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Report of the PSARC Pelagic Subcommittee Meeting November 16, 1999

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Pacific Biological Station
Nanaimo, British Columbia V9R 5K6

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PELAGIC

INTRODUCTION

The PSARC Pelagic Subcommittee met November 16, 1999 at the Pacific Biological Station in Nanaimo. The Subcommittee Chair opened the meeting welcoming the participants. During the introductory remarks the objectives of the meeting were reviewed, and the Subcommittee accepted the meeting agenda (Appendix 1). The Subcommittee reviewed two working papers (Appendix 2).

A number of external participants attended: Don Hall (Nuu-chah-nulth Tribal Council), Andrew Day and Danielle Edwards (Regional Management Aquatic Society), Lloyd Webb (Pacific Sardine Association and Fisheries Vessels Owners Association), Don Pepper, Cliff Tarnowski and Byron Wright (Pacific Sardine Association). A list of meeting participants is included as Appendix 3.

GENERAL SUBCOMMITTEE DISCUSSION

The Subcommittee discussed issues with respect to old business and the subject of a Herring Modelling workshop. A small working group has been tasked to identify an agenda for this workshop, likely to occur in May 2000.

WORKING PAPER SUMMARIES, REVIEWS AND DISCUSSION

P99-8 Distribution of spawning eulachon stocks in the Central Coast of British Columbia as indicated by larval surveys

P.B. McCarter and D.E. Hay **Accepted subject to revisions**

Summary

The anadromous eulachon (*Thaleichthys pacificus*) spawns in the lower reaches of coastal rivers and streams from northern California to Alaska. Although the distribution and timing in some rivers is well known, the occurrence in other rivers is uncertain or unknown. The presence of larval eulachons in estuaries and marine waters adjacent to rivers is a strong indication that a river is used by eulachons for spawning. Some British Columbia rivers are known to have long-established runs, but the status of many other rivers is uncertain. In this report, the authors present data from larval surveys that confirm the presence of eulachons in Central Coast rivers where they were known or believed to occur. The authors also identify several rivers that apparently support eulachons where they were previously undocumented.

Central British Columbia mainland inlets were surveyed in 1994, 1996 and 1997 to determine distribution patterns and relative abundance. A total of 767 plankton

net hauls were completed in 3 intensive surveys. Salinity-temperature- depth profiles and bathymetric distributions of larvae were also examined in some inlets. Each survey was conducted in a 2 week period in the spring, after larvae had hatched and had been flushed from nearby eulachon spawning rivers into adjacent estuarine and marine waters. In most inlets that have two or more eulachon-spawning rivers, the geographical distribution of larvae in estuarine and marine waters was continuous, indicating that larvae from different rivers were mixed. In some instances, the larval distributions were continuous between adjacent inlets. We suggest that this apparent mixing of young larvae may limit or preclude the potential for differentiation of spawning populations between closely adjacent rivers, or inlets. In most inlets, it appears that estuarine circulation may retain larvae. This period of retention may last for a period of several weeks or longer. In some instances, surveys detected larvae several months after hatching. In general, eulachon larvae were confined to the upper brackish outflow layer that extended out from some estuaries a distance of 100 kilometres or more. The authors looked for larvae in some small inlets where they had not previously been described, and sometimes they found some. The presence of larvae in these inlets indicates that eulachon spawn in some nearby streams or rivers that had not previously been known to support eulachon spawning.

The authors discuss the results of these surveys in the context of the availability of suitable spawning rivers for eulachons and their present status. They estimate the eulachon spawning biomass required to produce the numbers of larvae they observed, but emphasise that these are not estimates of the total spawning biomass, which they believe would be larger, perhaps by an order of magnitude or more. They use these estimates, however, to provide an approximate biomass scaling among different areas and review these estimates in the context of the available information of eulachon spawning biomass estimate for different rivers.

The main conclusions of the report are as follows:

1) The larval surveys corroborated the occurrence of spawning eulachon runs in B.C. rivers. These surveys can also indicate undocumented eulachon spawning areas.

