Is what is there what you catch?
Baited Remote Underwater Video in the southern Great Barrier Reef
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Baited Remote Underwater Video in the southern Great Barrier Reef

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Published July 2007

Cover photographs:  (Top) CapReef Baited Remote Underwater Video unit about to be deployed (Bottom) Goldspotted Rockcod getting up close and personal with the BRUV camera.

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Acknowledgements

The contribution of the following are acknowledged in relation to this project.

Thanks go to the Fitzroy Basin Association and the Natural Heritage Trust for providing funding to CapReef. This allowed the CapReef team to establish a Baited Remote Underwater Video (BRUV) unit.

Thanks to the Great Barrier Reef Marine Park Authority for their support of CapReef and for providing the permit required to use the BRUV in the Marine Park, including Marine National Park Protection Zones (no fishing zones).

Thanks to the Department of Defence for providing access to the Shoalwater Bay Training Area and to Kim Martin for his work in liaising with the Department. Without the support of the Department of Defence the collection of this data in Shoalwater Bay would not have been possible.
About CapReef

CapReef is a community based monitoring program that has been established following a series of changes to management of the Great Barrier Reef (GBR).

The purpose of CapReef is to improve community involvement and knowledge in management of the Capricorn part of the Great Barrier Reef ecosystem by monitoring and analysis of local effects of management changes on the GBR ecosystem.

In recent years the most significant changes in history have been made to management arrangements of the GBR. Major changes resulted from:

- Fisheries (East Coast Trawl) Management Plan 1999
- Great Barrier Reef Marine Park Zoning Plan 2003
- Great Barrier Reef Coast Marine Park 2004
- Fisheries (Coral Reef Fin Fish) Management Plan 2003/04

As part of the consultation processes for the zoning changes in 2004 enforcement and monitoring emerged as significant community concerns. In response Capricorn Sunfish, GBRMPA Local Marine Advisory Committee and other interested groups developed the concept of a community based monitoring approach. CapReef has received initial funding from the Fitzroy Basin Association for 2005/06 and 2006/07.

A number of projects were established under CapReef to collect data on the effects of the management changes, particularly on fish and fishers. However, CapReef is an umbrella for data being collected in the Capricorn part of the GBR and is working with a number of research projects also collecting data.

Projects to date have focused on:

- Coordinating CapReef and providing feedback to the community
- Measuring changes in catch and effort, relative abundance and size structure of key fish species
- Determining changes in fisher participation and fishing patterns resulting from the new Management Plans.
- Obtaining information on the movement of key fish species from extended marine national park and conservation zones in the new Management Plans

CapReef has also provided support for Coral Trout monitoring around the Keppel Islands by James Cook University, collection and identification of larval reef fish by the Central Queensland University and water quality sampling at Rosslyn Bay by the Australian Institute of Marine Science.

As part of its program to provide feedback to the community a series of technical reports will be provided dealing with various aspect of the data being collected. This report is another in that series.
Fish names cause considerable confusion as there are many names that can be applied to the same fish species, even in the same region. The Australian Fish Names Committee has developed a list of standard names (Yearsley et al. 2006). A copy of the Australian Fish Names List is available from www.fishnames.com.au. CapReef uses the Standard Name for fish species in all reports.

