Coral Sea Fishery

Line, Trawl and Trap Sector Sub-fisheries

Overview of the fishery

The Coral Sea Fishery is comprised of several sub-fisheries:
- the hand collection sub-fishery, which includes the following sectors:
  - aquarium (NB although hand-held rods are permitted within the Aquarium sector, it is still classed as a hand collection sub-fishery)
  - lobster and trochus
  - sea cucumber (beche-de-mer)
- the line sector sub-fishery, which includes auto-longlining, demersal longlining and other line fishing
- the otter trawl sub-fishery
- the finfish trap sub-fishery

In recent years 40-160t per year was taken across all Coral Sea sub-fisheries (40t in 1988/89; 150t in 2001/02). The GVP of the combined Coral Sea Fishery was $1,201,200 in 2002/03, $850,000 in 2003/04, $1,100,000 in 2004/05.

i) Line sub-fishery (auto-longline, demersal longlone, other line)

There are nine fishing concessions across the multi-gear, multi-method line sector. All line sub-fisheries are eligible to operate from each permit. Approval must be sought from AFMA to use auto-longline equipment. Catches were >30 t in 2002 and 2003 but fell by more than 50% in 2004.

Auto-longlining employs automatic baiting and, as opposed to the other line gears, has the capacity to rapidly set a large number of hooks: a maximum of 15000 hooks may be used, stowed and/or secured on the boat. Autolonglining has targeted the following species: red bullseye, comet grouper, rock cods, coral trout, blue-eyed trevalla, rosy jobfish/king snapper, sea bream snapper, northwest ruby fish, and flame snapper.

Demersal longlining employs has no restrictions on the number of hooks (but this would be limited by practicality) and has targeted the following species: tiger shark, blacktip sharks, white tip reef shark, grey reef shark, scalloped hammerhead, flame snapper, bar rockcod, northwest rubyfish and blue-eyed trevalla. Catches in 2004 showed more than a five-fold increase over 2001 catches.

Other line fishing includes setline, dropline manual hauling, dropline hydraulic hauling, handline, troll and trotline. Target species include rosy jobfish/king snapper, northwest ruby fish, bar rockcod, Mozambique bream, Japanese sea bream, tropical snapper, comet grouper, whaler sharks, red emperor, redthroat emporer, wahoo, Spanish mackerel, greeneye dogfish, bronze whaler, green jobfish, coronation grouper, pearl perch, gemfish, jobfish, flame snapper, rock cods, and tiger shark. There was a four-fold increase in 2003 catches relative to

2001-02, but 2004 catches dropped by 10% relative to 2003. There was a 3-4-fold increase in dropline hooks in 2004, for which no explanation could be given.

The overall status of the line sub-fishery is uncertain and most stocks are not assessed. Discarding is reported in logbooks to be approximately 16%, not including bite-offs.

ii) Otter trawl sub-fishery

The otter trawl sub-fishery undertakes benthic and midwater trawling. The sub fishery actually comprises separate finfish and crustacean fisheries, each with different permit conditions. The finfish sector of the sub-fishery mainly targets alfonsino, but also catches gemfish, bar rock cod and northwest rubyfish. The average trip duration is 7-10 days.

The overall status of the fishery is uncertain and most stocks are not assessed. The 2000-2002 annual trawl catch was about 50-100t. Catches have decreased steadily from 80 down to <40t/year for the calendar years 2002-2004 despite a steady increase in effort. In recent years trawling has been intermittent because of the transferred interest to trapping during 2005-06.

iii) finfish trap sub-fishery

Finfish traps were trialed in the fishery from July 2004 until June 2007. The method was adopted from July 2007 and is restricted to operators holding a permit for trawl or line sectors (i.e. those catching finfish); as such 11 CSF fishing concessions were amended to allow trap fishing. Much line and trawl effort has been diverted to traps (100% of trawl effort in 2005). During the trap trial period most operators met the minimum fishing day requirements for line and trawl licenses with trap effort.

It is a requirement of the use of finfish trap gear that traps must be individually hauled; that is, not be looped together. Full trap details must be provided with a fishing plan including trap design, and no other method of fishing is permitted on that trip unless the boat is carrying an observer.

Species targeted include: trout cod, trevally, red emperor, rosy jobfish/king snapper, goldband snappers, redthroat emperor, Japanese sea bream, sea bream snapper, coral trout, samsonfish, amberjack, golden-eyed jobfish, long nose emperor, grass emperor, spangled emperor and red-eared emperor. The July-December 2004 six-month catch was >18t, and the 2005 12-month catch from logbooks was >90t.

Traps are typically set at 60-120m depth, with most catch occurring between 80-100m depth. If the traps are hauled slowly from depth, fish do not suffer barotrauma and may be discarded without harm. Red bass is the main discard species.

Review of the current management of the fishery

i) line sub-fishery (auto-longline, demersal longlone, other line)

There are no TACs, but there are spatial controls. Autolongliners must fish in waters deeper than 200m. Observers must be used every 4th trip with an option to reduce this to one in eight trips. With observer coverage, 50% of lines may be set shallower than 200m.

There are no observer requirements for line fishing other than auto-longlining. The usual trip length is about 12 days fishing and two days each way steaming.

There is an MOU in the northern Coral Sea covering members of the Coral Sea Fishery Association (CSFA) for resource protection and tourism – in addition to the Lihou and Coringa-Herald reef closures, the waters within 4 km around an additional four islands are closed to line fishing; these reefs are Osprey Reef, two at Holmes and Herald Reef.

ii) Otter trawl sub-fishery

The otter trawl sub fishery comprises separate fishfish and crustacean fisheries, each with different permit conditions. There are two trawl fishing concessions. There are no size limits on boats, and there are no TACs or quotas. Input controls include gear restrictions of a minimum mesh size and fitting of Turtle Exclusion Devices (TEDs) for crustacean trawling operations.

Observers must be used every fourth trip (aim to cover 25% of all shots). The use of underwater video footage of gear operations is being discussed as a research priority.

iii) finfish trap sub-fishery

There are no TACs or quotas. All fish traps must be constructed of metal. The maximum trap size is 1.8 metres x 1.8 metres x 0.8 metres. No more than 50 traps may be used, stowed and/or secured on the boat. All fish trap doors are fitted with sacrificial anodes (of no more than one month life span) that will ensure the trap doors will open within 1 month if lost.

Observers are required on 1 in 4 trips, but once an operator has had more than 1000 trap sets observed, approval can be sought to reduce this to 1 in 8 trips. As a result of the observer coverage, there is a comprehensive amount of bycatch/byproduct data. There is the potential for application of spatial controls and this approach has been supported by industry.

