

**Protecting Inshore and  
Demersal Finfish  
Identification of Critical Habitats  
for Juvenile Dhufish Workshop Report**

NRM Juvenile Dhufish Workshop  
WA Fisheries and Marine Research Laboratories  
18 March 2010, 9am

G. Mitsopoulos and B.Molony



Government of Western Australia  
Department of Fisheries



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## **Contents**

|   |           |
|---|-----------|
| <b>Executive Summary</b> .....  | <b>1</b>  |
| <b>1.0 Background to project and objectives</b> .....   | <b>2</b>  |
| <b>2.0 Dhufish Background</b> .....   | <b>3</b>  |
| A. Summary of Dhufish Biology and Ecology .....   | 3         |
| B. Summary of fisheries targeting Dhufish.....  | 4         |
| C. Knowledge gaps.....  | 4         |
| <b>3.0 Background to workshop and objectives</b> .....  | <b>5</b>  |
| <b>4.0 Workshop presentations</b> .....   | <b>6</b>  |
| 4.1 Background to project and objectives (Brett Molony, DoF WA).....  | 6         |
| 4.2 Approaches to collection of juvenile pearl perch, a congeneric to WA Dhufish<br>(Wayne Sumpton, QDEEDI) ..... | 11        |
| <b>5.0 Workshop Discussion 1: Where are the juvenile dhufish?</b> .....   | <b>20</b> |
| <b>6.0 Workshop Discussion 2: Which methods should we use to survey<br/>    juvenile dhufish?</b> .....           | <b>22</b> |
| <b>7.0 Workshop Outcomes</b> .....  | <b>24</b> |
| <b>8.0 Project Plan</b> .....   | <b>25</b> |
| <b>9.0 Acknowledgements</b> .....   | <b>25</b> |
| <b>10.0 References</b> .....  | <b>26</b> |
| <b>11.0 Appendices</b> .....  | <b>27</b> |



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## **Executive Summary**

A Juvenile Dhufish Workshop was held at the Western Australian Fisheries and Marine Research Laboratories (WAFMRL) on 18<sup>th</sup> March 2010, which was the first component of a State Natural Resource Management (NRM) funded project entitled “Protecting Inshore and Demersal Finfish - Identification of Critical Habitats for Juvenile Dhufish”. The primary objective of the workshop was to provide a forum for discussion in order to compile all biological, ecological and anecdotal information on the early life history of dhufish, to create hypotheses of habitat requirements for juvenile dhufish and provide recommendations as to which sampling methods should be used to confirm the presence of juveniles at the identified habitats and locations.

The workshop brought together a wide range of stakeholders including managers and scientists from the WA Department of Fisheries, Murdoch University, University of Western Australia, CSIRO, Queensland Department of Employment, Economic Development and Innovation (QDEEDI), as well as commercial and recreational stakeholders and their peak representative bodies. The workshop included a presentation from the Department of Fisheries providing background information on the project and its objectives, current knowledge on the biology of dhufish, as well as current monitoring measures and stock assessments. A presentation from QDEEDI provided information on the biology of pearl perch, a congeneric to WA dhufish on the east coast of Australia, and detailed the sampling methods that have proven successful in obtaining juvenile pearl perch to determine distribution and abundance information.

This document summarises the information to define the most likely locations and habitats of juvenile dhufish in the Metropolitan region and the West Coast Bioregion. It also outlines a range of potential sampling techniques that could be trialled in order to confirm the presence of juvenile dhufish in particular habitats. Finally, it outlines a plan for the next stage of the project based on the ideas identified at the workshop.

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## **1.0 Background to project and objectives**

West Australian dhufish (*Glaucosoma hebraicum*) are endemic to the south west of Western Australia. Aside from being an iconic Western Australian species, it is also the target of both commercial and recreational fishers in the West Coast Bioregion.

The most recent stock assessments in 2005-2006 and 2007-2008 have indicated the stock is experiencing over-fishing and is in a depleted state. Recently, significant management changes have been implemented and include a 50% reduction in the catch by commercial and recreational fishers for the suite of demersal species in the West Coast Bioregion, of which the dhufish is one of three indicator species for the status of the suite. Management changes also include specific targets in relation to dhufish catches within each management zone, and changes to recreational fishing rules (e.g. closed season, reduced bag limits).

Management changes to the commercial and recreational fisheries aim to ultimately result in a recovery of the stocks of demersal species, including dhufish. The recovery of dhufish is complicated by a range of factors, including the longevity of the species (in excess of 41 years) making them highly vulnerable to exploitation. In addition, information currently available for monitoring the stock and recovery are limited to catch and effort data and age samples from line fishing operations (both commercial and recreational sectors). The selectivity of the line fishing means that dhufish only become vulnerable to the gear from about their 3<sup>rd</sup> or 4<sup>th</sup> year of age, becoming fully recruited by their 9<sup>th</sup> or 10<sup>th</sup> year of age. Dhufish younger than 3-4 years of age are rarely encountered. As such, little is known about the early life history of dhufish.

The recruitment of dhufish is poorly understood and appears to be influenced by environmental factors that vary annually. However, overall recruitment variability appears to be relatively low for dhufish (Lenanton et al. 2009a). From information from age samples, the current fishable portion of the stock of dhufish is supported only by 4 or 5 year classes of fish. This suggests that the breeding biomass is relatively low and that dhufish age distributions have become truncated due to high fishing mortality.

The current monitoring regime is focussed on adult fish that have recruited to the commercial or recreational fishery. Most of the samples comprise of individuals greater than seven years of age with fish less than three years of age being extremely rare in the catches by either sector. Thus, the strength of new year classes is only known as they recruit into the fishery. Managers and scientists ideally would like to know information on the relative recruitment strength well in advance of recruitment into the fishery to provide information to fishers, other stakeholders and managers in regard to the potential relative year class strength and stock recovery. This may permit managers to react to changes in recruitment patterns. Nonetheless, it is critical for managers to ensure that there is not severe age truncation through high fishing mortality.

One of the biggest gaps to the understanding of the biology and ecology of dhufish is what happens during the first few years of life. By knowing the habitat preferences and requirements of juvenile dhufish, habitat protection can be considered by managers. Additionally, if an index of recruitment may be generated, information on relative recruitment strength can be provided as additional advice to managers to provide some forewarning of relatively stronger or weaker year classes before they enter the fishery. This has implications not only to fisheries management in terms of commercial and recreational fishers, but also the recovery of the stock of dhufish and their long-term sustainability.

As a result, this project will focus on attempting to identify methods for reliably observing and/

or capturing juvenile dhufish at the smallest potential size. The aim is to locate juvenile dhufish below one year of age and less than 100-150 mm TL (total length) and provide information on the type of habitat needed and extent of this important juvenile habitat in the Metropolitan Zone and West Coast Bioregion. This information will not only supply additional management information to fisheries managers, but also provide more information to consider other management tools (e.g. management and protection of critical juvenile habitat).

This project will pool all known information about the early life history of dhufish in order to determine likely habitats for young, small fish.

---

## **2.0 Dhufish Background**

### **A. Summary of Dhufish Biology and Ecology**

The West Australian dhufish (*Glaucosoma hebraicum*) is a member of the small monogeneric Family Glaucosomatidae. *G. hebraicum* is endemic to south-western Australia. It occurs between the Recherche Archipelago near Esperance (ca 34°10S, 122°15E) and Shark Bay (ca 26°S, 113°E), though they are found most commonly between Augusta and Kalbarri. They can attain sizes of up to 1200 mm TL and 26 kg. Further details of biology and age and growth of dhufish are summarised in Lenanton et al. (2009b).

#### **Habitat**

Habitat requirements for dhufish appear to change as they increase in size. Juveniles less than 150 mm TL have been reported to occur on hard, flat substrate adjacent to reefs, where sponges are abundant (Hesp et al. 2002). Dhufish of 150-300 mm TL have been observed and collected (though in very low numbers) over low lying reef, with low profile rock ledges, while those greater than 300 mm TL have most commonly been caught among prominent reef structures consisting of substantial limestone and coral reef formations and ledges of at least 2 m in vertical height (Hesp and Potter 2000; Hesp et al. 2002). Diet changes throughout ontogeny of dhufish (Platell et al. 2010) which may also influence habitat requirements and distribution at different stages of life.

#### **Reproductive Biology**

West Australian dhufish are gonochoristic (i.e. have separate sexes) but are sexually dimorphic. Male dhufish have an elongated filament on their dorsal fin, have very small testes relative to the weight of ovaries of females, and reach larger sizes than females. Such dimorphism suggests that they have a social structure; males are likely to compete for female mates during the spawning season and spawning is likely to occur in pairs (Mackie et al., 2009).