<table>
<thead>
<tr>
<th>Standard Name</th>
<th>Local Names</th>
<th>Scientific Name</th>
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<tbody>
<tr>
<td>Barcheek Coral Trout</td>
<td>Coral Trout, Island Trout</td>
<td><em>Plectropomous maculatus</em></td>
</tr>
<tr>
<td>Common Coral Trout</td>
<td>Coral Trout</td>
<td><em>Plectropomous leopardus</em></td>
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<td></td>
<td><strong>The identification of these two species is often confused by those inexperienced with the species</strong></td>
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<tr>
<td>Goldspotted Rockcod</td>
<td>Cod, Estuary Cod, Goldspot Cod</td>
<td><em>Epinephelus coioides</em></td>
</tr>
<tr>
<td>Blackspotted Rockcod</td>
<td>Cod, Estuary Cod, Blackspot Cod</td>
<td><em>Epinephelus malabaricus</em></td>
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<tr>
<td></td>
<td></td>
<td><strong>These two species are collectively referred to as Estuary Cod however their identification should not be confused</strong></td>
</tr>
<tr>
<td>Longfin Rockcod</td>
<td>Matty Cod, Wirenetting Cod</td>
<td><em>Epinephelus quoyanus</em></td>
</tr>
<tr>
<td>Saddletail Snapper</td>
<td>Largemouth Nannygai, Red Jew</td>
<td><em>Lutjanus malabaricus</em></td>
</tr>
<tr>
<td>Crimson Snapper</td>
<td>Smallmouth Nannygai, Red Jew</td>
<td><em>Lutjanus erythroboterus</em></td>
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<td></td>
<td></td>
<td><strong>These two tropical Snapper species are collectively referred to as Red Jew and there is often confusion in their correct identification</strong></td>
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<tr>
<td>Red Emperor</td>
<td>Red Emperor</td>
<td><em>Lutjanus sebae</em></td>
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<tr>
<td>Stripey Snapper</td>
<td>Stripey</td>
<td><em>Lutjanus carponatus</em></td>
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<td>Hussar</td>
<td>Hussar</td>
<td><em>Lutjanus adetii</em></td>
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<td>Brownstripe Snapper</td>
<td>Hussar</td>
<td><em>Lutjanus vitta</em></td>
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<td><strong>These two species are collectively referred to as Hussar even though there is little confusion with their identity</strong></td>
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<td>Venus Tuskfish</td>
<td>Parrotfish</td>
<td><em>Choerodon venustu</em></td>
</tr>
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<td>Snapper</td>
<td>Snapper, Pinkie</td>
<td><em>Pagrus auratus</em></td>
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<tr>
<td>Redthroat Emperor</td>
<td>Redthroat, Sweetlip, Lipper</td>
<td><em>Lethrinus miniatus</em></td>
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<td>Grass Emperor</td>
<td>Grassy, Grass Sweetlip</td>
<td><em>Lethrinus fletus</em></td>
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<td>Spangled Emperor</td>
<td>Yellow Emperor, Yellow Lipper</td>
<td><em>Lethrinus nebulosus</em></td>
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<td>Collar Seabream</td>
<td>Iodine Bream, Baldy Bream</td>
<td><em>Gymnocranius audleyi</em></td>
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<td>Rainbow Monocle Bream</td>
<td>Bananafish, Whiptail</td>
<td><em>Scolopsis mongramma</em></td>
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<td>Paradise Threadfin Bream</td>
<td>Whiptail</td>
<td><em>Pentapodus paradiseus</em></td>
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<td>Painted Sweetlips</td>
<td>Blackall, Moke, Morwong</td>
<td><em>Diagramma pictum</em></td>
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<td>Scribbled Rabbitfish</td>
<td>Happy Moment, Spinefoot</td>
<td><em>Siganus spinus</em></td>
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<td>Starry Triggerfish</td>
<td>Triggerfish</td>
<td><em>Abalistes stellaris</em></td>
</tr>
<tr>
<td>Moon Wrasse</td>
<td>Moon Wrasse, Wrasse</td>
<td><em>Thalassoma lunare</em></td>
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</tbody>
</table>

Table 1: Names used in this report for key fish species
Summary

A common perception is that fish are becoming scarce and the catches of the past are no longer possible. CapReef seeks to examine recreational catches to distinguish if catch rates are in fact decreasing.

However catch rates alone do not necessarily indicate if fish are becoming less prevalent. It may be for instance that fish are still present but are less susceptible to being caught. To examine this issue it was considered desirable to use a fishery independent method to observe fish present as a comparison with catch measures.

Baited Remote Underwater Video (BRUV) is a technique that uses video technology to observe fish that approach baits attached to a frame on which an underwater video camera is mounted. This simulates bait fishing.

It has several advantages in that it offers a safe technique that can be used to observe over a long period of time in a range of depths beyond the usual capacity of divers. It also is somewhat comparable with line fishing in that it uses similar baits and can be deployed at most sites that are bait fished.