By nature, this fishery is exploratory and its overall status is uncertain as most stocks are not assessed. Trap discard is approximately 16%. Discards could potentially be reduced by use of a "fisheye" device[1]. Traps have some environmental advantage (over line fishing) of having no interaction with sharks and no loss due to "bite off".

It was suggested at the October 2006 stakeholder meeting that a limit should be placed on the number of traps that may be carried per vessel. The group had reservations about looping and the option for monofilament traps. The latter permits more ghost fishing and may be eaten by large predators. Steel traps are expensive so operators make a strong effort to retrieve them. Steel traps also have no interactions with large predators. Subsequently, management rules were amended in 2007 to limit the number of traps on board at any time to 50, and to allow only metal traps.

It should be noted that traps typically catch smaller fish of a given species than do lines (e.g. rosy jobfish average weight 4-7kg on line, 1.5kg in trap).

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[1] The fisheye is a Bycatch Reduction Device, typically used in the cod end of trawl nets, that takes the advantage of fish behaviour to reduce by-catch by allowing the active swimming fishes to escape from the trawl. The 'Fisheye' consists of a simple metal frame with the elliptical-escape opening and it is attached with the top of the cod end through which the fishes swim and escape.

Proxies against the Harvest Strategy Policy Reference Points

Clearly it is not possible to set meaningful triggers against each species captured by the fishery, particularly given the changes in main target species over time. However, by establishing a suite of triggers to detect and react to changes in the fishery (defined as changes in species composition, changes in spatial fishing patterns, declines in overall CPUE), it is hoped that the entire fishery will be vicarously represented and hence managed. Additionally, by including absolute triggers in terms of i) an overarching total catch trigger, ii) separate triggers for highly vulnerable species, and iii) sets of triggers of increasing value against key functional species and/or species groups, the strategy is defensibly precautionary.

Given the developmental status of the fishery, together with its temporally variable species composition, there is as yet no qualitative or quantitative notion of target reference points in terms of maximum economic yield. For developing fisheries with low GVP and no current overfishing concerns, there is a need to strike a balance between allowing for controlled expansion and economic development while still managing the fishery in a precautionary and proactive manner, consistent with the intent of the Harvest Strategy Policy.

The series of triggers proposed under the harvest strategy is designed to allow for controlled expansion of the fishing, and hence optimize economic yield, while at the same time being precautionary in detecting changes in species composition and setting conservative values for triggers against key functional species groups that provide checks if the fishery expands. The inclusion of two levels of values for each trigger facilitates the expansion of the fishery by assigning progressively higher data and analysis requirements with higher trigger values. As such, the risk associated with further expansion is minimized.

The two levels of trigger aim to do this by setting the lower trigger level at a value that will detect early changes and result in analysis to identify the reasons behind these without immediately placing limitations on the fishery. The second trigger level acts a limit reference point in the absence of further information. Should the fishery wish to further expand, it will need to invest in more detailed/robust assessments that will provide stronger justification for continued expansion and upward revision of the trigger point.

General description of the harvest strategy

Fishery Issues; justification for approach

- The Coral Sea Fishery is exploratory by nature and its overall status is uncertain as most stocks are not assessed. However, given current catch levels, it is unlikely that any species is currently overfished (McLoughlin 2006).

- The GVP for the fishery is low and minimal research funding is available.

- There is much latent effort in the Coral Sea sub-fisheries. A small number of boats are used and historically the licences were rotated in order to meet minimum fishing day requirements, which were in place until 30 June 2007.

- Observer requirements (applying as at 2007 to autolongline, trawl and trap activities) will be reviewed in the process of addressing information needs for the fishery.

- Ultimately, key target species should be identified around which the harvest strategy can be established. Fishing is currently exploratory in nature, and as such the catch data is survey-esque, and provides a reasonable baseline. However, at this developing/exploratory stage of the fishery (as at September 2007) there are difficulties with identifying a suitable list of key species and setting appropriate values for triggers against these. This is due to three main issues: 1) the lack of habitat mapping for the fishery, so that the size of the resource and the exploitation rate are currently unknown; 2) the high instance of misreporting (species mis-identification) in the fishery; 3) the highly variable nature of the fishery, whereby high annual catches for one species can be followed by no catch in the next year.

- The nature of the desired fishery needs to established (e.g. shark or snapper as the main target species in the line sector?) as this has implications with respect to (for example) conservation issues (e.g. in the case of sharks) and longevity of the main target species.

- Additional closed areas should be considered, particularly for trawling. Indeed, trawling may not be able to exist without additional closures demonstrating a responsible approach to ensuring the sustainability of the resource. While there are several large reserves protecting shallow water habitat, further closures probably need to focus on deep water habitats affected by trawling. These closures would also apply to the trap and line sectors.

Harvest strategy overview

The harvest strategy to be adopted for the Line, Trawl and Trap sector sub-fisheries will be one of a suite of triggers invoking a series of management responses. The key points are

- The harvest strategy will apply uniformly across all gear types

- A set of trigger values should be determined that encapsulate the dynamics of the fishery in such a way that is demonstrably consistent with the intent of the Harvest Strategy Policy.

- Each trigger should have two levels, as follows. The first, lower level, trigger (Level 1) should be set at a level at which it would be deemed appropriate from a management, economic and/or conservation viewpoint to clarify why observed changes are occurring in the fishery. The second, higher level (Level 2) is one that is demonstrably precautionary, and at which an assessment should be undertaken on the species (single or multiple) deemed responsible for the trigger being reached. Until the completion of the assessment, the trigger will remain at its current level in each year. Once exceeded, where possible and where knowledge exists, all possible measures must be taken to avoid catching the species responsible in that year. In the absence of knowledge of how to avoid that species, trip limits may be imposed for the remainder of the year. Upon completion of the assessment, the trigger value may be revised in light of the improved information obtained for the species concerned.

(Note that there is a need to be precautionary if the assessment is based only on recent data and the species of interest has a short life cycle. The assessment may be overly optimistic if the available data encapsulates a "boom" phase for the species).

- The agreed framework is a general approach where triggers are set to detect changes in species composition, changes in spatial fishing patterns, declines in overall CPUE and at overarching values for total catch. Separate triggers for vulnerable species are included. In the first instance, this approach is advocated as being a more general framework that should identify changes in the fishery without having to nominate key species with certainty. As the fishery develops, a clearer notion of key species and their sustainability in given areas should be obtained. When this occurs, the harvest strategy can be increasingly augmented by setting species-specific trigger values. Thus the harvest strategy framework can be considered evolutionary in the face of the current developmental state of the fishery.

