pink and spiny scallop dive fishery has followed the phased approach for new and developing invertebrate fisheries. In 2000, a framework for the assessment and management of pink and spiny scallop fisheries was adopted by the Pacific Scientific Advice Review Committee (PSARC) Invertebrate Subcommittee. In 2003, data from the first two years of the experimental fishery were presented and some preliminary biological reference points were proposed.*

Beginning in early 2009, the Department of Fisheries and Oceans (DFO) started consultations with all stakeholders to discuss converting the licensing of the scallop dive and trawl fisheries to commercial from experimental. Fisheries and Aquaculture Management (FAM) has indicated that possible expansion (through both an increase in licenses and areas fished) of the scallop fisheries may occur, if the change to a commercial fishery goes ahead. Since the Framework was developed in 2000, advances in technology and the acquisition of new equipment have provided opportunities to update the survey methodology used to assess scallop stocks. A number of additional years of biological data have been

collected, providing opportunities to update and refine analysis methods and biological reference points. This, combined with the potential for expansion of the fishery, prompted a request for science advice from FAM to document, evaluate and review the revised assessment methodology and new data respecting the assessment and management of this fishery.

This Science Advisory Report has resulted from a Fisheries and Oceans Canada, Canadian Science Advisory Secretariat Regional Advisory Process. Additional publications resulting from this process will be posted as they become available on the DFO Science Advisory Schedule at http://www.dfo-mpo.gc.ca/csas-sccs/index-eng.htm.

SUMMARY

- A revised assessment framework for the pink and spiny scallop dive fishery was presented in 2010 describing new survey methodology and providing revised and new estimates of pink and spiny scallop density and biomass, along with updated estimates of population parameters and a new look at harvest rates.
- Pink and spiny scallop density and biomass at survey locations in 2008–2009 was found to be 25–35% lower than the same locations in 2001–2002 but it is unknown whether the differences in density and biomass represent a declining trend, a change in distribution, or a natural fluctuation in population size.
- A cautious approach to harvest is recommended in response to the unexplained drop in density and biomass estimates that appears to have occurred between the 2001-2002 and 2008-2009 sampling events in PFMA 18-1 and PFMA 29-5.
- As there are only two areas (Mayne Island – PFMA 18-1, Valdes Island – PFMA 29-5) with any time series of biomass surveys, continuation of annual or biannual biomass assessment surveys and collection of biological data from these two areas is recommended.
- Given the continuing paucity of time series for biomass assessment surveys and biological data, the current harvest rate of 4% of legal-sized biomass is recommended for the areas to be fished. However, planning of future fishing opportunities in PFMA 18-1 (Mayne Island) and PFMA 29-5 (Valdes Island) requires particular caution, given the large decrease in densities observed between 2001-2002 and 2008-2009.
- Should harvest from unexploited areas be considered, the collection of biological samples from these areas is required to confirm maximum size and age for pink and spiny scallops, and delineation of bed areas is recommended.

BACKGROUND

Distribution and Biology

Pink and spiny scallops are distributed discontinuously throughout BC in small discrete beds, with some aggregations within close proximity of each other (within 10 km) and others in relative isolation. Pink and spiny scallops are found subtidally to depths of 200 m. The distribution of the two species overlaps, and a single scallop aggregation or bed often contains both species. In general, pink scallops tend to be found on softer substrates than spiny scallops, and have a broader depth distribution, extending to 200 m, compared to 150 m for spiny scallops. There have been no detailed studies of natural populations of pink and spiny scallops in BC, and the complete distribution and degree of exchange or dispersal between and among discrete aggregations is unknown.

Pink and spiny scallops are smaller than other scallop species, and rarely exceed a maximum

shell height of 80 mm. Sexes are separate with spawning occurring twice per year in spring and fall for pink scallops, and once per year in the summer for spiny scallops. Larvae are pelagic, with settlement thought to occur within 5-6 weeks. Both species are sexually mature at 25-35 mm shell height, or approximately two years old. Pink scallops grow more slowly than spiny scallops and achieve a smaller maximum shell height. Both species are 3–4 years old when they reach a shell height of 55 mm (the minimum legal size). Maximum age for both species is believed to be six years. For both species, reproductive output increases with age.