This report examines three questions:

- Is there evidence that fish are present despite low catch rates? That is, is there evidence that some species may become less catchable in fished locations or are fish actually not present?
- Do fish use different feeding strategies which affect their catchability?
- Are there differences in the willingness of fish to feed in no fishing areas (green zones) compared to fished areas?

A permit was obtained from the Great Barrier Reef Marine Park Authority (GBRMPA) to use the BRUV within the Marine Park. The BRUV was deployed in the most popular fishing locations within the Capricorn Bunker Group, around the Keppel Islands and in Shoalwater Bay. It was also used in no fishing (green) zones around Egg Rock and adjacent to Halfway Island.

In a total of 56 sets in the Capricorn Bunker Group the video recordings showed 835 fish from over 40 species. A total of 35 species were recorded in more than 1 set and 14 species in greater than 10 sets.

In the same number of sets in the Keppels, 1060 fish from 56 species were observed, however the fish were less dominated by one or two species. Scribbled Rabbitfish and Hussar were the most numerous species (8.2 and 7% of fish respectively), however Red Emperor and Coral Trout were observed in the most sets (69.6 and 55.4% of sets respectively), 45 species occurred in more than 1 set and 17 in more than 10 sets.

No evidence of an imminent collapse of bottom fish stocks was observed, rather the most commonly caught species were regularly observed by the BRUV.

The percentage occurrence of fish species in BRUV sets provides a useful comparison with their occurrence in fishing trips. If fish are more common in the BRUV observations, it suggests that the species may be present more often than the catch rates indicate.
In the Capricorn Bunker Group Venus Tuskfish, Coral Trout, Collar Seabream, Longfin Rockcod and Starry Triggerfish were more common in the BRUV observations while Redthroat Emperor, Red Emperor, Stripey Snapper and Grass Emperor were more common in the catch.

In the Keppels, all of the most commonly caught species were more common in the BRUV observations, however the proportion of trips where fish fed in video observations provided a different comparison. Amongst feeding fish Red Emperor, Hussar, Saddletail Snapper, Goldspotted Rockcod, Crimson Snapper, Scribbled Rabbitfish and Starry Triggerfish were more common in the BRUV observations but Longfin Rockcod, Coral Trout and Stripey Snapper were less common. Probably the best interpretation of this is that fish were present more often than catch rates indicate at this location, but some are more likely to be caught because of their willingness to feed on baits.

The fact that most fish caught by anglers are observed in BRUV sets more commonly probably indicates that species may be present more often than catch rates indicate.

The percentage of fish that fed on BRUV baits should indicate the willingness of fish to take baits. The comparison between no fishing (green) zones and fishing zones (open) showed that a larger proportion of all species observed fed in the green zones than in the open zones. However the difference for Red Emperor, Coral Trout and Longfin Rockcod was small.

For combined species 65% of fish in the green zones were observed to feed while in the open zones only 32% fed. This indicates that fish in open zones are less susceptible to capture. This could be the result of increased wariness in fish in heavily fished locations.

Group 1 feeders, which are fish that tear pieces off the bait, include Venus Tuskfish and Collar Seabream and a number of other mostly small mouthed species including Angelfish, approached baits readily, often initiated feeding and fed by tearing pieces off the bait.

Group 2 feeders, which are fish that grab the bait whole, were typically large mouthed and usually did not feed until feeding was initiated by other species. They then fed by rushing at the bait and grabbing it whole, often entirely in the mouth. This group included the species that dominate the retained catch including Emperors, Coral Trout, Rockcods and Snappers.

Feeding strategies used by fish help explain why some species were captured more frequently. Eight of the top ten species in the video observations were from group 1 feeders while five of the top ten caught species were group 2 feeders.

BRUV also provides an opportunity to observe fish behavior and response. The video scenes showed three examples of fish with fish hooks still visible in their mouths. This both shows that fish are able to survive successfully with hooks in their mouths as well as indicating that BRUV may have important applications in assessing released fish survival.