- The Harvest Strategy may be periodically reviewed given that the fishery is currently in a developmental/expansion phase, and is likely to exhibit changes in its dynamics and/or key target species.

Decision Rules (see subsequent section for annotated version with additional explanation and rationale)

1. Maintain existing spatial closures

These include the existing Lihou and Coringa-Herald closures, and the waters within 4km around an additional four islands that are closed to line fishing: Osprey Reef, two at Holmes Reef and Herald Reef

In addition, the voluntary closures by members of the Association should be included.

2. Maintain existing management arrangements, as follows:

a. Autolongliners:

Autolongliners must fish in waters deeper than 200m. Observers must be used every fourth trip (or every third trip with Best Fishing Gear). With observer coverage, 50% of lines may be set shallower than 200m. After 100,000 hook sets have been observed on a boat, application may be made to reduce observer coverage to every eighth trip.

b. Otter trawl:

Gear restrictions of a minimum mesh size. Observers must be used every fourth trip (aim to cover 25% of all shots.)

c. Trap:
Traps must be individually hauled (not looped together) and sacrificial anodes must be used. Observers are required on one in four trips, but once an operator has had more than 1000 traps sets observed on a boat without the concession holder or skipper changing, approval can be sought to reduce this to one in eight trips. All fish traps must be constructed of metal. The maximum trap size is 1.8 metres x 1.8 metres x 0.8 metres. No more than 50 traps may be used, stowed and/or secured on the boat. All fish trap doors are fitted with sacrificial anodes (of no more than one month life span) sufficient to ensure the trap doors will open within 1 month of the trap being lost.;

3 <u>Establish/refine data collection protocols to obtain age and length information.</u>

Length frequency information is currently being collected as part of the observer program.

For a suite of key species, begin to collect otoliths and/or shark vertebrae to store for ageing purposes if required.. At least 400 otoliths and 1000 length frequency measurements should be obtained for each key species per year, at a minimum of 10% per operator per year.

The suite of key species may be subject to periodic review; however, it should be noted that the value of the data is optimised when collected over a longer time series.

4 <u>Set of triggers resulting in management actions if reached</u>

A set of trigger values should be determined that encapsulate the dynamics of the fishery in such a way that is demonstrably consistent with the intent of the Harvest Strategy Policy.

The triggers are to apply to the catch across all gear types.

Each trigger should have two levels, as follows.

The first, lower level, trigger (Level 1) should be set at a level at which it would be deemed appropriate from a management, economic and/or conservation viewpoint to clarify why observed changes are occurring in the fishery. This clarification should occur via

- *detailed logbook analysis (including spatial and possibly trip-specific information)*

- *Industry consultation in an attempt to determine why the observed change is occurring and whether it is deemed to be significant from an industry viewpoint.*

- *Revised risk analysis*

- *If a reasonable justification for the change in the fishery can be made that does not relate to potential overfishing (e.g. new market for species), then the fishery may continue with no management intervention. However, in the absence of any other explanation, a precautionary management response may be invoked. This may include*

  - *The introduction of spatial closures and/or move-on provisions*

  - *Revision of the second trigger level(s) to lower values.*

The second, higher level (Level 2) is one that is demonstrably precautionary, and at which an assessment should be undertaken on the species (single or multiple) deemed responsible for the trigger being reached. Until the completion of the assessment, the trigger will remain at its current level in each year. Once exceeded, where possible and where knowledge exists, all possible measures must be taken to avoid catching the species responsible in that year. In the absence of knowledge of how to avoid that species, trip limits may be imposed for the remainder of the year. Upon completion of the assessment, the trigger value may be revised in light of the improved information obtained for the species concerned. The assessment may include, but is not limited to

- *Obtaining age information from stored otoliths/shark vertebrae.*

- *Undertaking catch curve analyses using the collected age and size data, to estimate fishing mortality, F, and natural mortality, M. Indicators could be the ratio of fishing to natural mortality (F/M), and/or the spawner biomass per recruit (SBPR) (all empirically derived from the catch curve analysis) (e.g. what level of fishing mortality would reduce the stock to 50%*

SBPR?) A time series of total mortality (Z) could also be obtained. Once F/M and/or SBPR have been determined, the trigger can be reconsidered, with a view to possibly setting TACs for some key species.

- *DeLury depletion curves (CPUE vs time) are an option for biomass estimation of an area, which could be combined with habitat mapping. This is a more sophisticated form of analysis and its validity will depend on reconciling the different CPUEs associated with the different gears (e.g. line vs traps).*

- *Examining CPUE trends and attempting to undertake CPUE standardisations.*

- *Examining spatial and temporal trends in length-frequency and age.*

The agreed option for the setting of trigger points is a general framework that should identify changes in the fishery without having to nominate key species. Triggers are set as changes in species composition, changes in spatial fishing patterns, declines in overall CPUE and at overarching values for total catch. As the fishery develops, a clearer notion of key species and their sustainability in given areas should be obtained. When this occurs, the harvest strategy can be increasingly augmented by setting species-specific trigger values. Thus the harvest strategy framework can be considered evolutionary in the face of the current developmental state of the fishery.

The range of general triggers

i. Overarching catch triggers

- *Must be less than the total highest catches across the main species caught to date*

- *Proposed Level 1 value: 450t (to be revised pending habitat mapping)*

- *Proposed Level 2 value: 1000t*

ii. Species-specific triggers(high risk/vulnerable AND key species)

- *Whitetip reef shark: Level 1: 2.5t (1/6 historical high catch); Level 2: 5t (1/3 historical high catch). May be revised pending resolution of species identification issues.*

- *Grey reef shark: Level 1: 13t (1/2 historical high catch); Level 2: 26t (historical high catch). May be revised pending resolution of species identification issues.*

- *Note there is currently no-take on white pointer, grey nurse and sawshark*

- *Other vulnerable species, pending risk assessment*

- *Few (4-5) key species to be determined (to mitigate against sudden high catches of single species and be adequately precautionary in the context of the Harvest Strategy Policy).*

iii. Triggers pertaining to changes in catch composition

- *If the relative catch proportion of any species changes by >30% from its historical average AND the catch of this species is greater than 1t, invoke a Level 1 response on the relevant*

species. If this is accompanied by a $\geq 50\%^{2}$ overall decline in CPUE over the last 3 years[2], invoke a Level 2 response.