Dhufish have a protracted spawning period between November and April, with the majority of spawning activity occurring between December and March when the water temperature is at its highest. Female dhufish are multiple spawners and mature and/or spawning individuals have been caught at a wide range of depths, i.e. 10-200 m (Hesp et al. 2002; Fairclough, Department of Fisheries, unpublished data). They reach sexual maturity, on average, at approximately three to four years of age and 300-350 mm TL.

Research indicates that the recruitment of dhufish appears to be relatively consistent between years, especially in comparison to other long-lived reef species in the West Coast Bioregion (e.g. pink snapper), though it has been demonstrated that greater recruitment variability exists in more southern latitudes (Lenanton et al. 2009a). Successful annual spawning and the resultant recruitment strength may be positively correlated with the strength of the northward flowing Capes Current and northerly drift that occurs on the continental shelf during its summer spawning period (Lenanton et al. 2009a).

### **Age and Growth**

Hesp et al. (2002) demonstrated using marginal increment analysis of sectioned sagittal otoliths, that a single opaque growth zone (annuli) forms annually; therefore the number of annuli can be used to determine the age of individuals of this species. Dhufish are a long-lived species (reaching at least 41 years of age) with low natural mortality ( $M = 0.10$ , Hesp et al. 2002). It has been demonstrated that male dhufish grow to a larger size than females, attaining greater lengths and weights (Hesp et al. 2002).

## **B. Summary of fisheries targeting Dhufish**

Dhufish are one of the most iconic species in the West Coast Bioregion and one of the most popular targets for recreational anglers, particularly in the Metropolitan zone. They are also one of the major target species supporting the commercial West Coast Demersal Scalefish Interim Managed Fishery (WCDSIMF), which is currently valued at approximately \$5 million annually.

The West Australian dhufish is one of three indicator species for the inshore demersal suite of species in the West Coast Bioregion. The status of dhufish and other indicator species (pink snapper and baldchin groper) are used to indicate the status of the suite of all inshore demersal species. Recent stock assessments indicate that dhufish stocks are experiencing high levels of overfishing throughout the Bioregion (Wise et al. 2007). Recent age composition data for dhufish demonstrate that the commercial and recreational fisheries are supported by 4 or 5 year classes (most fish are between 10 and 15 years of age) and suggests that the dhufish breeding stock has declined in the West Coast Bioregion. These results, in combination with estimates of fishing mortality and a weight-of-evidence approach for the other demersal indicator species (Wise et al. 2007), have been used to support significant changes to the management of the inshore demersal fish resources in the West Coast Bioregion and the fishery. Measures have been recently introduced to reduce the total catch by 50% in both the recreational and commercial sectors, to ensure long-term sustainability of the resource. Management measures for the commercial sector include; a spatial closure in the Perth metropolitan zone (Lancelin to Mandurah); effort controls and limited access in the commercial fishery; and a temporal closure, a reduced bag limit and the introduction of boat limits for dhufish for the recreational sector (including charter operators).

## **C. Knowledge gaps**

Very little is known about the early life history of dhufish between the time of spawning and becoming vulnerable to fishing. Dhufish become vulnerable to fishing gears (*i.e.* line fishing), during their 3<sup>rd</sup> and 4<sup>th</sup> years of life (approximately 300-350 mm TL), but are not fully recruited to the fishery until 10 years of age. Juveniles are rarely observed by divers or captured by

fishers and are virtually ‘invisible’ to current monitoring and assessment for at least the first three years of life. Knowledge is particularly limited with regard to the type of habitat occupied by juveniles, and the extent of juvenile dhufish distribution.

Monitoring of stock status has been focused on adult fish captured by commercial and recreational fishers, and as such, it is not possible to monitor recruitment strength using this method until full recruitment has occurred. As dhufish are one of the three indicator species for the health of stocks in the WCDSIMF, knowledge of recruitment and juvenile abundance (and the environmental factors influencing this), juvenile habitat requirements and the extent of this habitat would be valuable additional information for fishery managers. It would also enhance the provision of advice to managers, such as the relative merits of considering additional spatial management.

If the habitat requirements for juvenile dhufish can be established and an efficient sampling regime can be developed for ongoing monitoring, it can then be determined whether a juvenile recruitment index can be utilised as a method to enhance the monitoring of stock status. In addition, risks to critical juvenile habitats can be assessed and managed accordingly.

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### **3.0 Background to workshop and objectives**

The first component of the project aimed to compile biological and ecological information of the early life history of dhufish in order to create hypotheses of habitat requirements for juvenile dhufish. This was achieved via a workshop involving fishery managers, scientists from the WA Department of Fisheries, University of WA, Murdoch University, QDEEDI and CSIRO, as well as commercial and recreational stakeholders and their peak representative bodies.

The workshop included two group discussion segments: the first aimed to document where juvenile dhufish have been captured or reported in the past, and the second, to identify the type of habitats where juvenile dhufish are most likely to occur, and assess the methods in which to confirm their presence in these identified habitats and locations. Two background presentations were provided in advance of the two discussion sessions.

## 4.0 Workshop presentations

### 4.1 Background to project and objectives (Brett Molony, DoF WA)

Slide 1

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### Identification of Critical Habitats for Juvenile Dhufish

Workshop, 18<sup>th</sup> March 2010

Brett Molony  
Supervising Scientist  
Finfish Branch

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Natural Resource Management in Western Australia

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### Welcome

- House keeping
- Introductions
- The workshop
  - Key stakeholders = Experts

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### Dhufish

- Target species of commercial and recreational fisheries in West Coast Bioregion
- Indicator species for the demersal suite of species
- Assessed via weight-of-evidence (incl Catch curve/F-based)
- Current status – experiencing over-fishing
- At least 50% reduction in catches

**Figure 1**

**Legend**

- Abrolhos, CAES, blocks
- WCB Areas
- Kalbarri Area
- Mid-West Area
- Metropolitan Area
- South-West Area
- Offshore Area
- 200 m limit (APZ boundary)

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### Background: Size-at-age

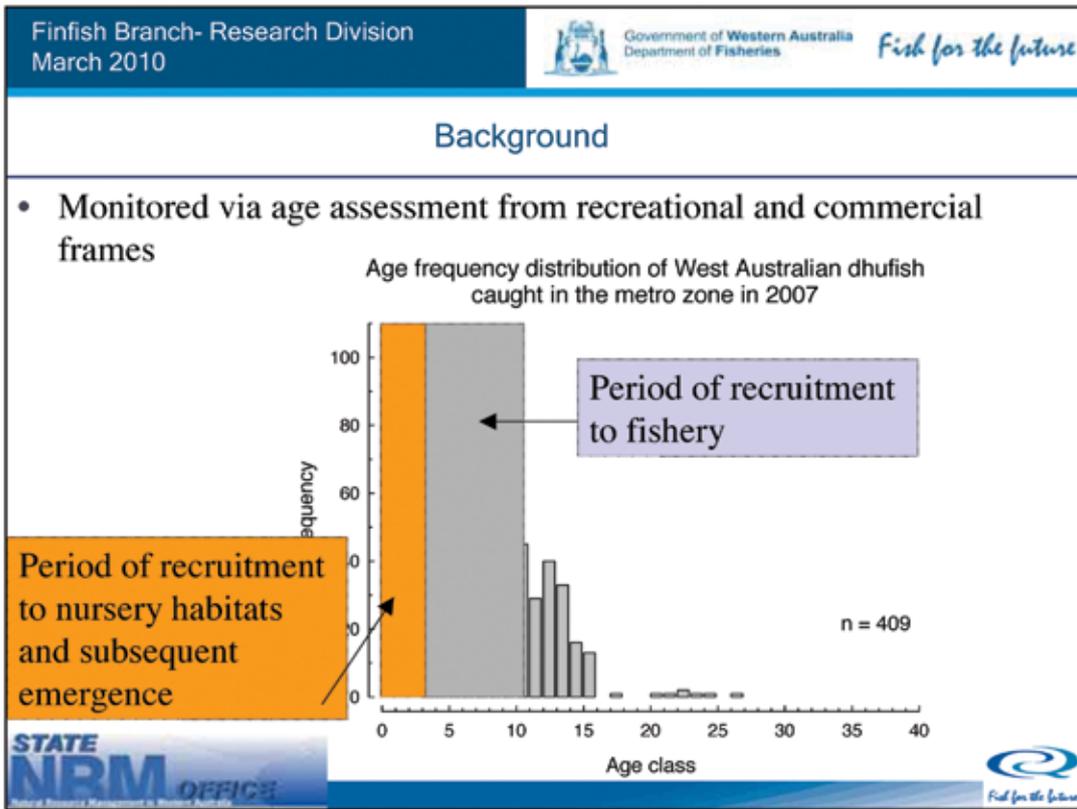
#### Lengths at age of female West Australian dhufish