It is often the perception of fishers that if fish have not responded to baits within 10-15 minutes they are unlikely to do so or there are no fish there. Several examples occurred on the BRUV images where no feeding occurred for up to 30 minutes despite the presence of targeted species and the obvious interest of a number of fish in the baits.
Is what is there what you catch?
Baited Remote Underwater Video in the southern Great Barrier Reef

1. Introduction

A common perception is that fish are becoming scarce and the catches of the past are no longer possible. CapReef seeks to examine recreational catches to distinguish if catch rates are in fact decreasing. However catch rates alone do not necessarily indicate if fish are becoming less prevalent. It may be for instance that fish are still present but are less susceptible to being caught. To examine this issue it was considered desirable to use a fishery independent method to observe fish present as a comparison with catch measures.

Baited Remote Underwater Video (BRUV) is a technique that uses video technology to observe fish that approach baits attached to a frame on which an underwater video camera is mounted. This simulates bait fishing.

The Australian Institute of Marine Sciences (AIMS) has used the technique to observe the fish species present throughout a number of underwater habitats in Australian Waters (Cappo et al 2001 at www.aims.gov.au). CapReef used a method modified from the AIMS technique to allow the equipment to be deployed from small boats using a single operator and to allow real time observation of the fish feeding on baits.

It has several advantages in that it offers a safe technique that can be used to observe over a long period of time in a range of depths including depths beyond the usual capacity of divers. It also is somewhat comparable with line fishing in that it uses similar baits and can be deployed at most sites that are bait fished.

Because fish are free to feed on the baits used and are not influenced by the presence of divers, behaviors used by fish in feeding on baits are natural and are visible. The BRUV can also be used in depths beyond the usual capacity of divers extending the value of the technique.

BRUV also provides an opportunity to examine fish in different management zones including Marine National Park Protection Zones (no fishing or green zones) without adverse impacts. This allows comparison of fish feeding between areas open and closed to fishing. This may indicate if fish are more willing to feed on baits in locations where fishing is banned.

This report examines three questions:

- Is there evidence that fish are present despite low catch rates? That is, is there evidence that some species may become less catchable in fished locations or are fish actually not present?
- Do fish use different feeding strategies which affect their catchability?
- Are there differences in the willingness of fish to feed in no fishing areas (green zones) compared to fished areas?
2. Methods

Images of fish feeding on baits were captured using a colour CCTV camera (with a resolution of 500 TV lines producing a PAL signal) in a waterproof casing (Deep Blue model by Splash Cam Inc). The camera was mounted on custom built frame with an arm that allowed bait to be attached with the camera directed at the bait. Initially a home made frame was used to test for the best frame design. This was later improved with a custom built stainless steel frame (Figure 1).

Baits of squid and fish of types used by fishers were attached to the bait arm, in the field of view of the camera, using stainless steel clips or lengths of nylon fishing line. Fish could feed freely on the baits. In all cases each set of the equipment continued until the bait had been removed. The equipment was deployed in each location until a full video tape was recorded (approximately one hour).

A permit was obtained from the Great Barrier Reef Marine Park Authority (GBRMPA) to use the BRUV within the Marine Park. The BRUV apparatus was deployed in the most popular fishing locations within the Capricorn Bunker Group, around the Keppel Islands and in Shoalwater Bay (Figure 3). It was also used in green zones around Egg Rock and adjacent to Halfway Island. Observations were made in Shoalwater Bay in the Shoalwater Bay Training Area. This area is open to fishing but its isolated location, access difficulties and closure during military exercises ensures it is subject to little fishing pressure.

Signals from the camera were transferred to the surface through a cable containing power and video signal wires and recorded on a digital video camera/recorder (Figure 2).

![Figure 1: CapReef BRUV unit including frame, camera and bait arm](image-url)
Figure 2: Digital camera and viewing screen used to collect BRUV images and monitor deployment

Figure 3: Locations where BRUV has been deployed
Recorded digital video images were later viewed on a television monitor. Two variables were determined for each deployment (set):

- Abundance and types of fish observed to feed on the bait; and
- Abundance and types of fish apparently attracted to the feeding event but not feeding.

The number of sets where each species was observed was also recorded.

The feeding strategies of fish at the baits were also observed. The numbers of fish of each species observed to use either of two classes of strategy were recorded:

- Those tearing pieces off the baits (group 1); and
- Those grasping the whole bait usually after rushing at the bait (group 2).