- *If the relative proportion of any species in the catch declines interannually by 10% or greater over 3 consecutive years, invoke a Level 1 response. If this is accompanied by a $\geq 50\%^{2}$ overall decline in CPUE over the last 3 years[2], invoke a Level 2 response.*

- *Note that the above would not apply to new species in the catch until these were evaluated in their own right (i.e. Level 1 response) when any of the above trigger levels are met.*

<u>*iv. Triggers pertaining to spatial changes*</u>

- *If the following changes occur:*

  - *i) the percentage of areas fished increases by $\geq 40\%^{2}$ (fishery expansion) OR*

  - *ii) the percentage of areas fished decreases by $\geq 40\%^{2}$ (fishery contraction), OR*

  - *iii) if $\geq 40\%^{2}$ of the total catch is taken from a single area (fishery contraction/undue fishing pressure on one area) OR*

  - *iv) if $\geq 40\%^{2}$ of once-exploited areas are no longer fished*

  invoke a Level 1 response to determine why, with the added option of imposing spatial management measures, such a closures or move-on provisions. If any of the above triggers are accompanied by a $\geq 50\%^{2}$ overall decline in CPUE over the last three years[2], invoke a Level 2 response.

- *Note that if the above occurs in conjunction with the catch of a new species, the spatial patterns shall be evaluated in the context of the changes in target species (i.e. Level 1 response) when any of the above trigger levels are met.*

- *Note that areas and their size need to be defined. For reef species, areas could be on the scale of named reefs. For trawl species, areas could be delineated according to bathymetry (via industry consultation).*

<u>*v. Triggers pertaining to CPUE*</u>

- *If CPUE for any species shows a decline over the last three years[2], but without any of the above indicators being triggered, a Level 1 response shall be invoked if the decline is less than or equal to $50\%^{2}$, and a Level 2 response shall be invoked if the decline is greater than $50\%^{2}$.*

Consistency with Harvest Strategy Policy

As at September 2007, the fishery is still considered to be in a developmental/exploratory phase. There is very little information available other than logbook data (which has problems

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[2] Note that these values have been set arbitrarily pending analysis of existing CPUE and spatial data. In the interim, the threshold level for overall CPUE decline (50%) was chosen to be relatively high to acknowledge the high inherent variability in this quantity, while still being able to detect potentially significant declines. The 40% threshold values for spatial changes were chosen with the intent of being theoretically pragmatic: low enough to enable changes to be detected, but high enough to avoid the triggers being reached with unnecessary frequency.

with species mis-identification) and some length-frequency information which has been collected by observers but not analysed. No habitat mapping has been undertaken and as such there is no estimate of the size of the resource or the exploitation rate.

Ideally, and pragmatically (given the low GVP), the fishery should aim to be managed as a Tier 3 fishery; that is, using age and length information to provide estimates of natural and fishing mortality and spawner-biomass-per-recruit, which would form the basis for more informed decision rules. However, this information is not yet available, and the analysis required to obtain it is a cost that would be borne by industry once the fishery is developed to a point that greater justification would be required in order for further expansion to occur.

There is also a case for spatial management to applied to the fishery, similar to that applied to the Great Australian Bight trawl fishery (Moore and Knuckey 2007; Australian Government 2007b), given the large size of the resource, the range of habitats and gears, and the localised nature of fishing, and the possible propensity for vulnerable species to be taken largely from localised areas. Again, this cannot be implemented without a habitat mapping exercise having been undertaken.

Clearly no more sophisticated forms of management are currently able to be applied to the fishery. As such, a harvest strategy incorporating the current spatial closures and management controls, implementing a new data collection protocol, and developing a series of simple triggers to detect changes in the fishery, with increasing levels of assessment response, is proposed.

Given the developmental status of the fishery, and the fact that there is currently demonstrably no overfishing, the harvest strategy triggers should not be over-zealously applied. Having said that, checks should be in place to detect if and when the fishery demonstrates changes, including fishery expansion, contraction, changes in species composition and/or spatial shifts.

The proposed harvest strategy should adequately detect changes in the fishery. However, it is worth emphasizing that although there is much latent effort, and the potential exists for new markets to open up, the fishery is one that is costly to enter: current market prices are low and operating costs are high. Thus there is some indirect economic management. Whether this changes if and when new markets arise remains to be seen. The point remains that any activation of latent effort would not occur in a rapid manner

Annotated description of Triggers and Decision Rules (providing extra explanation and rationale), and additional Harvest Strategy details

1.   Maintain existing spatial closures

These include the existing Lihou closure, and the waters within 4km around an additional four islands that are closed to line fishing: Osprey Reef, two at Holmes Reef and Herald Reef

In addition, the voluntary closures by members of the Association should be included.

The existing closures, marine parks and MOUs with tourism operators are important given the need to demonstrate good environmental custodianship, particularly in the context of trawling.

Whether these existing closures are deemed adequate, or whether additional voluntary closures should be implemented, particularly in deep water habitats (given that the current closures are mainly about reefs), is a matter for further discussion.

It should be noted that a habitat mapping exercise of the fishery is yet to be undertaken. However, industry feel that the trawl sector is currently exploiting only approximately 10-15% of the potential fishable area, and as such, are reluctant at this stage (September 2007) to consider any additional closures. Additionally, sea condition, weather and accessibility are limiting factors restricting the extent of spatial coverage by the fishery. Moreover, industry feels that the high cost of this fishery (low price of product and high operating costs) confers indirect management by economics. There is also the sense that fish movement is so dynamic that imposing "paddock" style closures would be of little value (clearly, though, this a species-specific issue related to migration potential and site fidelity).

The issue of additional voluntary closures should be revisited once habitat mapping has been undertaken.

2.   Maintain existing management arrangements, as follows:

a. Autolongliners:

Autolongliners must fish in waters deeper than 200m. Observers must be used every fourth trip if using Mustad automatic baiting system (or every third trip if using Best Fishing Gear automatic baiting system). With observer coverage, 50% of lines may be set shallower than 200m. Lines set <200m must have an observer on board and coverage on 50% of deployments. An autolongline permit holder that has had 100,000 hook sets observed by an AFMA observer (in the CSF and or other domestic fisheries) and who has met the current longline fishing Threat Abatement Plan requirements may apply to have their observer coverage reduced to one in eight trips with a minimum coverage of at least 10% of hooks set annually,

b. Otter trawl:

Gear restrictions of a minimum mesh size apply. Observers must be used every fourth trip (aim to cover 25% of all shots.)

d. Trap:

Traps must be individually hauled (not looped together) and sacrificial anodes must be used on trap doors sufficient to ensure their opening within one month of the trap being lost. Observers are required on one in four trips, but once an operator has set more than 1000 traps, approval can be sought to reduce this to one in eight trips. Full trap details must be provided with a fishing plan including trap design, and no other method of fishing is permitted on that trip unless the boat is carrying an observer.