2) Larval eulachon distributions are consistent with known oceanographic features, particularly estuarine circulation. Distributions of small eulachon larvae also have implications for understanding eulachon stock structure. We suggest that the smallest geographical area that can support a ‘unique’ eulachon stock is an estuary, and not necessarily a river. This is based on the observation that eulachon larvae spend very little time in rivers and substantially longer time in estuaries. Larval residency in estuaries may be sufficient for geographic imprinting to occur. It follows that the most appropriate management unit for eulachons is also the estuary, and not necessarily the river. There are a number of instances

where eulachon rivers drain into a common estuary, including the (1) Kitimat & Kildala (2) Kemano & Kitlope & Kowesas (3) Kimsquit & Bella Coola (4) Klinnaklini and Franklin. Consequently, the total number of eulachon populations is probably limited by the numbers of suitable estuaries, and not necessarily the number of suitable spawning rivers. This tentative conclusion is consistent with recent genetic and otolith chemistry analyses of eulachons.

3) Eulachon larval surveys in estuarine waters provide only approximate and conservative estimates of spawning biomass. These estimates, however, indicate that the relative spawning biomass of Central Coast eulachon populations is small compared to rivers such as the Nass, Fraser and Columbia. This conclusion is corroborated by a comparison of single point population biomass estimates made for certain years at different rivers, and by a comparison of catch data among different rivers, including the Fraser, Nass and Columbia Rivers, which were outside the range of the surveys.

Reviewer #1

Reviewer 1 felt that the paper provided a lot of interesting information and was easy to follow and understand. The reviewer was of the opinion that the goals of the paper were mainly achieved, but did provide some suggestions for further study, and also provided alternate viewpoints to provoke discussion.

This reviewer identified the four goals of the paper as:
1. Document which Central Coast rivers and estuarine systems presently support eulachon.
2. Evaluate larval segregation and retention in “home” estuaries.
3. Estimate adult biomass required to produce observed numbers of larvae.
4. Discuss the implications of observed larval distribution on larval ecology, as well as fishery and habitat management.

In each case, this reviewer noted that the goals had been achieved. He noted that a season long time series of observations within a single inlet would be useful in meeting the second and third goals.

Reviewer 1 also questioned or disagreed with a number of the particulars associated with the authors’ achievement of the fourth goal, but noted that his disagreements were more in the context of topics for thought, rather than essential revisions. In particular, his concerns related to the authors’ interpretation of the retention of larvae by Coriolis force. He felt that the logic presented was flawed and suggested that current patterns other than Coriolis might be at play. The reviewer also questioned the authors’ conclusions with regard to the definition of an eulachon stock and suggested that a single coastwide population might be a plausible alternate hypothesis. The reviewer commented that it would be useful to examine diurnal vertical migration patterns in larval eulachons and wondered why the authors' had not addressed fish farms as an estuarine risk factor in eulachon management.

Reviewer #2

Reviewer 2 did not provide a written review, but verbally commented that the paper represented excellent work, was well done, and had direct application to habitat management issues.

Subcommittee Discussion

There was a question regarding the interval between spawning and sampling time. It was suggested that the number of larvae could be used to estimate spawning biomass by adjusting them using published estimates of natural mortality (M). The authors responded by noting the need to relate sampling time to spawning time. In addition, M may be lower than for marine fish larvae because eulachon larvae reside in estuarine waters where there may be fewer predators. Next, it was pointed out that one reviewer suggested that one stock for the B.C. coast was as plausible as the estuarine-specific concept presented here. The authors responded by indicating that they have been unable to secure funding to continue the genetics analysis. They also stated that they felt that residence time in the river was too short to allow the animals to imprint there. It was then suggested that estuary size be used as an index of potential production. The authors suggest that there is no relationship between estuarine size and spawning biomass. It was pointed out that most recent genetics information suggested there may be only one single biological 'stock' in B.C. waters. The authors felt that these results are still inconclusive and that this assumption was not precautionary. It was recommended that a section be included which describes the current stock concept for eulachon in B.C. Information could include genetics, size-at-age, spawning time and anecdotal knowledge on taste of the oil. The authors added that recent chemical analyses of otloliths from different river systems suggest that there are differences between fish collected at very different locations (southern versus northern B.C.), but not between fish collected at adjacent locations (i.e. two adjacent estuaries). It was suggested that the recommendation regarding Marine Protected Areas (MPA's) should be more precise in terms of habitat protection.