Ecosystem Considerations

Bycatch: Bycatch of sublegal pink and spiny scallops in the pink and spiny scallop dive fishery is assumed to be nil, as divers select only the legal-sized individuals by hand-picking. Bycatch of other species is limited to the sponges (*Myxilla incrustans* or *Mycale adhaerens*) and other epibionts that are frequently encrusted on scallop valves.

Habitat and Benthic Impacts: Suitable habitat for pink and spiny scallops consists of subtidal reefs and pinnacles and associated flats and shoals at depths to 200 m. Benthic impacts from the pink and spiny scallop dive fishery are thought to be negligible, as catch is by hand picking only.

Water properties: Pink and spiny scallop larvae are pelagic and horizontal dispersal is therefore determined by water currents. However, the degree of exchange or dispersal between and among discrete aggregations is unknown. Water temperature is known to influence bivalve reproduction, including effects on gonad development and timing of spawning. In addition, water temperature is known to influence feeding activity. Bivalves are also sensitive to dissolved oxygen concentrations and levels of suspended sediment.

Species Interactions: Pink and spiny scallops feed on single-celled algae. As larvae, they are assumed to be vulnerable to predation from larger zooplankton and planktivorous fish. Predators of adult pink and spiny scallops are known to include sea stars, octopus, and sea otters. Large fluctuations in adult scallop abundance would likely affect the abundance and foraging strategy of their predators, as well as the structure of the benthic food web. Live pink and spiny scallops are frequently encrusted on both valves by one of two sponges, *Myxilla incrustans* or *Mycale adhaerens*, with which they share a mutualistic relationship.

Biotoxins: All scallops are suspension feeders that may ingest algae that are harmful to humans (e.g. “red tide” or PSP). Some algae, particularly *Aureococcus sp*. (“brown tide”) and several dinoflagellates, are also toxic to scallops, and may cause hatching failure, reduced feeding activity, inhibited growth, or even death.

Possible effects of human activities: Pink and spiny scallops may be caught incidentally by trawl fisheries, and may also be targeted by First Nation for Food, Social and Ceremonial Purposes (FSC) and recreational fisheries. Ocean dumping may affect pink and spiny scallop populations by burial, increasing suspended sediment, reducing oxygen content of the water, and exposure to toxic compounds. Pink and spiny scallops are likely susceptible to pollution such as heavy metals, hydrocarbons, PCBs, pesticides and sewage. In addition, pink and spiny scallops exposed to such pollutants may accumulate toxins and become toxic to humans.

Fishery

Management actions and key events for the pink and spiny scallop commercial and experimental / exploratory fisheries are documented in Table 1.

Table 1. Management actions and key events in the pink and spiny scallop commercial and experimental / exploratory dive fisheries in British Columbia 1982–2010.

Year	Event
1982	• First directed fishery for pink and spiny scallops in British Columbia; • First biological sampling of commercial trawl catch in PFMA 19 to determine appropriate legal size limit; • Size limit set at ≥ 60 mm shell height.
1985 - 1986	• Biological sampling of commercial dive catch in PFMAs 14, 17, 18, and 29 to investigate size at maturity, spawning, growth rates, and aging methods.
1989	• Size limit reduced to ≥ 55 mm shell height.
1993	• Trawl closures to protect dive habitat in PFMAs 17, 18, 19, 29.
1998 (end of year)	• PFMA 29-5 closed due to concerns regarding localized depletion.
1999	• Phase 0 Review presented to PSARC.
1999 (end of year)	• Commercial fishery closed.
2000	• Phase I Assessment Framework presented to PSARC; • Start of experimental fishery under scientific license; • Number of dive licenses unlimited; • Dive fishery restricted to PFMAs 13–20 and 29; • First industry biological samples collected from Shelter Point (14-13), PFMA 15-3, Gabriola Island (17-10), Mayne Island (18-1), and Valdes Island (29-5).
2001	• Dive licenses limited to stakeholders with a minimum of 10,000 lbs of landings in 1995–1999, or 6,000 lbs in any one of those years; • Stakeholders who didn't meet the eligibility criteria but participated in the first year of the experimental fishery restricted to PFMAs 13 and 20; • Industry biological samples collected in Juan de Fuca Strait (PFMA 20); • First dive/video biomass surveys at Mayne and Valdes Islands (PFMAs 18-1 and 29-5)..
2002	• Dive/video biomass surveys at Okisollo Channel (PFMA 13-8,13-10, 13-12), Sentry Shoal (PFMA 14-13), Gabriola Island (PFMA 17-10), and Valdes Island (PFMA 29-5)
2003	• Phase II Update to Assessment Framework presented to PSARC • License year changed to August 1 – July 31
2004	• Trawl fishery restricted to > 20 m to protect dive habitat and maintain separation between sectors
2006/07	• TAC set for PFMAs 18-1 and 29-5 based on 2005/06 catch
2007/08	• Minimal TAC set for PFMA 29-5 in anticipation of a biomass survey
2008 (March)	• Dive/ROV biomass survey at Valdes Island (PFMA 29-5)
2008/09	• TAC set for 29-5 based on survey results from March 2008
2009 (March)	• Dive/ROV biomass survey at Mayne Island (PFMA 18-1)
2009/10	• TAC set for 18-1 based on survey results from March 2009 • TAC set for 29-5 based on unused quota carried over from 2008/09
2009 (October)	• Dive/ROV biomass survey at Valdes Island (PFMA 29-5)
2010/11	• TAC set for 18-1 based on unused quota carried over from 2009/10 • TAC set for 29-5 based on survey results from Oct 2009