It should be noted that traps typically catch smaller fish of a given species than do lines (e.g. rosy jobfish average weight 4-7kg on line, 1.5kg in trap).

It was suggested at the October 2006 stakeholder meeting that a limit should be placed on the number of traps that may be carried per vessel. Some concern was raised about looping and the option for monofilament traps. The latter permits more ghost fishing and may be

eaten by large predators. Steel traps are expensive so operators make a strong effort to retrieve them. Steel traps also have no interactions with large predators. Only individually placed steel traps were assessed as part of the trap trial. Subsequently, management rules were amended in 2007 to limit the number of traps on board at any time to 50, and to allow only metal traps.

The observer requirements must facilitate an adequate collection of length and age data.

3 <u>Establish/refine data collection protocols to obtain age and length information.</u>

Length frequency information is currently being collected as part of the observer program.

For a suite of key species, begin to collect otoliths and/or shark vertebrae to store for ageing purposes if required.. At least 400 otoliths and 1000 length frequency measurements should be obtained for each key species per year, at a minimum of 10% per operator per year.

The suite of key species may be subject to periodic review; however, it should be noted that the value of the data is optimised when collected over a longer time series.

It is important to begin to accumulate a time series of biological information as soon as possible. If a Level 2 trigger is reached, the value of the subsequent analysis will be optimised if there is a history of available data as opposed to a snapshot. Despite difficulties with determining a list of key species in the developmental stage of the fishery, catch records and a risk analysis can be used in the first instance to determine a list of species on which data collection should be focused.

4 <u>Set of triggers resulting in management actions if reached</u>

A set of trigger values should be determined that encapsulate the dynamics of the fishery in such a way that is demonstrably consistent with the intent of the Harvest Strategy Policy.

The triggers are to apply to the catch across all gear types.

Each trigger should have two levels, as follows.

The first, lower level, trigger (Level 1) should be set at a level at which it would be deemed appropriate from a management, economic and/or conservation viewpoint to clarify why observed changes are occurring in the fishery. This clarification should occur via

- *detailed logbook analysis (including spatial and possibly trip-specific information)*

- *Industry consultation in an attempt to determine why the observed change is occurring and whether it is deemed to be significant from an industry viewpoint.*

- *Revised risk analysis*

- *If a reasonable justification for the change in the fishery can be made that does not relate to potential overfishing (e.g. new market for species), then the fishery may continue with no management intervention. However, in the absence of any other explanation, a precautionary management response may be invoked. This may include*

  - *The introduction of spatial closures and/or move-on provisions*

  - *Revision of the second trigger level(s) to lower values.*

The second, higher level (Level 2) is one that is demonstrably precautionary, and at which an assessment should be undertaken on the species (single or multiple) deemed responsible for the trigger being reached. Until the completion of the assessment, the trigger will remain at its current level in each year. Once exceeded, where possible and where knowledge exists, all possible measures must be taken to avoid catching the species responsible in that year. In the absence of knowledge of how to avoid that species, trip limits may be imposed for the remainder of the year. Upon completion of the assessment, the trigger value may be revised in light of the improved information obtained for the species concerned. The assessment may include, but is not limited to

- *Obtaining age information from stored otoliths/shark vertebrae.*

- *Undertaking catch curve analyses using the collected age and size data, to estimate fishing mortality, F, and natural mortality, M. Indicators could be the ratio of fishing to natural mortality (F/M), and/or the spawner biomass per recruit (SBPR) (all empiricallyderived from the catch curve analysis) (e.g. what level of fishing mortality would reduce the stock to 50% SPR?) A time series of total mortality (Z) could also be obtained. Once F/M and/or SBPR have been determined, the trigger can be reconsidered, with a view to possibly setting TACs for some key species.*

- *DeLury depletion curves (CPUE vs time) are an option for biomass estimation of an area, which could be combined with habitat mapping. This is a more sophisticated form of analysis and its validity may be limited given the different CPUEs associated with the different gears (e.g. line vs traps).*

- *Examining CPUE trends and attempting to undertake CPUE standardisations.*

- *Examining spatial and temporal trends in length-frequency and age.*

In terms of revising the trigger levels on the basis on the outcome of an assessment, there is a need to be precautionary if the assessment is based only on recent data and the species of interest has a short life cycle. The assessment may be overly optimistic if the available data encapsulates a "boom" phase for the species.

For developing fisheries with low GVP and no current overfishing concerns, there is a need to strike a balance between allowing for controlled expansion and economic development while still managing the fishery in a precautionary and proactive manner, consistent with the intent of the Harvest Strategy Policy. The two levels of trigger aim to do this by setting the lower trigger level at a value that will detect early changes and result in analysis to identify the reasons behind these without immediately placing limitations on the fishery. The second trigger level acts a limit reference point in the absence of further information. Should the fishery wish to further expand, it will need to invest in more detailed/robust assessments that will provide stronger justification for continued expansion and upward revision of the trigger point.

The agreed option for the setting of trigger points is a general framework that should identify changes in the fishery without having to nominate key species. Triggers are set as changes in species composition, changes in spatial fishing patterns, declines in overall CPUE and at overarching values for total catch. As the fishery develops, a clearer notion of key

species and their sustainability in given areas should be obtained. When this occurs, the harvest strategy can be increasingly augmented by setting species-specific trigger values. Thus the harvest strategy framework can be considered evolutionary in the face of the current developmental state of the fishery.

The range of general triggers

i. Overarching catch triggers

- *Must be less than the total highest catches across the main species caught to date.* If the overarching trigger is set equal to or higher than the this subtotal then it is unlikely to be adequately precautionary.

- *Proposed Level 1 value: 450t (to be revised pending habitat mapping).* At the August 2007 stakeholder meeting, industry were reluctant to set it lower, but a downward revision may follow given the DEW and Harvest Strategy Policy requirements for meaningful triggers.

- *Proposed Level 2 value: 1000t*

The aim of an over-arching catch trigger is twofold: it is a "safety net" if none of the other triggers are activated, and it provides a check on the overall expansion of this multispecies fishery.

ii. Species-specific triggers(high risk/vulnerable AND key species)

- *Whitetip reef shark: Level 1: 2.5t (1/6 historical high catch); Level 2: 5t (1/3 historical high catch). May be revised pending resolution of species identification issues.*

- *Grey reef shark: Level 1: 13t (1/2 historical high catch); Level 2: 26t (historical high catch). May be revised pending resolution of species identification issues.*

- *Note there is currently no-take on white pointer, grey nurse and sawshark*

- *Other vulnerable species, pending risk assessment*

- *Few (4-5) key species to be determined (to mitigate against sudden high catches of single species and be adequately precautionary in the context of the Harvest Strategy Policy).*

It is important to incorporate specific triggers for more vulnerable/high risk species in the context of the Harvest Strategy, as these species have the potential to limit the fishery due to conservation/sustainability issues. Demonstrating good stewardship and a pro-active approach potentially enables greater overall freedom to develop the fishery by avoiding external restrictions imposed as a result of ignoring vulnerable species catch.