Subcommittee Recommendations

The Subcommittee accepted the paper with revisions. The Subcommittee supported the concept of the estuary as the geographical unit that is most suitable to describe eulachon stock structure but agreed with the authors that this recommendation should not be interpreted as a suggestion for relaxing management vigilance within individual rivers. The Subcommittee also agreed that the method of larval surveys conducted in estuarine waters will under-estimate spawning biomass, and acknowledged that these data provide relative indices of spawning biomass for different rivers. The Subcommittee also supported additional surveys in areas not visited to date and additional genetics studies to address the stock concept issue.

P99-9 Life history of Pacific sardine and a suggested framework for determining a B.C. catch quota

D.M. Ware **Accepted subject to revisions**

Summary

Tagging results indicate that the sardines which range from British Columbia in the summer, to southern California in the winter belong to the same stock: the northern population. The oldest age groups of sardine in this stock migrate northward from California to B.C. in the summer, and complete a return migration in the fall. The migratory behaviour of sardine is complex and poorly understood. The generalisation that emerges from historical and recent accounts is that sardines are particularly abundant off B.C. in warm summers when the northern population biomass exceeds 1 million tonnes. Both conditions appear necessary to produce a large run. Historically, an average of 10% of the northern stock appears to have migrated to B.C. The actual percentage varies from year-to-year in response to changes in water temperature, and other factors. The U.S. is currently harvesting the portion of the northern stock available to the California fishery at a rate of 5 to 15%. To be precautionary, the Canadian fishery should harvest the resource at similar rates, which would average about 10%. However, for management reasons [like an undesirable bycatch of sensitive species like coho and chinook salmon, or the appearance of sardines in sensitive (or unfishable) areas] it may be advisable to set a lower quota for a few years, until B.C. sardine fishermen become more experienced, and the bycatch risks associated with the fishery are more fully understood. DFO must make it very clear to the industry from the outset that <u>the potential catch is a ceiling, not a target</u>. Because of the dynamic and unpredictable movements of this highly migratory species there is no guarantee that the B.C. sardine fleet will catch the annual quota. Industry must also be aware that sardine undergo large fluctuations in abundance in response to variations in ocean climate. Accordingly, if the current favourable conditions begin to deteriorate the sardine could 'disappear' from the B.C. coast (for a while at least), like they did in the late 1940s. Regardless of whether a preseason or inseason biomass estimate is used to determine the potential catch, it is advised that soundings be conducted in inshore waters to assess the relative abundance of sardines in the area before a fishery commences. Even though sardine are migratory, all the catch should not be removed from one area. This requirement recognises that sardine is a potential forage fish in the ecosystem.

<u>Reviewers Comments</u>

Both reviewers indicated that the paper provided a good review or synopsis of the historical sardine fishery in B.C. Both noted that the paper provided suggestions and options for future assessments of this species. Both recommended acceptance of the paper subject to minor revisions, but both reviewers had comments on the harvest policy options or recommendations made in the paper. Most of the reviewers' comments were on this aspect of the paper. The discussion of future harvest policy was the basis for virtually all-subsequent Subcommittee discussion (summarized below).

In addition, the first reviewer specifically noted that aerial surveys using Lidar or other telemetry equipment might be useful in developing an index of sardine abundance off the West Coast of Vancouver Island.

Reviewer 2 recommended that the author use one or the other of pilchard or sardines as the common name for the species in question, but not to use both interchangeably. He also suggested that it would be useful to have a brief description of the U.S. methodology for setting TAC, since the advice of the paper is to use the U.S. TAC as a basis. Finally, the second reviewer also noted the need to be cautious with respect to potential bycatch, especially salmon in inshore areas.

Subcommittee Discussion

The Subcommittee resolved to use 'sardine' or 'Pacific sardine' for a common name, and not pilchard. This practice will eliminate potential confusion in future discussions about this species.

The question was asked about the actual fishing locations of the Canadian fleet in the 1930s and 1940s. The answer is that some part of the fleet may have fished in what are now U.S. waters. It is also probable, that some U.S. vessels fished in what are now Canadian waters. Therefore, the total landings by country probably provide a reasonable indication of the proportion of the total catch taken by each nation. It was noted that the U.S. harvest rate is set to vary between 5-15%, with the 1999 fishery forecast to take about 133,000 short tons.

