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ASSESSMENT UPDATE OF MANILA CLAMS IN AREA 7 OF THE CENTRAL COAST OF BRITISH COLUMBIA AND EVALUATION OF THE MANILA CLAM FISHERIES MANAGEMENT STRATEGY

Photo: Julie Carpenter, Heiltsuk Fisheries Program

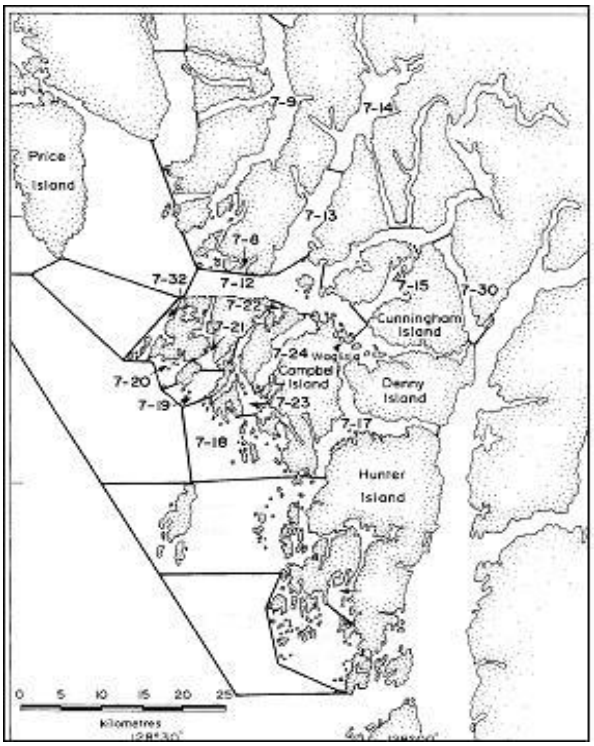

Figure 1. Subareas of Pacific Fisheries Management Area (PFMA) 7 in which the Central Coast Manila Fishery is focused.

Context:

The Area 7 intertidal clam fishery began in 1993 and was managed using an arbitrary total allowable catch (TAC) of 113.6 t, or tonnes (250,000 lb) for each of Manila (Venerupis philippinarum), littleneck (Protothaca staminea) and butter (Saxidomus gigantea) clams. The fishery was reviewed in 1999: the TAC was reduced to 68.2 t (150,000 lb) for Manila clams and the other two species removed from the commercial fishery (Gillespie et al. 1999). An assessment program was developed in 1999 that identified heavily harvested beaches within each subarea and these beaches were surveyed in both 1999 and 2000. Gillespie et al. (2001) examined the application of the Magnusson-Stefansson Feedback Gain Model to provide management targets for this data limited fishery. This model was tested with the first two years of survey data and the research document recommended that managers consider adopting subarea thresholds as a means of guiding the fishery.

The Heiltsuk Fisheries Program (HFP) has conducted index biomass surveys in ten subareas within Area 7 since 1999. The results of these surveys were used, with the harvest (fishery yields) for each subarea, to obtain subarea threshold estimates using the model recommended in 2001.

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SUMMARY

- A pilot clam fishery was started in 1993 with the Heiltsuk First Nation.
- Assessment and harvest data from the fishery was reviewed in 1999 (Gillespie et al. 1999) and a management and assessment framework for this fishery was established in 2001 (Gillespie et al. 2001).
- This assessment framework is still being used and will continue to be used for this fishery.

BACKGROUND

In 1988, the Heiltsuk Tribal Council (HTC) requested that Fisheries and Oceans Canada (DFO) examine the possibility of establishing a Manila clam fishery in the Central Coast. Exploratory surveys in the early 1990s indicated that there were harvestable densities of Manila clams on the beaches in the Waglisla area (Bourne and Cawdell 1992, Bourne et al. 1994). Based on this information and after consultation with the HTC, DFO established a pilot communal commercial fishery for the Heiltsuk First Nation in selected subareas within Area 7 (Figure 1). The original management plan restricted the number of fishers to 75 Heiltsuk First Nations, with 50 of those participating in the Manila clam harvest and 25 participating in the littleneck harvest. Arbitrary total catches (TACs) of 113.6 t (250,000 lbs) were set for each of three clam species (Manila, littleneck and butter).