Setting triggers for a small number of "key" species (defined in the first instance as those with historically higher catches) is necessary given that the triggers below do not constitute decision rules in an absolute sense, and on their own are difficult to defend against the intent of the Harvest Strategy Policy. As stated above, the list of key species can and should be reviewed and augmented as the fishery develops and a clearer notion of key species and their sustainability is obtained.

Total catch of vulnerable species should include mortality due to discarding when considering this value relative to the trigger value. (Note, however, that if discarding

practices are assumed to be constant over time, the triggers should be appropriate if considered only with respect to retained catch, as their values are based on fractions of historical high catch, which presumably did NOT include discards. However, discarding is likely to increase in proximity to a trigger being reached).

Triggers may ultimately be area-specific. Spatial aspects are worth considering – for example, the impacts of trapping on one reef. If there appears to be localized depletion, then measures such as move-on provisions can be introduced.

<u>*iii. Triggers pertaining to changes in catch composition*</u>

- *If the relative catch proportion of any species changes by >30% from its historical average AND the catch of this species is greater than 1t, invoke a Level 1 response on the relevant species. If this is accompanied by a ≥50%[2] overall decline in CPUE over the last three years[2], invoke a Level 2 response.*

- *If the relative proportion of any species in the catch declines interannually by 10% or greater over 3 consecutive years, invoke a Level 1 response. If this is accompanied by a ≥50%[2] overall decline in CPUE over the last three years[2], invoke a Level 2 response.*

- *Note that the above would not apply to new species in the catch until these were evaluated in their own right (i.e. Level 1 response) when any of the above trigger levels are met.*

This is a more general trigger that is attempting to detect shifts in species composition in the catch. Such shifts may simply reflect a new market for a species, but may also indicate species declines, increasing effort, or shifts in exploitation patterns. While the fishery is in its developing stages and it is difficult to define a suitable list of key species, this trigger is a means by which to examine all species in the fishery simultaneously, with the caveat that it is only invoked if catch of the species is not so low as to be negligible. Even once a suitable list of key species is developed, this indicator still has value as a trigger in its own right, since changes in overall species composition in a multispecies fishery are important to monitor and may not be detected by species-specific triggers alone.

By considering the trigger in conjunction with the CPUE in determining the strength of the management response, we are seeking to mitigate against over-reacting to what may be relatively "benign" changes. While explanations for these changes should be sought, a more costly assessment is not considered to be warranted unless the changes are accompanied by a decline in the catch rate, suggesting that sustainability issues may be the reason for the change.

It was initially proposed that regular monitoring (i.e. two-monthly, as regular aspect of logbook data entry) should occur if these triggers are to be effective and adequately precautionary. However, this is not sensible in that the catch composition is likely to show fluctuations during the year (as an extreme example, if only a few species are caught in the first two months of the year, their relative proportions will be skewed upwards).

See "Worked Examples" section for an evaluation of possible values for the species/catch composition triggers.

<u>*iv. Triggers pertaining to spatial changes*</u>

- *If the following changes occur:*

    - *i) the percentage of areas fished increases by ≥40%[2] (fishery expansion) OR*

    - *ii) the percentage of areas fished decreases by ≥40%[2] (fishery contraction), OR*

    - *iii) if ≥40%[2] of the total catch is taken from a single area (fishery contraction/undue fishing pressure on one area) OR*

    - *iv) if ≥40%[2] of once-exploited areas are no longer fished*

    invoke a Level 1 response to determine why, with the added option of imposing spatial management measures, such a closures or move-on provisions. If any of the above triggers are accompanied by a ≥50%[2] overall decline in CPUE over the last 3 years[2], invoke a Level 2 response.

- *Note that if the above occurs in conjunction with the catch of a new species, the spatial patterns shall be evaluated in the context of the changes in target species (i.e. Level 1 response) when any of the above trigger levels are met.*

- *Note that areas and their size need to be defined. For reef species, areas could be on the scale of named reefs. For trawl species, areas could be delineated according to bathymetry (via industry consultation).*

Similar to the above species composition trigger, these are general triggers that are proposed in the absence of habitat mapping and given the current development state of the fishery and low degree of spatial exploitation. Their aim is to detect spatial changes in fishing behaviour, specifically expansion or contraction. These triggers may have less value once habitat mapping has been undertaken, since some form of spatial management may then be appropriate.

By considering the trigger in conjunction with the CPUE in determining the strength of the management response, we are again seeking to mitigate against over-reacting to what may be relatively "benign" changes. While explanations for these changes should be sought, a more costly assessment is not considered to be warranted unless the changes are accompanied by a decline in the catch rate, suggesting that sustainability issues may be the reason for the change.

See "Worked Examples" section for an evaluation of possible values for the triggers pertaining to spatial change.

v. Triggers pertaining to CPUE

- *If CPUE for any species shows a decline over the last three years[2], but without any of the above indicators being triggered, a Level 1 response shall be invoked if the decline is less than or equal to 50%[2], and a Level 2 response shall be invoked if the decline is greater than 50%[2].*

Triggers set against key species focus on catches exceeding given thresholds. However, it is equally as important to respond to apparent declines in species abundance that may suggest overfishing.

See "Worked Examples" section for an evaluation of possible values for the triggers pertaining to CPUE.

Process for review

The list of "key species" must be subject to periodic review given the temporally dynamic nature of the fishery.

Triggers for additional vulnerable species may have to be included in the harvest strategy pending the outcome of a risk assessment.

The outcomes of habitat mapping will be imperative in informing options for deep water closures.

Reviews should seek to ascertain whether the nature of the fishery is resolving itself in a specific direction (e.g. shark or snapper as the main target species in the line sector?) as this has implications with respect to (for example) conservation issues and longevity of the main target species.

The harvest strategy performance should be evaluated in the context of the distribution of effort across the various gear types. If this becomes strongly biased towards one type of gear (such as traps), trigger values may need to be reconsidered, as different size ranges of the same species are targeted by different gears.