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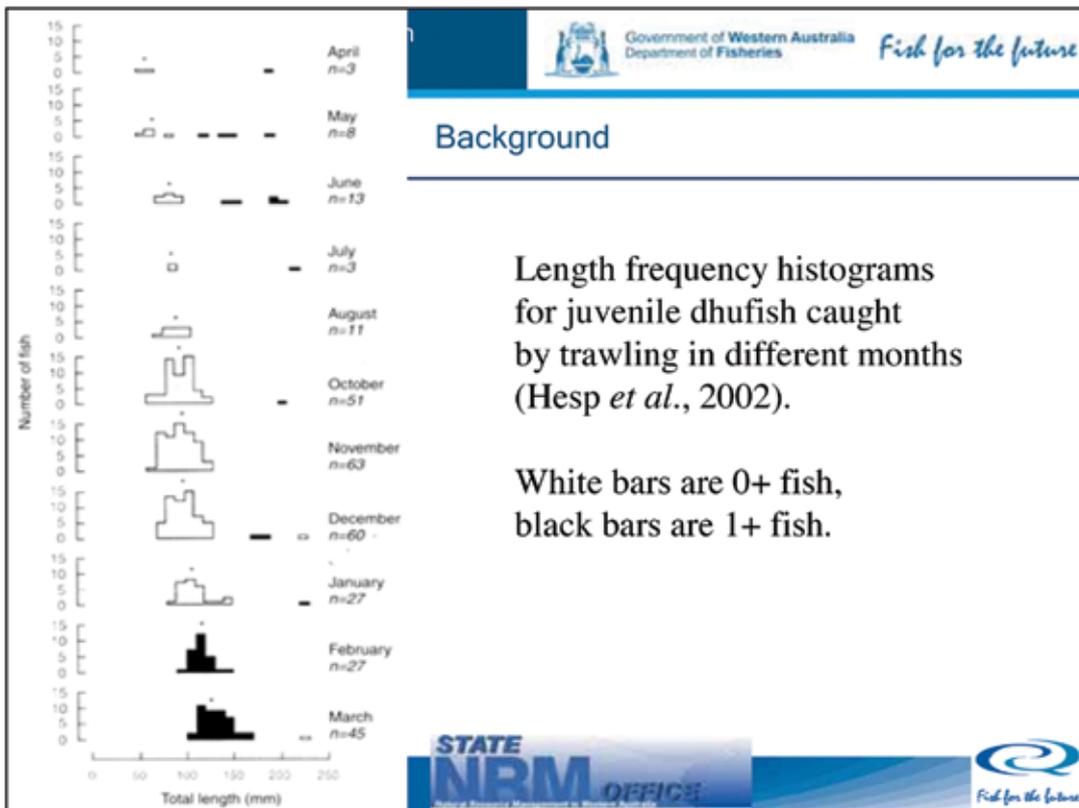
Data courtesy of Dr Alex Hesp (Hesp *et al.*, 2002)  
Murdoch University Centre for Fish and Fisheries Research

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Slide 5



Slide 6



Slide 7

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### The Problem

- Recruit to the fishery between 3 – 7 years
- Difficult to sample
- Young, juvenile dhufish
  - rarely captured by commercial or recreational line fishers
  - Rarely seen by divers
  - But some anecdotal reports
- Invisible to monitors and managers
- Being able to reliably enumerate juveniles would give information on future fishery recruitment (3 – 6 years out)

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### This Workshop

- Aims to collect knowledge and 'best information' from all stakeholders on;
  - where young, juvenile dhufish are likely to be
  - What types of habitats they utilise, and where
  - What are the best approaches to survey them?⇒ Workshop report
- Then
  - go out and try to find juveniles with identified likely methods
  - Identify their habitat
  - Map the extent of habitat
  - Commence development of index of recruitment

Slide 9

|   |  |   |
|---|--|---|
| Finfish Branch- Research Division<br>March 2010   |    |  |
| <h2 style="margin: 0;">Workshop</h2>  |  |   |
| <ul style="list-style-type: none"> <li>• <u>You</u> are the experts</li> <li>• All contributions are valued</li> </ul> <p style="text-align: center; margin-top: 20px;"><i>Eliminate the impossible, and what you are left with are the possible and the probable</i></p> |  |   |
| STATE NRM OFFICE  |  |   |

Slide 10

|  |   |   |                        |   |       |             |         |       |             |         |       |                      |  |       |                     |                      |  |                 |                      |  |                     |                      |
|--|---|---|------------------------|---|-------|-------------|---------|-------|-------------|---------|-------|----------------------|--|-------|---------------------|----------------------|--|-----------------|----------------------|--|---------------------|----------------------|
| Finfish Branch<br>March 2010   | 9:00  | Welcome and introductions   | Brett (DoFWA)          |  |       |             |         |       |             |         |       |                      |  |       |                     |                      |  |                 |                      |  |                     |                      |
|  | 9:15  | Background to project and objectives  | Brett (DoFWA)          |   |       |             |         |       |             |         |       |                      |  |       |                     |                      |  |                 |                      |  |                     |                      |
|  | 9:30  | Aims of workshop and expected outcomes <ul style="list-style-type: none"> <li>- Document where juvenile dhufish have been reported or captured in the past</li> <li>- Identify the habitats and locations of where juvenile dhufish are most likely to occur</li> <li>- Assess the methods in which to confirm the presence of juvenile dhufish in the identified habitats and locations</li> </ul> | Brett Molony (DoFWA)   |   |       |             |         |       |             |         |       |                      |  |       |                     |                      |  |                 |                      |  |                     |                      |
|  | 9:45  | Approaches to collection of juvenile pearl perch, a con-generic of WA Dhufish   | Wayne Sumpton (QDEEDI) |   |       |             |         |       |             |         |       |                      |  |       |                     |                      |  |                 |                      |  |                     |                      |
| <p style="text-align: center;"><b>Workshop 1: Where are the juvenile dhufish?</b></p> <ul style="list-style-type: none"> <li>- Document where juvenile dhufish have been reported or captured in the past and what methods</li> <li>- Identify the habitats and locations of where juvenile dhufish are most likely to occur</li> <li>- Document the supporting evidence               <ul style="list-style-type: none"> <li>- Document the supporting evidence</li> </ul> </li> </ul>  |   |   |                        |   |       |             |         |       |             |         |       |                      |  |       |                     |                      |  |                 |                      |  |                     |                      |
| <p style="text-align: center;"><b>Workshop 2: Which methods should we use to survey juvenile dhufish?</b></p> <ul style="list-style-type: none"> <li>- Use the outcomes of Workshop 1 Document</li> <li>- Assess the methods in which to confirm the presence and collection of juvenile dhufish in the identified habitats and locations.</li> <li>- Which methods should be tested in which habitats?</li> <li>- Who can is best placed to do this?</li> </ul> <p>Document the supporting evidence</p>   |   |   |                        |   |       |             |         |       |             |         |       |                      |  |       |                     |                      |  |                 |                      |  |                     |                      |
| <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%; padding: 5px;">12:00</td> <td style="width: 40%; padding: 5px;">Report back</td> <td style="width: 50%; padding: 5px;">Scribes</td> </tr> <tr> <td style="padding: 5px;">14:30</td> <td style="padding: 5px;">Report back</td> <td style="padding: 5px;">Scribes</td> </tr> <tr> <td style="padding: 5px;">14:45</td> <td style="padding: 5px;"><b>Afternoon tea</b></td> <td style="padding: 5px;"></td> </tr> <tr> <td style="padding: 5px;">15:15</td> <td style="padding: 5px;">Summary of findings</td> <td style="padding: 5px;">Brett Molony (DoFWA)</td> </tr> <tr> <td style="padding: 5px;"></td> <td style="padding: 5px;">Open discussion</td> <td style="padding: 5px;">Brett Molony (DoFWA)</td> </tr> <tr> <td style="padding: 5px;"></td> <td style="padding: 5px;">Where to from here?</td> <td style="padding: 5px;">Brett Molony (DoFWA)</td> </tr> </table> |   |   |                        |   | 12:00 | Report back | Scribes | 14:30 | Report back | Scribes | 14:45 | <b>Afternoon tea</b> |  | 15:15 | Summary of findings | Brett Molony (DoFWA) |  | Open discussion | Brett Molony (DoFWA) |  | Where to from here? | Brett Molony (DoFWA) |
| 12:00  | Report back   | Scribes   |                        |   |       |             |         |       |             |         |       |                      |  |       |                     |                      |  |                 |                      |  |                     |                      |
| 14:30  | Report back   | Scribes   |                        |   |       |             |         |       |             |         |       |                      |  |       |                     |                      |  |                 |                      |  |                     |                      |
| 14:45  | <b>Afternoon tea</b>  |   |                        |   |       |             |         |       |             |         |       |                      |  |       |                     |                      |  |                 |                      |  |                     |                      |
| 15:15  | Summary of findings   | Brett Molony (DoFWA)  |                        |   |       |             |         |       |             |         |       |                      |  |       |                     |                      |  |                 |                      |  |                     |                      |
|  | Open discussion   | Brett Molony (DoFWA)  |                        |   |       |             |         |       |             |         |       |                      |  |       |                     |                      |  |                 |                      |  |                     |                      |
|  | Where to from here?   | Brett Molony (DoFWA)  |                        |   |       |             |         |       |             |         |       |                      |  |       |                     |                      |  |                 |                      |  |                     |                      |
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## 4.2 Approaches to collection of juvenile pearl perch, a congeneric to WA Dhufish (Wayne Sumpton, QDEEDI)