Commercial Fishery (1982–1999)

Pink and spiny scallops have been fished commercially in BC by both dive and trawl since 1982. Since 1986, fishing has occurred exclusively in inshore waters of the Strait of Georgia, with the dive fishery landing about 85% of the total catch. From 1986–1999 catches ranged from approximately 35-95 tonnes annually, reaching a maximum of 95 t in 1996 (Figure 2). The dive fishery was worth on average approximately $300,000 per year, reaching a maximum of $495,000 in 1996. Historically, both the dive and trawl scallop fisheries were unlimited entry (i.e. there was no limit to the maximum number of licenses), but had a relatively low participation rate. At the peak of the fishery in 1994-1996, there were 14–16 participants with landings.

Management controls consisted of seasonal and area closures as well as a size limit specifying a minimum shell height of 55 mm, measured perpendicular to the hinge. There were no catch limits. Little biological information was available, and the two species were managed as a single population.

Experimental / Exploratory Fishery (2000–2010)

Following the closure of the unlimited commercial dive fishery for pink and spiny scallops at the end of 1999, scientific licenses were issued for an experimental fishery to conduct research surveys, collect biological data, test management strategies, and develop commercial markets. The fishery was restricted to the areas previously exploited by the commercial fishery in PFMAs 13–20 and 29. Since August 2007, because of concerns about using scientific licences for this fishery, scientific licenses were replaced by non-transferable exploratory licences. Beginning in early 2009, the Department started consultations with all stakeholders to discuss the possibility of converting to commercial licences. Landings from the experimental/exploratory dive fishery have declined from approximately 50 t per year in 2001–2004 to less than 10 t per year in 2006– 2010 (Figure 2). The number of participants with landings has decreased from 10 in 2000 to less than three per year since 2007, with only one license holder per year making landings in 2008/09 and 2009/10. As landings have declined, the value of the fishery has also declined from $277,000 per year in 2000 to less than $60,000 per year since 2006, although the average price per pound has remained steady at around $2.80/lb.

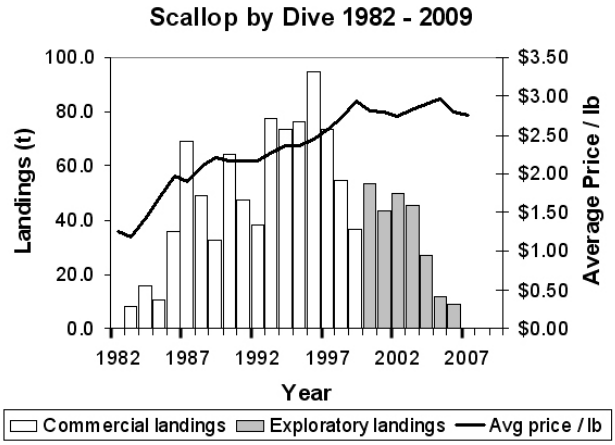

Figure 2. Landings (t) and average price per pound ($/lb) for pink and spiny scallop fisheries in BC, 1982 – 2009. Note that landings in 1982 and after 2006 are not reportable due to the low number of participants in the fishery.