Reviews should focus on how robustly the general triggers pertaining to i) changes in species composition of the catch, ii) spatial changes and iii) changes in CPUE are performing. These should be triggered appropriately and avoid being hyper-sensitive. An immediate post-implemenation priority will be to finalise analyses of CPUE and spatial data to provide more informed values for the triggers related to CPUE declines and spatial changes, respectively,

Reviews should also consider the value of setting area-specific triggers. Spatial aspects are worth considering – for example, the impacts of trapping on one reef. If there appears to be localized depletion, then measures such as move-on provisions can be introduced.

Worked examples

Triggers pertaining to changes in catch composition

The financial year species-specific catch data from 1999 to 2007 were used as a basis for worked examples to consider values for the following species composition triggers.

- *If the relative catch proportion of any species changes by >x% from its historical average/maximum AND the catch of this species is greater than a nominal level (e.g. 60t), invoke a Level 1 response on the relevant species.*

To test possible values for this trigger, the relative proportion of each of the 172 recorded species in the catch was averaged over the eight years. Years where no catch of that species was taken were excluded. The proportion in each year was then compared to this average. If the difference was greater than some threshold (x%) AND the catch by weight was greater than 1t (60t of annual take has only ever been exceeded for alfonsino and rosy snapper), then the trigger was recorded as being reached.

The following table gives the frequency (number of years – maximum eight) in which the trigger was reached for what number of species, for a range of difference thresholds (30%, 50%, 100%, 120%, 150%) and a 1t or a 5t minimum catch threshold:

	difference threshold									
1t limit	30%		50%		100%		120%		150%	
	# years	# species	# years	# species	# years	# species	# years	# species	# years	# species
	0	136	0	139	0	153	0	158	0	161
	1	21	1	25	1	27	1	23	1	21
	2	12	2	10	2	3	2	3	2	2
	3	9	3	5	3	1	3	0	3	0
	4	2	4	5	4	0	4	0	4	0
	5	3	5	0	5	0	5	0	5	0
	6	1	6	0	6	0	6	0	6	0
	7	0	7	0	7	0	7	0	7	0
	8	0	8	0	8	0	8	0	8	0
	More	0	More	0	More	0	More	0	More	0
5t limit	30%		50%		100%		120%		150%	
	# years	# species	# years	# species	# years	# species	# years	# species	# years	# species
	0	165	0	165	0	171	0	173	0	174
	1	8	1	9	1	10	1	9	1	8
	2	5	2	6	2	3	2	2	2	2
	3	5	3	4	3	0	3	0	3	0
	4	0	4	0	4	0	4	0	4	0
	5	1	5	0	5	0	5	0	5	0
	6	0	6	0	6	0	6	0	6	0
	7	0	7	0	7	0	7	0	7	0
	8	0	8	0	8	0	8	0	8	0
	More	0	More	0	More	0	More	0	More	0

When the difference threshold was set at 30% of the average, across of a total of 172 species the trigger was reached once in the eight years for 21 species, twice for 12 species, three times for nine species, four times for two species, five times for three species and six times for one species. These are shown below, together with their average annual catch and its rank relative to the catches of other species (NB no "green" species and only one "yellow" species [the "main concern" and "moderate concern" species as nominated by David Williams] were NOT included in the species for which the trigger was reached using these specifications).

SPECIES FOR WHICH THE 30%, >1t TRIGGER WAS REACHED IN EIGHT YEARS:

SPECIES	AVG CATCH	RANK OF CATCH	# YEARS TRIGGER REACHED
Amberjack	861.71	48	1
Bigeyes (mixed)	466.00	64	1
Bluespotted Emperor	372.80	53	1
Bronze Whaler	971.00	46	1
Comet Grouper	649.40	51	1
Grass Emperor	1814.50	30	1
Green Jobfish	1016.00	41	1
Highfin Grouper	818.67	47	1
Long Tail Rubies/Snapper	1176.50	40	1
Painted Sweetlip	708.00	52	1
Pelagic morid and eucla cods	1231.14	34	1
Purple Rockcod	1529.67	39	1
Red Bass	1271.50	38	1
Robinson's Seabream	617.00	56	1
Saddletail Snapper	1336.83	11	1
Sandbar Shark	1380.00	43	1
Sea Bream Snapper	491.71	49	1
Sea Perch	456.60	57	1
Snapper	414.50	33	1
Spotcheek Emperor	1558.33	36	1
Trevallies	428.25	65	1
Blacktip shark (mixed)	4441.29	18	2
Blue-eye Trevalla	1704.86	26	2
Commercial scallop	1807.50	8	2
Coral trout (mixed)	1565.71	20	2
Fish (mixed)	1118.38	31	2
Flame Snapper	6006.80	12	2
Hapuku	1391.25	37	2
Mozambique Seabream	1089.14	42	2
Paddletail Seabream	8994.75	5	2
Red spot king prawns	1623.33	17	2
Redthroat Emperor	6463.86	10	2
Tropical snappers unspecified	759.25	50	2
Alfonsino	41392.40	1	3
Amberfish	3744.25	7	3
Goldband snappers	2073.63	23	3
Grey Reef Shark	1674.25	21	3
Rockcod (mixed)	1139.57	44	3
Ruby Snapper	8319.63	4	3
Scalloped Hammerhead	3046.80	22	3
Tiger Shark	7614.00	6	3
Whitetip Reef Shark	2614.50	25	3
Gemfish	6502.67	9	4
Rusty Jobfish	2429.63	19	4
Bar Rockcod	5095.14	13	5
Red Emperor	8233.63	3	5
Sharks (mixed)	2267.00	14	5
Rosy Snapper	26525.88	2	6

When the difference threshold was set at 30%, BUT with no restriction on the amount of catch for the trigger to be reached, across of a total of 174 species the trigger was reached more than twice for 66 species, and more than five times for 27 species. This illustrates the importance of setting a sensible minimum catch threshold

- *If the relative proportion of any species in the catch declines by y% or greater over z consecutive years, invoke a Level 1 response.*

Over the 8 years, 31 of the 172 species showed continuous declines in the value of their relative proportion of the catch compositions, over at least three consecutive years (note that there was no minimum catch threshold imposed in these calculations). Within these series of declines, the minimum percent interannual decrease was 0.37% (see table below), but the average interannual decline was 61%. Thus, suitable trigger values could be interannual declines of 10% or greater in the relative proportion of any species in the catch, over three consecutive years.