Slide 1

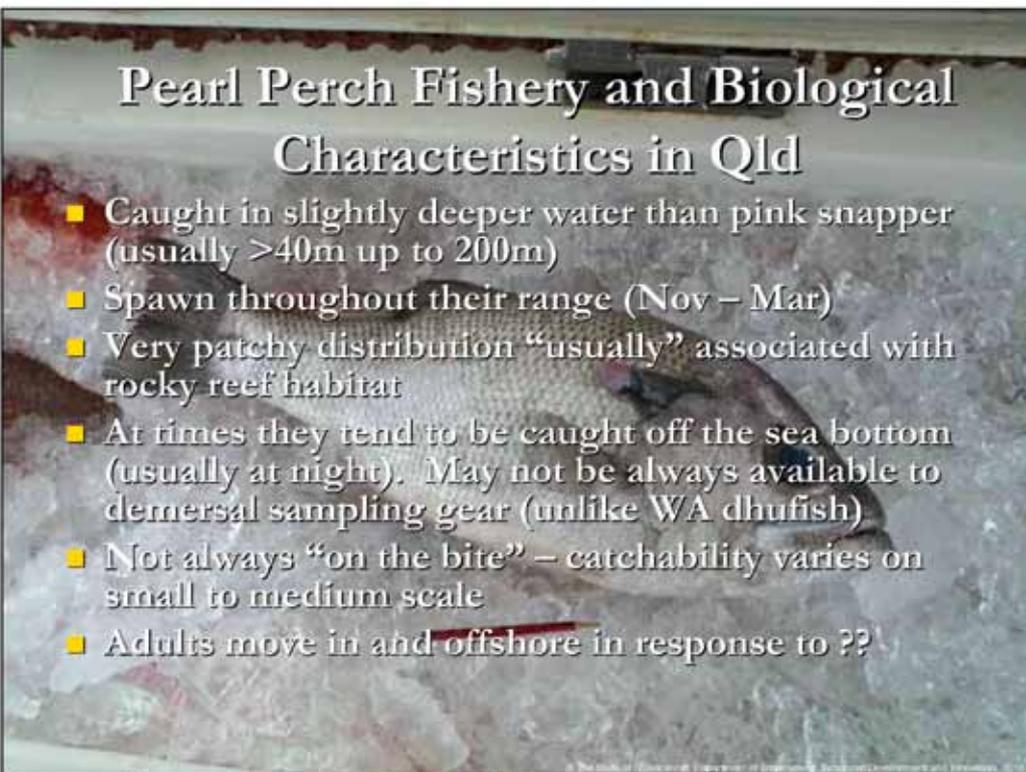


### Habitat and environmental conditions in southern Queensland

- Southward moving East Australian current with a northerly inshore counter current.
- Large current eddies are common
- Fish can be associated with only small changes in relief of seafloor (30cm rubble bumps)
- Our rocky reefs are in bands in depths of 24, 36, 42 and 50 fathoms usually starting a few nautical miles from shore. Isolated and patchy rubble and weedy areas as well

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Slide 2

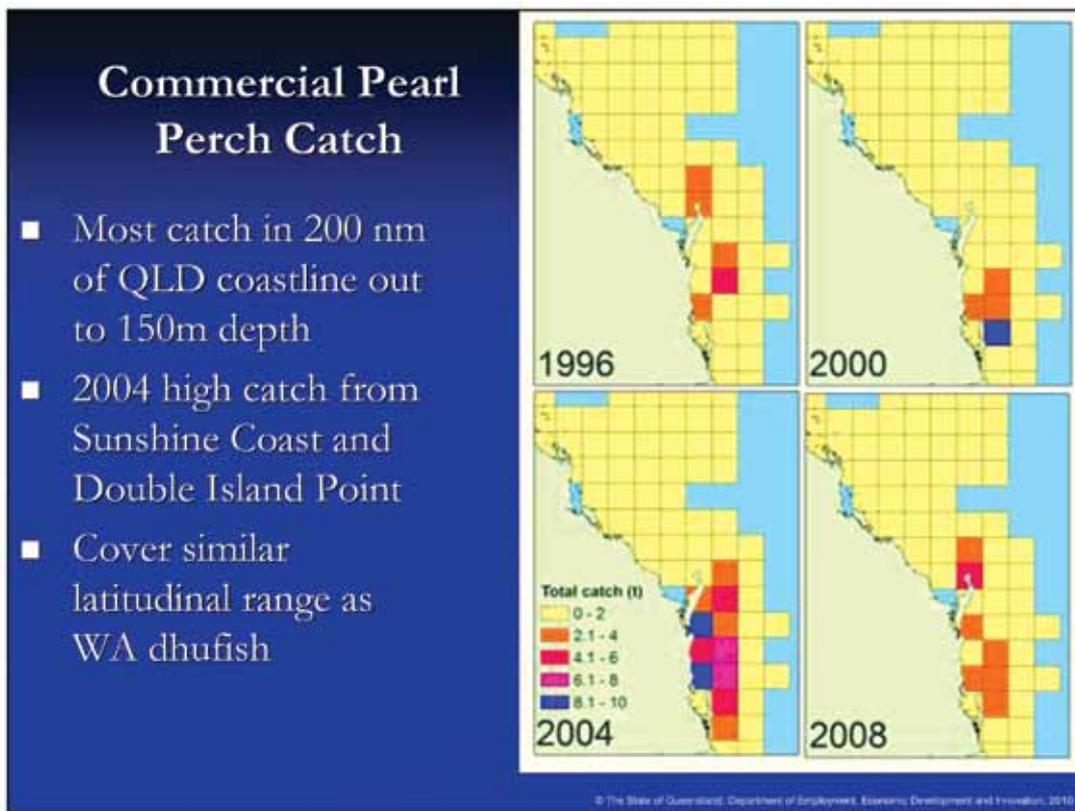


### Pearl Perch Fishery and Biological Characteristics in Qld

- Caught in slightly deeper water than pink snapper (usually >40m up to 200m)
- Spawn throughout their range (Nov – Mar)
- Very patchy distribution “usually” associated with rocky reef habitat
- At times they tend to be caught off the sea bottom (usually at night). May not be always available to demersal sampling gear (unlike WA dhufish)
- Not always “on the bite” – catchability varies on small to medium scale
- Adults move in and offshore in response to ??

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Slide 3



Slide 4



Slide 5

## Trapping of Pearl Perch

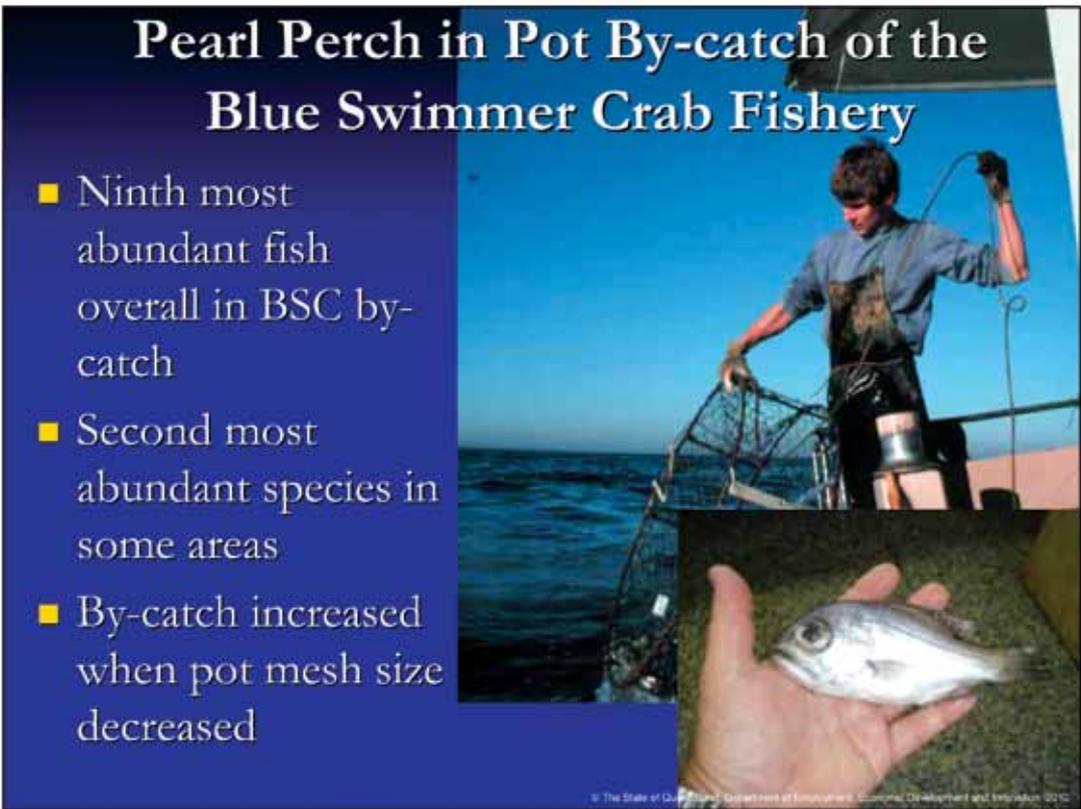


- Adult-pearl perch do trap but not as well as pink snapper
- Traps have on average 10 times more snapper than pearl perch (not necessarily reflective of abundance)
- Poor trapping confirmed by NSW trap fishers