Management controls for the exploratory dive fishery continue to include biotoxin and area closures, as well as a minimum size limit of 55 mm shell height. From 2001, the number of scallop dive licenses was limited at the request of stakeholders to those with a minimum of 10,000 lbs of landings in 1995-1999 or 6,000 lbs in any one of those years. The results of biomass assessment surveys in 2001–2002 were used to establish informal catch ceilings, with catches monitored through logbooks and sales slip records. A hail program and TACs were implemented for 2006/07 and subsequent years. Following 2006/07, the dive exploratory fishery was only open in areas 18-1 and 29-5. Initial TACs were based on previous years' catch or were arbitrary, but TACs based on the results of biomass surveys were applied for 2008 and subsequent years (Table *2*). A biomass survey would be required prior to opening additional areas for fishing.

Table 2. Total Allowable Catches (TACs) allocated to the experimental / exploratory dive fisheries for pink and spiny scallops in British Columbia, 2006–2011. The basis for the TAC (biological or otherwise) is indicted in brackets.

License Year (August 1 – July 31)	TAC (kg)		Total (kg)
	PFMA 18-1	PFMA 29-5	
2006/07	4545 (Previous Year's Catch)	6818	11363
2007/08	0	900 (Arbitrary)	900
2008/09	0	11000 (Survey-based)	11000
2009/10	5000 (Survey-based)	9000 (Carried-over)	14000
2010/11	3300 (Carried over)	8923 (Survey-based)	12223

ASSESSMENT FRAMEWORK

Data Sources

Scallop commercial landings and harvest locations were obtained from fisher logbooks and are stored in the ScallopDiveLogs database while biological and survey data are stored in the ScallopDiveBio database. Both databases are maintained by the Shellfish Data Unit (Fisheries and Oceans Canada, 3190 Hammond Bay Road, Nanaimo, BC V9T 6N7).

A total of nine fishery independent scallop SCUBA dive / video and SCUBA dive / ROV surveys were conducted from 2000 to 2002 and 2008 to 2009. Survey data were used for estimation of biomass and population parameters such as age, growth and mortality. In addition, eight biological samples were provided by the scallop dive industry in partnership with DFO in 2000–2001. Recent SCUBA dive / ROV surveys (2008–2009) have occurred in PFMAs 18-1 and 29-5 at Mayne Island and Valdes Island (Figure 1) because both sites had been previously surveyed and both were identified by stakeholders as being of interest for continued fishing opportunities.

Revised Framework

Biomass Surveys

The goal of scallop biomass surveys is to estimate the total and legal-sized (≥ 55 mm shell height) biomass of pink and spiny scallops on specific harvestable scallop beds. A range of total allowable catch (TAC) options are presented to FAM based on applying a harvest rate to the estimated legal biomass and associated confidence intervals. The TAC options are expressed as total legal biomass, because landings from the pink and spiny scallop dive fishery are reported as the combined weight of legal sized pink and spiny scallops.

In 2003, a methodology was presented for conducting scallop biomass surveys which incorporated dive surveys in conjunction with a video drop-camera. Since that time, advances in technology and the acquisition of new equipment have provided opportunities to update the survey methodology for the assessment of pink and spiny scallop stocks. Recent (2008–2009) biomass surveys used an underwater remotely operated vehicle (ROV) equipped with a digital

still camera in place of the video drop-camera, and the original survey methodology was adapted accordingly.

A review of the analytical procedures and bed areas used to estimate pink and spiny scallop biomass revealed that previously reported results were overestimating the legal biomass. The estimation methodology was therefore revised. Revised estimates are provided for total and legal density and biomass of pink and spiny scallops for biomass surveys conducted to date at Mayne and Valdes Islands (Table 3 and Table 4).

Density and biomass estimates in 2008-2009 are notably less than 2001–2002 estimates, with Valdes Island at approximately 20% of 2001–2002 levels and Mayne Island at approximately 35% of 2001 levels. Reasons for the difference in density and biomass are unknown, but overfishing is considered unlikely. As there is no information on density or biomass for 2003-2007, it is unknown whether the difference in estimates represents a declining trend, a change in distribution, or a natural fluctuation in population size.

Table 3. Total and legal density estimates (g/m^2) and 95% confidence intervals (C.I.s) for pink and spiny scallop dive/video and dive/ROV surveys at Mayne Island in 2001 and 2009 and Valdes Island in 2001, 2002, 2008, 2009.