INTERANNUAL PERCENTAGE DECLINE IN RELATIVE PROPORTION OF CATCH, RELATIVE TO THE PREVIOUS YEAR

Species	1999/2000	2000/2001	2001/2002	2002/2003	2003/2004	2004/2005	2005/2006	2006/2007
Alfonsino				40.98632	47.31127	99.83084		
Amberjack						65.07233	6.00359	79.01027
Bar Rockcod							70.74546	79.5151
Blue-eye Trevalla		93.71711		21.34805	99.32308		98.13429	
Bluestriped Snapper							57.77304	53.9871
Comet Grouper							75.55262	49.28046
Coral trout (mixed)			96.25017		0.405947	75.82914	56.75045	
Fish (mixed)		95.18499		67.90472			48.26113	22.32713
Flame Snapper							53.86757	80.89048
Gemfish				84.81889		95.68589	92.98059	
Goldband snappers		78.07736	29.53458			89.15702	58.32342	81.04958
Grass Emperor							22.56491	7.333357
Greeneye dogfish		88.93933				97.61543	87.76921	
Highfin Grouper							77.26548	19.12682
Hussar					75.25014	90.33943		
Leatherjackets				80.5121	2.428439			
Mozambique Seabream			70.7839				79.60629	5.321763
Pearl Perch					29.07168	84.02196		
Pelagic morid and eucla cods			42.58593	2.560499	38.63262		74.13015	
Red Emperor		89.61881	84.86199	29.82036				73.52731
Redthroat Emperor			15.99894				73.52017	0.370971
Robinson's Seabream				96.53633		97.63415	53.52301	
Rosy Snapper			70.15808			31.20979	54.29294	54.20595
Ruby Snapper					56.93253	18.27512	53.59888	88.94723
Rusty Jobfish		85.53636			15.49582	36.20454	59.65666	84.75879
Samson Fish					58.34689		90.20231	40.41987
Sharks (mixed)		68.36418		80.28115	84.96939	84.24836		98.60042
Tang's Snapper							77.7305	1.85092
Tiger Shark							11.6882	46.73616
Trevallies			59.67208	75.50013				75.94362
Yellowedge Coronation Trout						84.34929	14.08618	

Background to HS development: October 2006 stakeholder meeting outcome

Summarised below is the approach that was agreed upon in October 2006: that of setting triggers for a suite of key species. On paper, it appeared that it is possible to identify key species in the first instance as being those for which catches have been historically consistently high, and for which there may potentially be sustainability concerns.

At the August 2007 stakeholder meeting, there was considerable resistance towards both nominating a list of key species and assigning meaningful trigger values against these. The rationale was that i) the current lack of habitat mapping combined with the low level of exploitation to date mean that there is no notion of the size of the resource, nor of the exploitation rate – while trigger values can be set as proactive checkpoints, their values are somewhat arbitrary in this context; ii) to date, there has been high inter-annual variability in the catch levels of even the higher-catch species, such that setting meaningful trigger values is difficult; and iii) there is a history of species mis-identification in the logbooks, which compromises the value of the catch data.

As a result of the impasse caused by this resistance, a suite of more general triggers was proposed (where triggers are set as changes in species composition, changes in spatial fishing patterns, declines in overall CPUE and at overarching values for total catch). This is a more general framework that should identify changes in the fishery without having to nominate key species. As the fishery develops, a clearer notion of key species and their sustainability in given areas should be obtained. When this occurs, this harvest strategy could be increasingly augmented by setting species-specific trigger values. Thus this harvest strategy framework can be considered evolutionary in the face of the current developmental state of the fishery.

The October 2006 harvest strategy framework was as follows:

The harvest strategy should apply across all gear types, as follows:

- Review available data, identify key species
    - o The following table lists the information available for each sector. The available information should be analysed to define key species for each fishing method.

Information	Line (shark, scalefish)	Trap	Trawl
Catch and effort: over 20 days minimum; inconsistent over time	Per day, latitude, longitude	Per trap lift, latitude, longitude	Per shot
Observer data: species composition, length frequency, otoliths, wildlife interactions	No requirement except on autolongliners	First trip then 1 in 4; 1 in 8 after 1000 trap sets	First trip then 1 in 4

- Undertake risk assessment

- Set initial catch triggers for key species (irrespective of fishing method) that are demonstrably precautionary

- Monitor fishery CPUE/length (refine existing approach)

- If triggered, implement increased monitoring – eg age 'snapshots'

- Enables assessment at Tier 3 level

- Cease targeted fishing if a trigger is reached in any one year

   o Note trigger remains at this level until an assessment is completed

- Key species to be determined via

   o time series of logbook catch compositions (Table 1, Figure 6)

   o identification of high-risk species (including sharks)

- Triggers may be area-specific. Spatial aspects are worth considering – e.g. impacts of trapping on one reef. If there appears to be localized depletion, then introduction provisions such as a move-on provision.

- Monitor fishery CPUE/length (refine existing approach): improved monitoring program can provide information necessary to assess stock status (including "snapshot" assessments) in the context of the triggers

   o Additional data collection (e.g. length-frequency, otolith sampling) should be initiated (port-based?).

   o at least 400 otoliths and 1000 length frequency measurements should be obtained over a year

   o If a precautionary trigger is reached before the age/length data has been collected and the desktop study completed

      ▪ Immediate funds would have to be obtained in order to achieve a "desktop snapshot" of stock status (in the absence of any knowledge of fishing mortality).

      ▪ Indeed, this "desktop snapshot" analysis should occur as an initial assessment, and then be ongoing as more data is collected.

   o A project should be established to obtain length and age information within a year.

   o The assessment process was mapped out as follows:

      1. Analysis of data: to identify species against which to set precautionary triggers

      2. Develop a 12-14 month project to obtain information for a "snapshot" analysis and development of Tier 3 indicators for key species. This project would conduct catch curves, and obtain F/M, SPR indicators, with a view to implementing revised triggers.

- o Collection of biological information to be properly designed such that samples are obtained throughout the year.

- Assess data and apply Tier 3/4 and/or spawner-biomass-per-recruit (SBPR) approaches

  - o Analyse CPUE trends

  - o By collecting additional data, fishery can move to a Tier 3 fishery (i.e. age data used as an indicator):

    - Tier 3-level information allows fishing and natural mortality, and spawner-biomass-per-recruit to be estimated. As such it allows for larger changes depending on the estimate of fishing mortality.

    - Age/size data would enable catch curve analyses to be undertaken:

      - o natural and fishing mortality (M and F) could be estimated

      - o indicators could be the ratio of fishing to natural mortality (F/M), and/or the spawner biomass per recruit (SBPR) (e.g. what level of fishing mortality would reduce the stock to 50% SPR?)

      - o time series of total mortality (Z) could be obtained

      - o calculations done as a desktop exercise when data collected

- Modify triggers as appropriate

  - o Once F/M and/or SBPR have been determined, the trigger can be reconsidered, with a view to possibly setting TACs for some key species