As a general preliminary point, members of the Subcommittee advocated caution in the development of the fishery, and mentioned that it would not be wise to set expectations above what can be delivered in the future. In particular, we do not know enough about sardine biology at this point, so the development of the fishery should proceed cautiously.

It was pointed out that the Working Paper suggested pegging the Canadian catch to the pre-season size of the total stock estimated by U.S. analysts. An identified alternative was to use the U.S. pre-season biomass estimate less the cutoff, this would follow the U.S. precedent. It also was pointed out, that in-season biomass estimation, particularly if it were based on echo sounding, might not be reliable. Other comments noted that the paper provided several options but advocated using only one. This was regarded as being unnecessarily restrictive for the future. Although the Subcommittee may choose to endorse one option for the present time, this should not be taken as a rejection of other options for the future.

There was some general discussion of the locations of fisheries, and ‘inshore’ versus ‘offshore’ locations. The response of some Subcommittee members was that it was not appropriate to differentiate – because all of the fish were from the same biological ‘stock’. It was generally acknowledged and agreed, however, that some fishing activities for sardines in inside waters, particularly those occurring in the vicinity of sports fishers, could be potentially controversial. In response to this discussion, the author pointed out that the old records/literature indicated that inshore sardines were taken first. Therefore, DFO needs some mechanism to control fishing in some areas, perhaps some sort of ‘cap’. Also, there seems to be some inshore-offshore movement – but it is not clear how much. In any event, the author recommends that all of the fish should not be taken from one area.

In response to questions about what sardines eat (relative to their ecological position relative to other small pelagic fishes) some unpublished data were presented indicating a heavy consumption of diatoms, as well as frequent consumption of euphausiid eggs and calanoid copepods. (Large diatom consumption is not known for other small pelagic species in B.C. waters such as herring or smelts). Chinook salmon are also known to feed on sardines.

Industry representatives pointed out that the sardines are highly mobile. It is very difficult to estimate fish with an area (sardines are found mainly in the surface layers). It can be difficult to find sardines, and even when found, it can be very difficult to estimate total biomass. One industry representative agreed that in-season assessment by hydro-acoustic methods is difficult, but still feels that there should be some assessment conducted. At the very least, the work could confirm when sardines are not in an area. One industry representative also advocated setting of quotas, but with the flexibility to adjust, as required.

Several science representatives stressed the utility of summer survey to estimate biomass and to determine how sardine fit into the ecosystem. A two week offshore survey does not seem excessive relative to the potential value of this resource.

It was also noted that some offshore areas are particularly susceptible to high levels of bycatch, particularly chinook salmon.

<u>Target harvest rates.</u>

One view was that Canada should opt for a 10% harvest rate so that we do not lock into something too conservative for the future. Others suggested that the Canadian fishery should begin modestly (<10% harvest rate), and expand if the future size of the stock can support it. It was noted that the productivity of the northern sardine stock increases with water temperatures, so the U.S. harvest rate also increases with temperature. Canada could adopt a similar harvesting policy with a maximum harvest rate of 15%. One member pointed out that setting catch rates too high could result in fishing too hard in some years, and the fishing pressure in some inlets could be too high. Alternatively, other members noted that if we believe that sardines belong to one large migratory stock, then some years of relatively hard fishing (say 13-14%) should not be a problem, remembering that we would be fishing only on a small portion (i.e. 10%) of the total stock.

In general, for the short-term the Subcommittee endorsed the approach outlined in the paper, and noted that more research should be done to improve our knowledge of sardine in Canadian waters. In response to the general discussion about the harvest policy, the Subcommittee noted that this is a new fishery, and there is a lot of uncertainty in the behaviour and movements of this species, and potential by-catch problems that we don't understand yet. Accordingly, to be precautionary, the Subcommittee recommended that a conservative harvest rate (of 5%) be adopted for a few years until more scientific information becomes available. At that time, (if stock conditions permit) the Canadian harvest rate could be increased to match the U.S. harvest rate. Accordingly, the Canadian harvest rate would be expected to vary from year to year, but would not exceed the U.S. harvest rate in the same year. The Subcommittee also reaffirmed the author's statement that the resulting Canadian catch quota is a ceiling, and not a target. Because the movements of this species are so dynamic and unpredictable, there is no guarantee that the Canadian sardine fleet will be able to catch the potential quota. It was acknowledged that at this point in time, the most appropriate approach is to use the U.S. estimates of stock size, and their harvest rate policy.