Survey	Total Density (g/m^2)		Legal Density (g/m^2)	
	Mean	95% C.I.	Mean	95% C.I.
Mayne 2001	301.8	(274.0 – 330.0)	171.8	(156.0 – 187.8)
Mayne 2009	70.7	(55.4 – 89.3)	61.9	(48.5 – 78.2)
Valdes 2001	280.0	(249.3 – 309.9)	160.0	(142.5 – 177.1)
Valdes 2002	223.4	(205.2 – 242.2)	211.1	(193.9 – 228.9)
Valdes 2008	54.6	(45.6 – 63.3)	39.5	(33.0 – 45.8)
Valdes 2009	43.4	(36.3 – 50.8)	37.0	(30.9 – 43.3)

Table 4. Total and legal biomass estimates (kg) and 95% confidence intervals (C.I.s) for pink and spiny scallop dive/video and dive/ROV surveys at Mayne Island in 2001 and 2009 and Valdes Island in 2001, 2002, 2008, 2009.

Survey	Bed Area (ha)	Total Biomass (kg)		Legal Biomass (kg)	
		Mean	95% C.I.	Mean	95% C.I.
Mayne 2001	111.2	335,559	(304,666 – 366,934)	191,001	(173,417 – 208,860)
Mayne 2009	158.1	111,785	(87,615 –141,117)	97,884	(76,719 –123,569)
Valdes 2001	133.5	374,100	(333,067 – 414,033)	213,753	(190,307 – 236,570)
Valdes 2002	133.5	298,370	(274,127 – 323,606)	281,942	(259,034 – 305,789)
Valdes 2008	133.5	72,923	(60,918 – 84,523)	52,738	(44,056 – 61,127)
Valdes 2009	133.5	58,027	(48,450 – 67,909)	49,453	(41,291 – 57,876)

Population Parameters

Updated estimates are provided for growth parameters and natural mortality. Recruitment was identified in the original framework as a parameter to be estimated; however, current data collection does not address recruitment, and a consistent time series of abundance data would be required to develop estimates of the intrinsic rate of population increase. Harvest rate calculations are revisited; however, in the continued absence of a time series of biological and abundance data, yield estimates and resultant harvest rates remain preliminary.

Age and Growth: A new analysis of pink and spiny growth was conducted by fitting the von Bertalanffy growth model to shell height at age for each species. The average asymptotic shell height was found to be 68.0 mm for pink scallops and 72.4 mm for spiny scallops, and the

maximum observed shell heights in the samples were 65.0 mm and 78.3 mm respectively. Although the maximum shell height reported in the literature for pink and spiny scallops is approximately 80 mm, individuals of this size appear rare, and the growth curves suggest that most pink and spiny scallops die before achieving their theoretical asymptotic shell height. The maximum age observed in the samples was six years, consistent with results reported by Bourne and Harbo (1987) and MacDonald et al. (1991).

Mortality: New estimates of natural mortality were provided for pink and spiny scallops, based on catch curve analysis and corroborated by estimates from life history parameters. The new estimates of instantaneous natural mortality (M) range from 0.6–2.0 for spiny scallops and 0.6–1.3 for pink scallops (corresponding annual mortality estimates M_a range from 0.5–0.8) and are within the range of published estimates for *Chlamys* species with similar life history.

Harvest Rates

Preliminary estimates of maximum sustainable yield (MSY) were calculated using a method based on the Fox surplus production model (Garcia et al. 1989) that uses a single year of biomass and catch data, and is valid for a population that is undergoing exploitation where virgin biomass is not known. Estimates of MSY from the Gulland model as used by Lauzier et al. (2005) were also examined and found to be within the same range as the Fox model. Despite the new estimates of mortality and biomass, the currently used 4% harvest rate remains consistent with best available estimates of MSY. The range in TAC options was based on applying a 4% harvest rate to the most recent revised biomass estimates for Mayne Island (PFMA 18-1) and Valdes Island (PFMA 29-5) and is presented in Table 5.

Table 5. Range in Total Allowable Catch (TAC) options for pink and spiny scallop dive fisheries based on applying a 4% harvest rate to the revised mean legal biomass estimates and 95% confidence intervals (C.I.) for Mayne Island (PFMA 18-1) and Valdes Island (PFMA 29-5).

Area	License Year to which harvest options apply	Upper 95% CI	Mean	Lower 95% CI
Mayne Island (PFMA 18-1)	2009/10*	4,943	3,915	3,069
Valdes Island (PFMA 29-5)	2010/11	2,315	1,978	1,652

* The TAC currently in place for 2010/11 at Mayne Island (PFMA 18-1) is based on carrying over the unused portion of the 2009/10 TAC to 2010/11.