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Slide 6

## Pearl Perch in Pot By-catch of the Blue Swimmer Crab Fishery

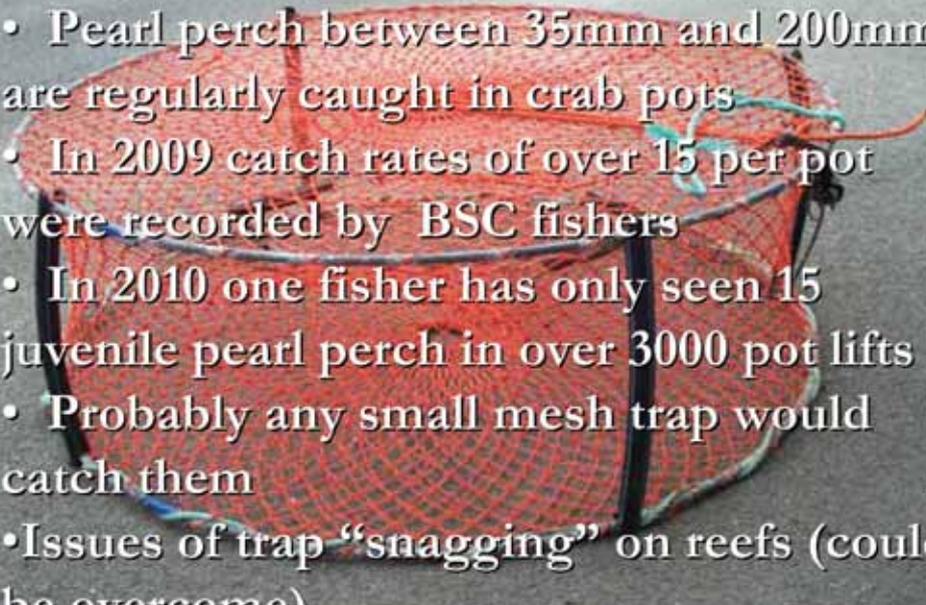


- Ninth most abundant fish overall in BSC by-catch
- Second most abundant species in some areas
- By-catch increased when pot mesh size decreased

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## Trapping juvenile pearl perch

- Pearl perch between 35mm and 200mm are regularly caught in crab pots
- In 2009 catch rates of over 15 per pot were recorded by BSC fishers
- In 2010 one fisher has only seen 15 juvenile pearl perch in over 3000 pot lifts
- Probably any small mesh trap would catch them
- Issues of trap “snagging” on reefs (could be overcome)



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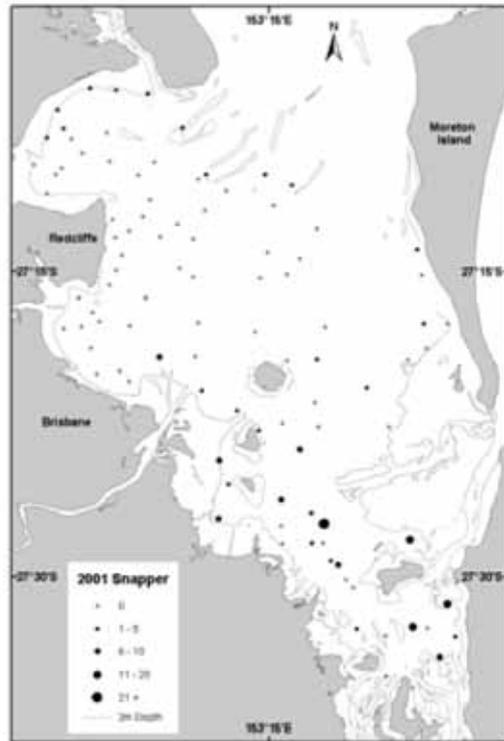
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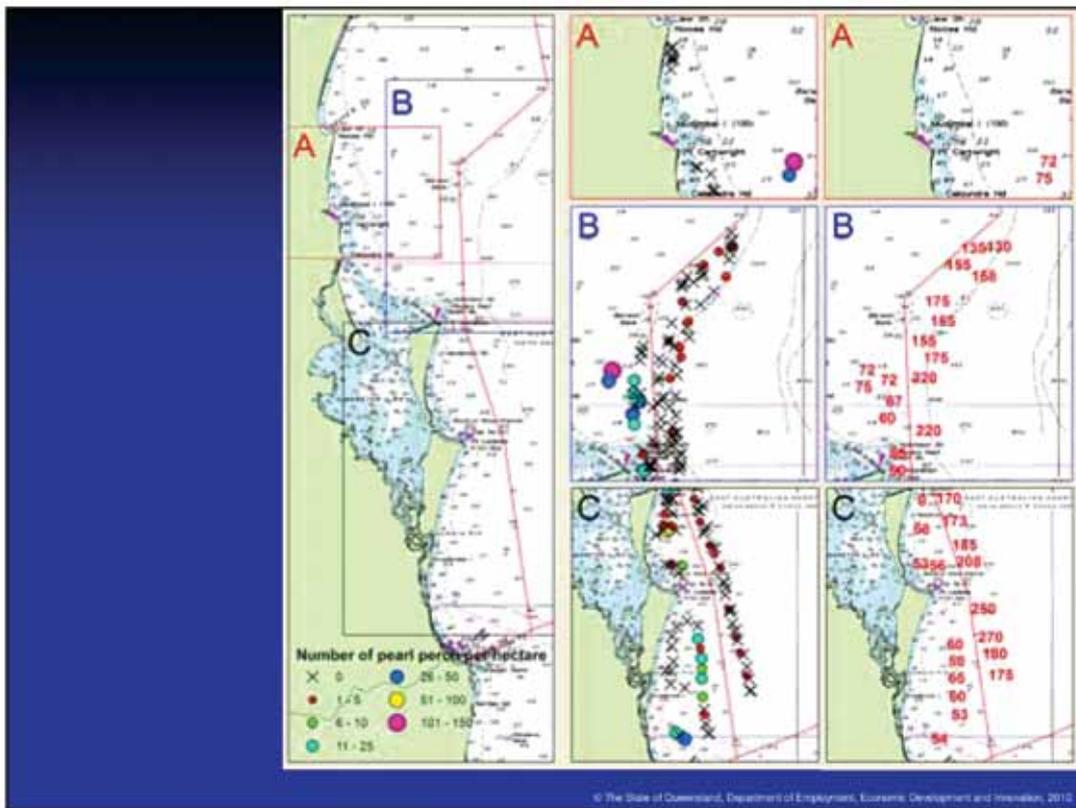
Slide 9

Pink snapper caught in estuarine conditions but no (few) pearl perch have been recorded inside Moreton Bay