Gillespie et al. (1999) completed a review of the fishery that recommended the following: limiting the commercial communal opportunity to Manila clams only; reducing the annual Manila clam quota to a level that reflects a more realistic expectation based on historic production; setting a quota of 68.2 tonnes (150,000 lb); continuing annual assessment of index beaches from each subarea, with selection of index beaches in each area reviewed annually; developing a harvest log card; and monitoring catch and effort by subarea in-season.

Gillespie et al. (2001) completed a second review of the fishery after two years of systematic surveys and explored the Magnusson-Stefansson Feedback Gain Rule as a model for developing subarea harvest thresholds. Their recommendations included: establishing in-season threshold levels for monitored subareas based on changes in biomass on index beaches, using the model; examining landing records and anecdotal information from harvesters to determine if the existing index beaches are representative of the subareas they monitor; establishing index beaches in subareas not currently monitored; and re-assessment of sustainability of the overall TAC should thresholds decrease in monitored subareas.

Since 2001, fishery managers have used the Magnusson-Stefansson Feedback Gain Model to set in-season thresholds for each of the monitored subareas. The community has continued to complete extensive annual surveys using standard protocols (Gillespie and Kronlund 1999) in each of the subareas and changes in estimated index biomass and the previous year's yield were used to set threshold recommendations for each year.

ASSESSMENT

The Magnusson-Stefansson Feedback Gain Model was outlined by Caddy (1998) for use as a reference point from past fishery yields in data-poor situations when only commercial or survey indices are available. This model was reported to be particularly useful for restoring a depressed fishery with declining stock size over time. The rule is:

$$Y_t = Y_{t-1}\left(1 + g\left(\frac{B_{t-1} - B_{t-2}}{B_{t-2}}\right)\right)$$

where *Y* is catch and *B* is an index of biomass (from survey or commercial Catch per unit effort or CPUE index) in year *t*; and *g*, referred to as the feedback gain, reflects the degree of proportionality between changes in biomass between the last and current year. *G* values of 1 or greater were reported to contribute to precautionary approaches in simulations, although higher values of *g* were effective, leading to progressively more frequent closures (Caddy 1998). *G* = 1.0 was used in the assessment and management frameworks.

The Heiltsuk Fisheries Program has conducted index biomass surveys in ten subareas of PFMA 7 since 1999 (Figure 1). In most cases multiple index beaches were surveyed in each subarea (Table 1). The results of these surveys (Table 2) were combined in the model with the annual harvests from each subarea (Table 3) to obtain the subarea threshold estimates (Table 4) for each subarea in the subsequent year. Subarea threshold estimates (Table 4) and total threshold estimates (Table 5) were provided to fishery managers who then determined the final TACs after data quality and logistical considerations. In some cases, an arbitrary 1 t (2,205 lb) threshold was used for unharvested and/or unsurveyed subareas to encourage exploration of fishery potential in new subareas. A summary of final TACs from annual management plans are listed in Table 6. In almost all years, the landings are lower than the TACs because once the fishery has reached its threshold within all the surveyed subareas, managers would then (on request) open unassessed subareas up to the 1 t (2,205 lb) arbitrary threshold to allow fishers continued opportunity. In almost all years many of these new subareas are not fished.

Table 1. Index beaches by subarea for the Area 7 Manila clam fishery. In the following tables the combined estimates for each subarea are from the beaches listed here.

Subarea	Beach Code	Beach
7-09	7-09-001	Oliver Cove.
	7-09-002	Powell Anchorage
	7-09-004	Lombard Inlet
	7-09-005	Lombard Inlet
7-12	7-12-007	Bachelor Bay
	7-12-012	Odin Cove
7-13	7-13-002	Spiller Channel
	7-13-005	Spiller Channel
	7-13-015	Yoe Cove
7-14	7-14-001	Neekas
	7-14-002	Bullock
	7-14-003	Bullock
7-15	7-15-012	Troup Passage
	7-15-028	Troup Passage
7-17	7-17-008	Rainbow-Cypress
	7-17-022/023	Kakushdish Harbour
7-21	7-21-001	Gale Passage
	7-21-015	Gale Passage
	7-21-019	Gale Passage
7-22 & 7-23	7-23-006	Joassa Channel
	7-23-022	Louise Channel
7-24	7-24-012	Raymond Passage
	7-24-013	Raymond Passage

Table 2. Estimated biomass (kg of legal-sized Manila clams) from index beach surveys by subarea for the Area 7 Manila clam fishery, 1999 to 2009.