Precautionary Approach

The development of a harvest strategy compliant with the Precautionary Approach (PA) is required for pink and spiny scallops. The minimum elements of the harvest strategy component of the DFO PA include a removal reference for three stock status zones delineated by a Limit Reference Point (LRP) and an Upper Stock Reference (USR) (DFO 2006).

Unfortunately, for British Columbia pink and spiny scallops stocks, there is a paucity of biological and time series data, so moving forward on this requirement will need to take place over several years. The current assessment framework, if implemented on an annual basis, will facilitate the development of PA compliant provisional reference points, which can then be evaluated to test for robustness to various stock size scenarios.

In the absence of PA reference points, a cautious approach to harvest should be taken in response to the unexplained drop in density and biomass estimates that appears to have occurred between the 2001/02 and 2008/09 sampling events.

Sources of Uncertainty

The primary source of uncertainty in an assessment of pink and spiny scallop stocks is the paucity of biological and time series data. The suggested harvest rate is inherently uncertain, as it is based on a preliminary estimate of maximum sustainable yield using a single year of catch and biomass data. Sources of uncertainty for biomass estimates include possible bias in the conversion of scallop counts to legal biomass if divers fail to collect the full size range of pink and spiny scallops. In addition, uncertainty is introduced by utilizing the field of view from the ROV still photos as the quadrant, since the distance of the ROV from the substrate, the slope and relief of the substrate, and distortion from the camera lens all contribute to inaccuracies in the estimation of the size of the field of view.

Sources of uncertainty for pink and spiny scallop growth parameters include variation in the size of the last annulus due to variable timing of sample collection; and for pink scallops, possible variation in size at age due to variable timing of recruitment. In addition, due to suspected problems with age determinations for many samples, only a subset of the size at age data was used for the analysis. The maximum age observed in the samples included in this analysis was six years, consistent with results reported by Bourne and Harbo (1987) and MacDonald et al. (1991). Ages in excess of six years are considered unlikely. However, Lauzier at al. (2000) reported scallops aged 7 and 8, and although these are from samples that were excluded from the present analysis, further investigation into the maximum age of pink and spiny scallops is required.

Sources of uncertainty for the estimates of pink and spiny natural mortality provided in this document include the same concerns regarding age: determination and maximum age as discussed for uncertainty in growth rates, paucity of biological and time series data, and the lack of data from unexploited populations.

CONCLUSIONS AND ADVICE

The updated survey methodology for the pink and spiny scallop dive fishery is endorsed, including new estimates of bed area and biomass estimation methods using more sophisticated technology, as it provides a more accurate estimate of biomass. As there are only two areas (Mayne Island – PFMA 18-1, Valdes Island – PFMA 29-5) with any time series of biomass surveys, continuation of annual or biannual biomass assessment surveys and collection of biological data from these two areas is recommended.

Pink and spiny scallop density and biomass at survey locations in 2008–2009 was found to be 25–35% lower than the same locations in 2001–2002 but it is unknown whether the differences in density and biomass represent a declining trend, a change in distribution, or a natural fluctuation in population size.

Specific advice related to future harvests include:

- Maintaining the current harvest rate of 4% of legal-sized biomass for the areas to be fished, given the continuing paucity of time series for biomass assessment surveys and biological data.
- Planning of future fishing opportunities in PFMA 18-1 (Mayne Island) and PFMA 29-5 (Valdes Island) requires particular caution, given the large decrease in densities observed between 2001-2002 and 2008-2009.

- Should harvest from unexploited areas be considered, the collection of biological samples from these areas is required to confirm maximum size and age for pink and spiny scallops, and delineation of bed areas is recommended.

SOURCES OF INFORMATION

This Science Advisory Report has resulted from a Fisheries and Oceans Canada, Canadian Science Advisory Secretariat Pacific Regional Advisory meeting of November 30 – December 2, 2010 on *Pink and Spiny Scallop, Sea Cucumber, Central Coast Manila Clam, Geoduck Clam Aquaculture, and Shrimp Trawl*. Additional publications from this process will be posted as they become available on the DFO Science Advisory Schedule at http://www.dfo-mpo.gc.ca/csas-sccs/index-eng.htm.

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