Other less common interactions such as fish snatching bait from others were also recorded individually.
2 Results

In a total of 56 sets in the Capricorn Bunker Group the video recordings showed 835 fish from over 40 species. A total of 35 species were recorded in more than 1 set and 14 species in greater than 10 sets (Figures 4 and 5). The most frequently observed fish species were Collar Seabream (186 fish, 22% of the total, observed in 86% of sets) and Venus Tuskfish (110 fish, 13% of the total in 84% of sets). These two species also initiated feeding on the most occasions (30 and 21 sets, respectively).

In the same number of sets in the Keppels, 1060 fish from 56 species were observed, however the fish were less dominated by one or two species. Scribbled Rabbitfish and Hussar were the most numerous species (8.2 and 7% of fish respectively) (Figure 7), however Red Emperor and Coral Trout were observed in the most sets (69.6 and 55.4% of sets respectively) (Figure 6), 45 species occurred in more than 1 set and 17 in more than 10 sets.

Figure 4: Species recorded in BRUV sets in the Capricorn Bunker Group

Figure 5: Percentages of species observed in BRUV sets in Capricorn Bunker Group
Figure 6: Species recorded in BRUV sets in the Keppels

Figure 7: Percentages of species observed in BRUV sets in the Keppels
Comparison with Line Fishing Catch

The percentage occurrence of fish species in BRUV sets provides a useful comparison with the occurrence in fishing trips. If fish are more common in the BRUV observations, it suggests that the species may be present more often than the catch rates indicate. Figures 8 and 9 show some fish more common in the catch, some with similar representation in the catch and BRUV images and others less common in the catch.

In the Capricorn Bunker Group Venus Tuskfish, Coral Trout, Collar Seabream, Longfin Rockcod and Starry Triggerfish were more common in the BRUV observations while Redthroat Emperor, Red Emperor, Stripey Snapper and Grass Emperor were more common in the catch.

Figure 8: Comparison of BRUV with catches in the Capricorn Bunker Group

Figure 9: Comparison of BRUV with catches in the Keppels
In the Keppels, all of the most commonly caught species were more common in the BRUV observations, however the proportion of trips where fish fed in video observations provided a different comparison. Amongst feeding fish, Red Emperor, Hussar, Saddletail Snapper, Goldspotted Rockcod, Crimson Snapper, Black Rabbitfish and Starry Triggerfish were more common in the BRUV observations but Longfin Rockcod, Coral Trout and Stripey Snapper were less common. Probably the best interpretation of this is that fish were present more often than catch rates indicate at this location, but some species such as Longfin Rockcod, Coral Trout and Stripey Snapper are more likely to be caught because of their willingness to feed.

**Comparison between No Fishing Zones and Fishing Zones**

The percentage of fish that fed on BRUV baits should indicate the willingness of fish to take baits. The comparison between no fishing (green) zones and fishing zones (open) showed that a larger proportion of all species observed fed in the green zones than in the open zones (Figure 10). However the difference for Red Emperor, Coral Trout and Longfin Rockcod was small.

Figure 10: Percentage of species observed feeding on BRUV baits in no fishing and fishing zones

Figure 11: Percentage of all fish observed feeding on BRUV baits in no fishing and fishing zones
For combined species 65% of fish in the green zones were observed to feed while in the open zones only 32% fed (Figure 11). This indicates that fish in open zones are less susceptible to capture. This could be the result of increased wariness of fish in heavily fished locations.

**Feeding Styles and Behaviors**

Group 1 feeders including Venus Tuskfish and Collar Seabream, and a number of other mostly small mouthed species including Angelfish, approached baits readily, often initiated feeding and fed by tearing pieces off the bait (Figure 12).

Group 2 fish were typically large mouthed and usually did not feed until feeding was initiated by other species. They then fed by rushing at the bait and grabbing it whole, often entirely in the mouth. This group included the species that dominate the retained catch including Emperors, Coral Trout, Rockcods and Snappers (Figure 13).

On a number of occasions fish from this group were observed to follow other fish holding larger pieces of bait in their mouths and snatch it from them.