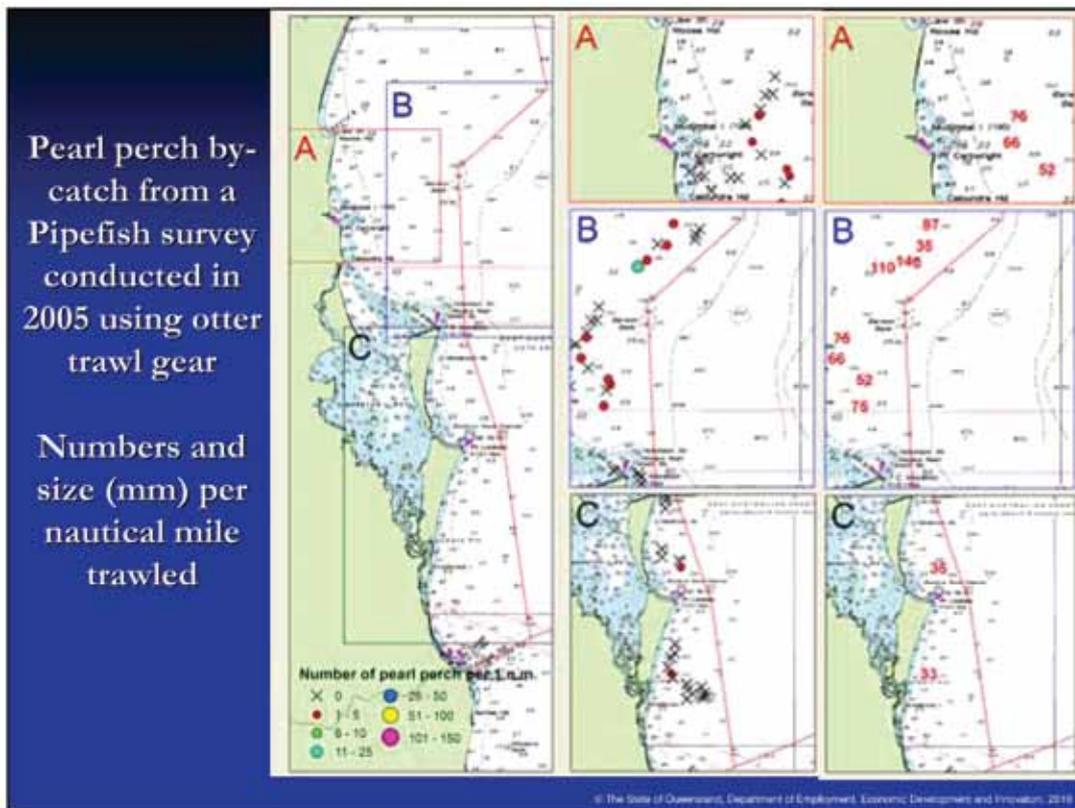
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Slide 10



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Slide 11

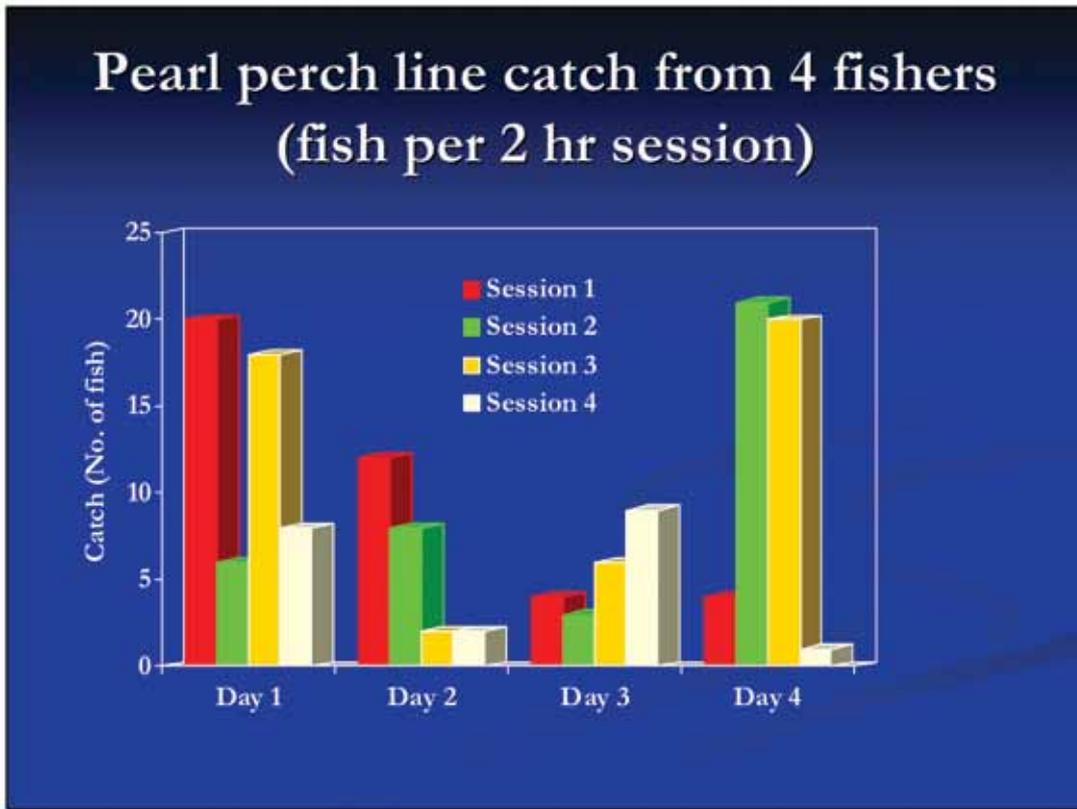


Slide 12

## Structured line fishing surveys

- Many fishers believed that there were no juveniles in their fishing areas as few fish < 25cm were caught
- Juveniles were caught when hook size was reduced but not as effectively as pink snapper
- Pearl perch appear on sounders but sometimes do not feed or take the bait (like most other fish)
- Not keen on line fishing surveys as a quantitative sampling tool given small scale variability in catch rate
- Probably OK to establish if the fish are present (zero catch does not mean they are not there)

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### BRUV Sampling

- Dhufish have been recorded in low numbers on BRUVS in WA and pearl perch have been recorded in NSW
- Preliminary trials have also shown pearl perch on rocky reefs in Queensland as well (CSIRO and ourselves)
- Issue of water clarity, current, deep water (light and logistics) amongst other things

Slide 15



Slide 16

## Other UVC methods, divers etc

- Dive clubs are a good source of supplementary data but depth is a limiting factor for diving surveys of pearl perch in QLD
- R.O.V.'s possibly an option but not within our budget
- Acoustic surveys – no information

The background of the slide features several pearl perch fish swimming in greenish water. The fish are silver with a yellowish tint and are oriented horizontally.

## Juvenile Sampling Issues

- Scale of sampling depends on questions that need addressing
- Not all methods are suitable in all habitats (can't trawl over reefs)
- Probably need to sample deeper areas (>100m) which creates logistical issues for some sampling methods
- Strong currents and varying water visibility are sampling issues as well for some methods (These vary over small spatial and temporal scales)
- Consider multiple methods because of individual biases (BRUVS and trawls)

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## **5.0 Workshop Discussion 1: Where are the juvenile dhufish?**

This workshop discussion documented information on a range of sampling methods that have previously proven effective in either capturing juvenile dhufish (e.g. trawling and line/spear fishing), or confirming their presence in certain areas through the use of other techniques (e.g. baited remote underwater stereo- video systems - stereo BRUVs - and diving). Participants were divided into two groups and were asked to discuss the topic using a table as a guide (Appendix 4).

### **Workshop 1 Outcomes:**

#### **Otter trawls**

Juvenile dhufish 150 mm TL or less (less than approximately 15 months of age) have been regularly caught 7–8 km from shore, north of Rottnest Island, in depths of 27–33m. Trawls were generally conducted between noon and midnight (allowing both day and night shots) and during most months of the year. Juvenile dhufish were most consistently caught over flat, hard substrate adjacent to reef, in areas consisting of sponge gardens with weed and low profile limestone reef (Hesp et al. 2002).

Juvenile dhufish 150–300 mm TL (15 months to approximately four years of age) were captured in low numbers in areas of relatively flat, hard substrate. It was thought that fish of this size range were not frequently caught over these substrates as they may no longer be present at this type of habitat and could possibly have transitioned to areas of low to medium profile reef habitat unsuitable for trawling.

Habitat type was a determining factor with regard to the length of the trawl shots conducted. Trawls of up to two hours duration were conducted over sandy or flat, hard substrate. However, areas of low-lying reef were unable to be trawled for longer than 30 minutes. The trawl net was modified by removing the ground chain in order to prevent snagging on the reef and minimise habitat destruction.

The abundance of juvenile dhufish captured increased during the months of October to December. Juvenile dhufish were also more consistently caught during the night trawls in all months.

#### **Line Fishing**

Anecdotal reports indicate that older juvenile dhufish (250–450 mm TL, approximately 3–6 years of age) have been captured in areas of high profile reef while targeting adult fish. Locations include Hale Road Reef (Perth Metropolitan area) in 12–19 m depth. There have also been reports of juveniles in this size range consistently caught in 30–50 m depths off Busselton and Port Geographe. While it is rare that juveniles less than 250 mm TL (less than 3 years of age) are caught by line fishing, there were reports of fish 150–200 mm TL (approximately 15 months to 2.5 years of age) being captured in the southern zone of the West Coast Bioregion (Quindalup and Bunker Bay) while targeting whiting, using small ganged hooks in shallow water (as shallow as 3 m).

There are anecdotal reports of fish with the striped appearance of juvenile dhufish being caught from rock walls and marinas throughout the Bioregion. However the identification of these fish has not been verified and it is likely that these fish may be a species of *Apogon* (cardinalfish) common in nearshore and estuarine waters of the southwest (Hutchins and Thompson, 2001, e.g., plate 140 and 141).

### **Spear Fishing**

Juvenile dhufish 150–300 mm TL (15 months to four years of age) have been obtained by spear-fishing in small numbers in areas of low-lying reef habitat (less than 30 cm vertical reef) with rock ledges.