	Index Biomass (kg)										
Subarea	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
7-09	-	-	-	-	4,649	5,171	3,073	3,134	4,571	4,502	4,538
7-12	2,326	3,525	4,056	3,302	3,138	2,109	1,830	2,441	4,114	5,019	4,764
7-13	-	-	730	462	157	509	-	-	-	-	-
7-14	-	-	-	-	-	-	1,313	1,557	1,164	882	627
7-15	-	1,325	9,523	3,121	3,753	5,570	4,915	3,605	9,875	10,873	8,741
7-17	7,109	3,810	10,063	4,203	5,651	2,559	7,159	7,530	9,308	13,141	7,559
7-21	4,307	1,262	4,615	5,374	8,929	11,211	15,139	9,380	9,660	7,606	8,466
7-22 & 7-23	405	179	746	876	796	831	383	519	868	1,234	591
7-24	1,381	2,244	2,605	3,350	1,553	2,960	1,702	2,812	4,341	2,606	4,314
7-32	-	-	1,121	-	-	-	-	-	-	-	-
Total	15,528	12,345	32,338	20,688	28,626	30,919	34,202	29,420	86,639	45,863	39,600

Table 3. Total harvest (kg) by subarea from the Area 7 Manila clam fishery, 1999/2000 to 2008/2009 fishing seasons. Data source: Dockside validated fish slips.

	Harvest (kg)									
Subarea	99/00	00/01	01/02	02/03	03/04	04/05	05/06	06/07	07/08	08/09
7-09	-	-	-	-	-	2,972	524	1,061	1,650	2,816
7-12	1,038	14,596	15,928	13,152	11,847	6,727	4,183	4,167	7,361	9,166
7-13	704	1,219	323	1,747	-	-	-	-		
7-14	-	-	-	-	-	-	-	-	797	0
7-15	15,683	13,416	18,046	5,699	6,346	9,747	5,985	4,649	12,470	12,093
7-17	16,596	13,042	17,665	7,089	8,653	2,767	7,931	8,341	11,138	15,231
7-21	12,886	3,845	8,271	10,530	9,651	20,144	23,779	15,278	15,888	12,785
7-22 & 7-23	9,672	13,321	2,894	4,089	2,057	1,813	549	569	3,664	4,611
7-24	3,999	12,413	5,462	6,357	1,015	1,293	1,356	2,567	2,930	3,246
7-32	-	-	-	1,439	-	-	-	-	-	
Totals	60,578	71,852	68,591	48,664	39,569	45,462	44,308	36,633	55,899	59,948

Table 4. Recommended subarea thresholds for the Area 7 Manila clam fishery, 2000/2001 to 2009/2010 fishing seasons.

	Threshold (kg)									
Subarea	00/01	01/02	02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10
7-09				1,000	1,000	1,661	535	1,729	1,625	2,839
7-12	15,819	16,795	13,352	12,499	7,990	5,837	5,580	7,025	8,980	8,980
7-13				518						-
7-14									604	0
7-15		19,299	5,958	6,853	9,315	8,601	4,390	12,734	13,731	9,722
7-17	8,774	25,227	7,295	9,531	2,927	7,743	8,341	10,311	15,725	8,761
7-21	3,776	11,014	9,588	17,496	20,862	27,201	14,732	15,735	12,510	14,230
7-22 & 7-23	4,275	18,086	4,567	3,716	2,368	837	743	952	5,209	5,209
7-24	2,012	14,410	6,777	2,947	1,825	743	2,240	3,963	1,759	5,373

Table 5. Total of recommended annual thresholds for the entire Area 7 Manila clam fishery from the 2000/2001 to 2009/2010 fishing seasons.