<u>Pre-season biomass estimation</u>.

The Subcommittee agreed that in-season management would be used to balance the catch in our coastal inlets to allow for ecological implications. For example, management should not allow harvest of all the fish in a specific location, such as a given inlet.

<u>DFO Observers</u>.

The Subcommittee agreed with the recommendation that all fisheries should be supervised by an approved DFO observer, who would obtain log set information, biological samples and other relevant research and management data.

Subcommittee Recommendations

The Subcommittee accepted the report with revisions, and specifically noted the following points:

1. Calculation of harvestable biomass in Canadian waters should be based on the use of the U.S. pre-season estimate of biomass, less the cut-off.
2. Based on historic catch rates, until better information is available it will be assumed that no more than 10% of the total stock is likely to migrate into Canadian waters.
3. The catch ceiling in any year should be based on a harvest rate not greater than the U.S. $F_{MSY,}$ which could range from 5% to 15%, depending on sea surface temperatures. Until more scientific information is available, the Canadian harvest rate ceiling should be 5% of the projected biomass in Canadian waters.
4. The use of inseason assessments to determine in-shore catchability.
5. The continued use of offshore trawl assessments to improve our biological knowledge of the species
6. Advice with respect to harvest rates (and potential Canadian catches) should be used as a ceiling , NOT a target harvest rate (or catch).
7. In season management should be used to balance catch among areas to allow for a precautionary treatment of potential ecosystem impacts
8. The use of onboard observers should continue.

Appendix 1 PSARC Pelagic Subcommittee Meeting Agenda, November 16, 1999

AGENDA
PSARC Pelagic Subcommittee

16 November, 1999

(1) Introduction and old business
- Planning for a herring modelling workshop

(2) P99-8 - The distribution of spawning eulachon stocks in British Columbia, as indicated by larval surveys.

(3) P99-9 – Sardine life history and suggested framework for determining a B.C. catch quota

(4) Review of the assessment status of all minor finfish stocks and identification of the scientific basis for management plans.

(5) Other Business

(6) Adjourn

Appendix 2: PSARC Pelagic Working Papers for November 16, 1999.

No.	Title	Authors
P99-8	Distribution of spawning eulachon stocks in the Central Coast	P.B. McCarter D.E. Hay
P99-9	Life history of Pacific sardine and a suggested framework for determining a B.C. catch quota	D.M. Ware

List of Reviewers

Name	Association
Schweigert, J.	DFO, Pacific Biological Station
Mackas, D.	DFO, Institute of Ocean Sciences
Orr, U.	DFO, North Coast Division
Chalmers, D.	DFO, South Coast Division

Appendix 3: Participants at Pelagic Subcommittee Meeting, November 16, 1999.

Name	Association
Radford, D.* (Subcommittee Chair)	DFO, Regional Headquarters
Stocker, M. (PSARC Chair)	DFO, Pacific Biological Station
Fort, C.*	DFO, Pacific Biological Station
West, K.	DFO, Fraser River Division
Clark, D.	DFO, South Coast Division
Hall, D.	Nuu-chah-nulth Tribal Council
Hay, D.*	DFO, Pacific Biological Station
Thompson, A.	DFO, Pacific Biological Station
Ware, D.*	DFO, Pacific Biological Station
Kadowaki, R.	DFO, Pacific Biological Station
McCarter, B.*	DFO, Pacific Biological Station
Day, A.	Regional Management Aquatic Society
Midgley, P.*	DFO, South Coast Division
Edwards, D.	Regional Aquatic Management Society
Pepper, D.	Pacific Sardine Association
Webb, L.	Pacific Sardine Association and Fisheries Vessels Owners Association
McFarlane, S.*	DFO, Pacific Biological Station
Schweigert, J.*	DFO, Pacific Biological Station
Tarnowski, C.	Pacific Sardine Association
Wright, B.	Pacific Sardine Association
Tanasichuk, R.*	DFO, Pacific Biological Station
Chalmers, D.*	DFO, South Coast Division
Thomas, G.*	DFO, South Coast Division

* Subcommittee Members