### **Baited Remote Underwater Stereo-Video Systems (Stereo BRUVs)**

Scientists and researchers from UWA have used stereo BRUVs as a non-destructive and non-invasive method for sampling fish communities across a broad range of depths and habitats. The use of stereo-video allows for the provision of precise length estimates of individual fish which can be used to generate weight estimates. Researchers from UWA have undertaken more than 4,000 stereo BRUV drops in selected areas from the Houtman Abrolhos to Broke Inlet, in depths ranging from 24–60 m (day sets only). From these sets, 13 juvenile dhufish less than 350 mm TL (less than five years of age) have been recorded, with only 1 fish less than 200 mm TL (less than approximately 2.5 years of age) recorded. The majority of these fish were associated with low-medium profile reef (less than 1 m vertical relief) and mixed sessile invertebrate habitat. Small dhufish have never been recorded on sand-inundated reef.

### **Diving**

Juvenile dhufish less than 250 mm TL (less than three years of age) are rarely seen by divers, presumably because they are not yet associated with the medium-high profile reef habitat likely to be favoured by divers. However, there were anecdotal reports of juvenile dhufish 200–350 mm TL (approximately between 2.5 and five years of age) observed while diving around low relief ledges near Moore River in depths of 10–20 m. It was noted that juveniles and adults have never been seen together, and different size classes of juveniles do not appear to aggregate or school. Small dhufish (less than 500 mm TL) have also been occasionally observed by commercial abalone fishers in the South Coast Bioregion.

### **Demersal Gillnet Fisheries**

The demersal gillnet fisheries on the west and south coast of WA are primarily shark fisheries, however there is also a scalefish component to the catch. The gillnet mesh size is restricted to between 165–178 mm (6.5–7.0”), thus there is minimal catch of small and undersized fish. Dhufish are a component of the scalefish catch in gillnets, however the majority are adult fish. The smallest dhufish recorded in gillnets to date is approximately 250 mm TL (approximately three years of age). The scalefish catch is generally associated with gillnets set in areas with significant benthic habitat with low to high relief.

### **Plankton tows**

A student thesis investigating larval fish assemblages in waters off Two Rocks on the southwestern Australian coast was carried out in conjunction with a CSIRO project examining physical and chemical geography, phytoplankton and zooplankton surveys. Plankton tows were conducted quarterly across the sample sites (and monthly for the inshore sites) over a 3 year period along a transect extending from inshore waters (less than 20 m) to offshore (1,000 m). Only one larval dhufish was recorded throughout the duration of this study.

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## **6.0 Workshop Discussion 2: Which methods should we use to survey juvenile dhufish?**

Using the information collated during the first workshop discussion, the second workshop discussion involved identifying the possible habitats where juvenile dhufish are most likely to occur, and outline which sampling methods could then be applied in order to confirm the presence of juveniles at the preferred habitat. Participants were again divided into two groups and were asked to discuss the topic using a table as a guide (Appendix 5).

### **Workshop 2 Outcomes:**

Given the low number of small, juvenile dhufish ever recorded (fewer than 300 fish in total, less than 150 mm TL), information on preferred habitats, habitat requirements, distribution and sampling approaches were limited.

There was a general consensus that the best way to proceed in establishing critical habitat requirements would initially be to return to the previously trawled grounds off the Perth metropolitan area where juvenile dhufish were captured (Hesp et al. 2002). It was suggested that the initial sampling regime should involve using towed cameras (and if available, ROV's and/or AUV's) through this area (during both day and night) in an attempt to confirm the presence of juveniles and identify and characterise the habitat in which they are found in conjunction with trawling.

It was noted that using towed cameras as the only method of sampling was unlikely to be effective as there are a number of factors involved which may not result in confirmation of presence, but not necessarily indicate absence in a particular habitat. These include, fish outside the field of view of a camera, hidden in cracks or under ledges, or poor visibility resulting in difficulties with fish identification and habitat characterisation. Video methods may also be of limited use if juvenile dhufish are nocturnal.

The potential negative public and political perceptions and ramifications of trawling were discussed. It was noted that a trawl fishery is permitted to operate in limited areas of the West Coast Bioregion and all trawling would be focussed in these permitted trawl areas where juvenile dhufish have previously been captured (see Hesp et al. 2002).

Data can be provided from previous trawls that have been successful in obtaining samples of juvenile dhufish ( $n \approx 300$  individuals less than 150 mm TL, Hesp et al. 2002). Information from the previous trawl samples - e.g. trawl coordinates, depths, time of day and time of year when juvenile catches were most likely - could be used to guide the new trawl surveys. It was recommended that consultation with commercial trawl operators would be beneficial, in order collect additional juveniles and to develop ways to modify the gear to improve efficiency if required (e.g. the use of smaller mesh and shorter trawl times). The possibility of attaching a camera to the trawl net was discussed, which may be able to provide finer detail and estimate the 'patchiness' of the habitat. If the presence of juvenile dhufish can be confirmed, a detailed description of the habitat can then be established and defined.

There were suggestions from some workshop attendees that juvenile dhufish may be in deeper areas (greater than 80 – 90 m) associated with limestone reefs, along the edge of the old, submerged coastline. These are areas that have been poorly sampled for small fish in the past. At these depths, trawling would be difficult and normal daylight cameras may not be a useful sampling tool. These areas may be useful targets for stereo BRUVs equipped with appropriate lights as well as trialling the use of traps.

From the Queensland experience with the congener, it was agreed to trial the use of a range of traps (e.g. modified lobster pots, crab pots, etc) to capture juvenile and small dhufish. It was noted that there are anecdotal records of 'small' dhufish captured in commercial lobster pots, although details of fish size are usually missing. It is anecdotally suggested that dhufish retained in commercial lobster pots would be relatively large due to mesh size and the size of escape gaps (S. de Lestang, pers. comm.). However, modified pots (e.g. smaller mesh) in particular areas may be a useful sampling tool to trial.

Given the range of techniques used in the West Coast Bioregion- commercial fishing gear, stereo BRUVs and other cameras, traps and divers - a very small number of small dhufish have ever been recorded (less than approximately 300 dhufish less than 150 mm TL and only one larvae). It was agreed that a wide range of techniques be used to potentially identify those techniques that can reliably observe or capture small, juvenile dhufish (less than 150 mm TL). However, it was noted that trawling was the only technique demonstrated to effectively and reliably sample juvenile dhufish less than 150 mm TL.

Once a description of the preferred habitat requirements for juveniles has been ascertained, towed cameras could be used to run transects in an attempt to locate similar areas of habitat throughout the Metropolitan zone and further throughout the West Coast Bioregion. Collaboration with UWA will be valuable, as they have already mapped some areas of habitat throughout the Metropolitan region and have the appropriate gears and expertise.

It was also recommended that a potential supplementary source of information may be provided through consultation with commercial trawlers, specimen shell and marine aquarium fish divers, who may be able to provide an account of their observations if they have encountered juvenile dhufish. Liaising with fishers that target adult dhufish may also be of value as the habitat that supports adult dhufish is likely to be located close to areas of hard substrate harbouring juvenile dhufish. Additional insight and information may also be provided by the WAMSI (West Australian Marine Science Institute) Node 4.4 project investigating the stock structure of dhufish using genetic approaches and analysing the chemical signals in otoliths to try to detect a juvenile signal. This may provide further information on the potential locations and range of juvenile dhufish.

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## **7.0 Workshop Outcomes**

Overall, the workshop brought together a wide range of stakeholders including recreational and commercial fishers, divers, and researchers from a range of Government Departments and Universities. This provided the best opportunity to collate all relevant information and knowledge on the likely locations, distribution and habitat preferences of juvenile dhufish and a range of techniques available to define habitat and extent of juvenile dhufish in the future. Ultimately, this may provide the first step to identify critical habitats for juvenile dhufish and potentially generate a relative index of dhufish recruitment in the future.

It was clear that despite the application of a wide range of commercial, recreational and scientific techniques, very few juvenile dhufish (less than 150 mm TL) have ever been observed or collected. However, negative information can still be valuable and we conclude;

1. As small, juvenile dhufish have not been reported from daytime BRUVs, it suggests that they may prefer low light conditions. This suggests that small juvenile dhufish may be nocturnal and/or more abundant in deep water. This is supported by a lack of observations of small, juvenile dhufish by divers.
2. Only one larval dhufish has been collected, however there could be a number of reasons for this, such as inappropriate spatial and temporal patterns of sampling or unsuitable methodology for sampling larval dhufish.
3. Small dhufish are unlikely to be captured by recreational line gear and as such, line fishing is unlikely to be a worthwhile sampling technique alone. However, the location of adult fish in spawning condition identified by line fishers may provide information on where juveniles may occur.
4. The capturing of juvenile dhufish in trawl gears suggests that low relief habitat (e.g. rubble) may be a preferred habitat.
5. Reports of dhufish in lobster pots suggests that dhufish are able to be captured in pots or traps although details of size are not typically recorded.