Fishing Season	Annual Total Thresholds Estimates (kg)
2000/01	41,904
2001/02	104,830
2002/03	47,535
2003/04	54,536
2004/05	46,287
2005/06	50,444
2006/07	31,575
2007/08	52,449
2008/09	58,396
2009/10	51,834

Table 6. Total allowable catches and landings from fishery management plans for the Area 7 Manila clam fishery, 1993/1994 to 2009/2010 fishing seasons. Data source: Fisheries and Aquaculture Management, Prince Rupert.

	TAC		Landings	
Season	**kg**	**lb**	**kg**	**lb**
1993/94	113,398	250,000	64,701	142,641
1994/95	113,398	250,000	113,999	251,324
1995/96	113,398	250,000	81,899	180,557
1996/97	113,398	250,000	71,099	156,746
1997/98	113,398	250,000	25,500	56,218
1998/99	113,398	250,000	77,500	170,858
1999/2000	68,039	150,000	66,900	147,490
2000/01	68,039	150,000	72,001	158,734
2001/02	68,039	150,000	69,448	153,107
2002/03	68,039	150,000	51,133	112,729
2003/04	55,544	122,454	44,480	98,061
2004/05	68,039	150,000	45,715	100,784
2005/06	68,039	150,000	50,354	111,012
2006/07	46,292	102,056	36,641	80,779
2007/08	61,507	135,600	55,909	123,258
2008/09	69,160	152,471	59,641	131,487
2009/10	60,817	134,078	50,576	111,502

As would be expected with both a developing survey series and a feedback model, thresholds fluctuated broadly at first and then stabilized (Table 4 & 5). Improved surveys and selection of appropriate index beaches lend stability to index biomass estimates, and feedback systems generally stabilize after time. The feedback model depends equally on changes in biomass indices and annual harvests, so when thresholds are not met (or in extreme circumstances where subareas were not harvested in a given year), threshold fluctuations can affect the model.

Sources of Uncertainty

The assessment framework functions under three major assumptions:

1. Stock surveys are representative of the true stock condition on each beach, or at least have been consistent enough to accurately index relative changes in legal stock size;
2. Landings are reported accurately by subarea; and
3. Stock condition on index beaches is representative of stock condition for the entire subarea.

We have no evidence to suggest that these assumptions are incorrect. Surveys are conducted in a consistent manner using approved protocols. Landings are tracked using fish slips and verified by dockside monitoring and the fishery is conducted in such a manner that only a few subareas are open at any time. Fishery guardian patrols are used to ensure that fishing does not occur outside open subareas. We have not received information from diggers or guardians that would suggest that index beaches are not representative of stock condition within subareas.

Ecosystem Considerations

This fishery was reviewed under the Sustainable Fisheries Framework in 2009. This review found:

- There is no retained bycatch; clams are sorted on the beach to make sure only legal-sized Manila clams are removed from the beach.
- Sublegal-sized Manila clams and other species are able to re-establish in the substrate once discarded; likelihood of survival is very high. A temperature closure (-5°C) prevents discard mortality during cold weather.
- None of the species captured or encountered in this fishery are listed by COSEWIC or under the Species At Risk Act.
- There are minimal benthic impacts to beaches from the digging activities as these are highly dynamic environments.
- The role of Manila clams in the intertidal ecosystem is well understood. Partial information on predator/prey interactions and environmental changes arising from human activities is available. Information on biological components of primary and secondary productivity is limited.
- Oceanographic conditions are not accounted for when calculating harvest thresholds.
- Impacts of lost fishing gear (buckets and rakes) are negligible.
- This fishery does not cause harm to fish species, corals, marine mammals, sea turtles and sea birds; impacts on other invertebrate species are minimal.

CONCLUSIONS

The Central Coast of B.C. Area 7 Manila Clam assessment and management strategy has provided sustainable stable expectations for harvest in all subareas and all years. This fishery has the additional advantage of effective co-management and employment opportunities for the Heiltsuk community.

SOURCES OF INFORMATION

This Science Advisory Report has resulted from the Fisheries and Oceans Canada, Canadian Science Advisory Secretariat Pacific Regional Advisory Meeting of November 30 – December 2, 2010 on *Pacific Invertebrate SubCommittee Meeting: 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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