Feeding strategies used by fish help explain why some species were captured more frequently. Eight of the top ten species in the video observations were from group 1 feeders while five of the top ten caught species were group 2 feeders.
4. Discussion

The BRUV technique has proven to be a useful technique to observe fish species present on the fishing grounds. Most of the species regularly caught were observed in the BRUV sets. Because the apparatus was deployed on the bottom it didn’t detect several pelagic species caught (eg Spanish Mackerel) however School Mackerel, Cobia and Shark Mackerel were observed. It is proposed to extend the BRUV analysis to monitor pelagic species in the next phase.

No evidence of an imminent collapse of bottom fish stocks was observed, rather the most commonly caught species were regularly observed by the BRUV.

The method revealed that several species that are seldom (if ever) caught, regularly feed on baits. Several species of Angelfish (for instance) were regularly recorded in both the Keppels and the Capricorn Bunkers, yet only one was recorded in the catch. A number of Sea Snakes and Moray Eels were also observed to feed but these were not taken in the catch. The influence of fishing on these species (eg how much they benefit from baits) is unknown and worthy of further investigation. Several of these species are small or have small mouths, so that the large hooks characteristic of the reef fishery may preclude their capture. Species such as Angelfish are likely to be seldom taken. A controlled study of the effectiveness of line fishing gear on different species may be warranted.
Other species, notably Redthroat Emperor and Grass Emperor, were less common in the BRUV observations and it may be that the method is not very effective in observing them. However it may also be that they are particularly susceptible to line fishing. This needs further clarification.

The fact that most fish commonly caught by anglers are observed in BRUV sets more commonly than they are found in fishing catches probably indicates that species may be present more often than fishing catch rate indicates. It is also notable that a proportion of the fish observed by the BRUV did not feed on the baits and that the proportion of fish feeding on baits in green zones is greater than in open areas. This may indicate that at least a proportion of fish are learning to avoid or be wary of fishing baits. It is proposed to further investigate this issue.

The results also indicate that Group 2 feeders (those that tend to grab whole baits in a rush response) may be at greater risk of being captured on large hooks than those that tear smaller pieces off the bait. Certainly Group 2 species form a higher proportion of the catch species. Conversely the behavior of species such as small Red Emperor, Starry Triggerfish, Venus Tuskfish and Collar Seabream in tearing and eating pieces of bait rather than swallowing baits whole may reduce their susceptibility to capture (and hence be under represented in the catch compared to video observations).

Figure 14: Barcheek Coral Trout with a hook embedded in its jaw
BRUV also provides an opportunity to observe fish behavior and response. The video scenes showed three examples of fish with fish hooks still visible in their mouths (Figure 14). This both shows that fish are able to survive successfully with hooks in their mouths as well as indicating that BRUV may have important applications in assessing released fish survival. A number of fish from three species (Red Emperor, Saddletail and Crimson Snapper) were observed with fish tags visible (Figure 15). It may be that fish tagging in combination with BRUV could provide an important contribution for several fishery related issues.

![Figure 15: Tagged Saddletail Snapper in Shoalwater Bay recorded on BRUV images](image)

It is often the perception of fishers that if fish have not responded to baits within 10-15 minutes they are unlikely to do so or there are no fish there. Several examples occurred on the BRUV images where no feeding occurred for up to 30 minutes despite the presence of targeted species and the obvious interest of a number of fish in the baits. Often once one fish commenced feeding several others would follow.

The BRUV also indicated several behavioral responses that may not have been captured by other methods. Some examples include:

Several Rockcod and Coral Trout were observed to snatch bait pieces from the mouths of other fish. This often happened after the fish had been watching the bait for some time. Several large Goldspotted Rockcod were also noted to chase others from baits, this occurred even though they had not fed. Cobia and Trevally were observed following large Rays and Shovelnose Rays apparently as a feeding strategy (Figure 15).
Given the huge positive response to the BRUV videos, it is planned that the project will continue and be extended to sample from a range of additional locations and to further examine differences in fish response between no fishing and fishing zones. It is also planned to attempt to observe pelagic fish activity.

Figure 16: Giant Shovelnose Ray with Cobia, Trevally and Remora in attendance

6. References