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## **8.0 Project Plan**

The next step is to implement the suggestions and ideas identified at this workshop. This will involve;

1. Contacting trawl operators and Dr Alex Hesp to confirm the areas where juvenile dhufish were previously collected (as reported in Hesp et al. 2002)
2. Undertake additional trawl surveys, given that this is the only method so far that has reliably captured juveniles less than 150 mm TL, as well as the use of video transects over trawl grounds where small, juvenile dhufish were captured by Hesp et al. (2002). Using these techniques together would allow the collection of information on the habitat where juvenile dhufish are captured, providing information on critical juvenile habitats.
3. Contacting trawl operators to report and save juvenile dhufish as bycatch
4. Contacting marine aquarium fish and marine shell collector licence holders to determine if they have observed small dhufish, and if so, collect details (e.g. locations, areas, depths, habitats, fish size and numbers)
5. Re-analyse UWA stereo BRUVs data to identify additional records of small, juvenile dhufish and report habitat, depth and other characteristics.
6. Trial a range of pot and trap designs to determine if juvenile dhufish will reliably trap, both within areas where juvenile dhufish have been previously recorded (i.e. trawl grounds) and to explore other areas (e.g. deeper areas).

Ultimately, if any one or more approaches were successful, mapping of the extent of preferred habitat would be the next step. In addition, focussing on the most successful techniques would allow the first steps in potentially developing a recruitment index of this iconic and important fishery species.

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## **9.0 Acknowledgements**

We gratefully acknowledge the financial support for this project from the State Natural Resource Management Office of Western Australia and the Department of Fisheries, Western Australia.

We also acknowledge the wide range of stakeholders including recreational and commercial fishers and divers, managers and researchers from a number of government organisations including the WA Department of Fisheries, UWA, Murdoch University, QDEEDI, CSIRO, and RecFishWest for participating in this workshop. Your contributions were very much appreciated and valued. A special thank you to Dr Wayne Sumpton, who travelled to WA from Queensland in order to participate. A full list of attendees can be found in Appendix 3.

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## **11.0 Appendices**

### **11.1 Appendix 1. Workshop Invitation**

The Department of Fisheries WA was recently successful in obtaining a one-year State NRM-funded project entitled, “*Identification of Critical Habitats for Juvenile Dhufish*”.

The first component of the project is to collate the knowledge and information on the critical habitats of juvenile dhufish. This will be achieved via a workshop involving commercial and recreational stakeholders, scientists from the Department of Fisheries and Universities, and Fishery managers. The objectives of the workshop will be to;

- Document where juvenile dhufish have been reported or captured in the past
- Identify the habitats and locations of where juvenile dhufish are most likely to occur
- Assess the methods in which to confirm the presence of juvenile dhufish in the identified habitats and locations.

The outcome of the workshop will be a report defining the likely locations and habitats of juvenile dhufish in the Metropolitan Zone, document the supporting evidence and identify the techniques most likely to be effective in sampling juvenile dhufish.

Subsequently, the project will trial the identified methods in the locations and habitats specified. If successful, the project will describe and map the extent of critical habitats for juvenile dhufish in the Metropolitan Zone and develop monitoring approaches for juvenile dhufish into the future.

I therefore invite you to the workshop on Thursday 18th March 2010 at the WA Fisheries and Marine Research Laboratory, starting at 9 am. I would appreciate that you confirm your attendance to Gabby Mitsopoulos by Friday 12th March, via the email in the cc header. Additionally, if you identify any other stakeholders who could contribute to the workshop, can you please pass their contact details to Gabby as soon as possible. An agenda will be sent to you for consideration prior to the workshop.

I look forward to seeing you at the workshop on the 18th March.

## 11.2 Appendix 2. Agenda

### NRM Dhufish Project Workshop

#### *Identification of Critical Habitats for Juvenile Dhufish*

18 March, 9 am – 4 pm

WA Fisheries and Marine Research Laboratories

|              |   |                             |
|--------------|---|-----------------------------|
| <b>8:30</b>  | <b>Tea and coffee</b>   |                             |
| 9:00         | Welcome and Introductions   | Brett (DoFWA)               |
| 9:15         | Background to project and objectives  | Brett (DoFWA)               |
| 9:30         | Aims of workshop and expected outcomes<br>Document where juvenile dhufish have been reported or captured in the past<br>Identify the habitats and locations of where juvenile dhufish are most likely to occur<br>Assess the methods in which to confirm the presence of juvenile dhufish in the identified habitats and locations  | Brett Molony (DoFWA)        |
| 9:45         | Approaches to collection of juvenile pearl perch, a con-generic of WA Dhufish   | Wayne Sumpton (QDEEDI)      |
| <b>10:15</b> | <b>Morning tea</b>  |                             |
| 10:30        | Workshop 1: Where are the juvenile dhufish?<br>Document where juvenile dhufish have been reported or captured in the past and what methods<br><i>Identify the habitats and locations of where juvenile dhufish are most likely to occur</i><br><i>Document the supporting evidence</i>  | Small groups                |
| 12:00        | Report back   | Scribes                     |
| <b>12:15</b> | <b>Lunch</b>  |                             |
| 13:00        | Workshop 2: Which methods should we use to survey juvenile dhufish?<br>Use the outcomes of Workshop 1 Document<br>Assess the methods in which to confirm the presence and collection of juvenile dhufish in the identified habitats and locations.<br>Which methods should be tested in which habitats?<br>Who can is best placed to do this?<br>Document the supporting evidence | Small groups                |
| 14:30        | Report back   | Scribes                     |
| <b>14:45</b> | <b>Afternoon tea</b>  |                             |
| 15:15        | Summary of findings   | Brett Molony (DoFWA)        |
| 15:30        | Open discussion   | Brett Molony (DoFWA)        |
| 16:00        | Where to from here?   | Brett Molony (DoFWA)        |
| <b>16:15</b> | <b>Close</b>  | <b>Brett Molony (DoFWA)</b> |

## 11.3 Appendix 3. Attendance list

### NRM Dhufish Project Workshop

#### Identification of Critical Habitats for Juvenile Dhufish

| Name              | Organisation   |
|-------------------|--|
| Brett Molony      | WA Dept of Fisheries   |
| Gabby Mitsopoulos | WA Dept of Fisheries   |
| Lindsay Joll      | WA Dept of Fisheries   |
| Rod Lenanton      | WA Dept of Fisheries   |
| Mark Pagano       | WA Dept of Fisheries   |
| Corey Wakefield   | WA Dept of Fisheries   |
| Gary Jackson      | WA Dept of Fisheries   |
| Ben Carlish       | WA Dept of Fisheries   |
| Tim Nicholas      | WA Dept of Fisheries   |
| Nikki Sarginson   | WA Dept of Fisheries   |
| Wayne Sumpton     | QLD Dept of Employment, Economic Development and Innovation  |
| Alex Hesp         | Murdoch University   |
| Joanna Strzelecki | Commonwealth Scientific and Industrial Research Organisation |
| Oliver Berry      | Commonwealth Scientific and Industrial Research Organisation |
| Jessica Meeuwig   | University of WA   |
| Kris Waddington   | University of WA   |
| Dianne Mclean     | University of WA   |
| Ian Riggs         | Commercial Trawl operator                                    |
| Andrew Rowland    | RecFishWest  |
| Dean Thorburn     | Recreational Diver   |
| Joe Petrovich     | Recreational Diver   |
| Andy McIntyre     | Recreational Angler  |

## 11.4 Appendix 4. Workshop Table 1.

Workshop 1: Where are the Juvenile Dhufish?

| Who's observation? | Where and When? [e.g. depth, location, date (time of year), day/night etc] | How? [e.g. line fishing, type of bait used, diving] | Fish observations? [number, size, solitary, schooling, associated with other species?] | Habitat? [substrate, relief, algae or sponge? Holes/caves/ledges?] | Any evidence, other data? | Rank [Order your observations from most likely to least] | Any other comments? |
|--------------------|--|---|--|--|---------------------------|--|---------------------|
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|                    |  |   |  |  |                           |  |                     |
|                    |  |   |  |  |                           |  |                     |
|                    |  |   |  |  |                           |  |                     |

## 11.5 Appendix 5. Workshop Table 2.

Workshop 2: Which methods should we use to survey Juvenile Dhufish?

| Who's observation? | Where and when?<br>[e.g. depth, location, date (time of year) day/night etc?] | Proposed Method?<br>[e.g. line fishing, type of bait used, diving] | Who should be involved?<br>[e.g. line fishing, diving] | Likely data?<br>[e.g. number, size etc.] | Any supporting information or documentation? | Rank<br>[order your preferred approaches from most preferred to least] | Any other comments? |
|--------------------|---|--|--|--|--|--|---------------------|
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