



Moray eel (Muraenidae) feeding behaviour observations using Baited Remote Underwater Video (BRUV)

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Introduction

While moray eels hold an important part as a predator in the marine ecosystem, differentiation in behaviour between species exists and have yet to be explored in depth. Black spotted moray eels are known to be shy, ambush predators that commonly hide in coral reefs, only coming out to hunt at night and catching mainly small invertebrates. In contrast, giant moray eels have been recorded in other BRUV experiments to be much more aggressive, grabbing the mesh bag with its teeth and creating a “knot” in its tail region in order to gain more traction (1). Baited Remote Underwater Video systems (BRUVs) allow scientist to observe marine life in their natural habitat without human disturbance. Using bait, species are attracted into the field of view of cameras. Using such methods for research on moray eels is progressively becoming more popular due to their obscure nature (1).

Material and Method

Surveys using BRUVs were conducted around the Gili Islands, located in the Lombok Strait immediately Northwest of Lombok, Indonesia. The Gili Islands have been classified as a Marine Protected Area (MPA) called the Gili Matra Marine Recreational Reserve. From October 2017 to March 2018, a total of 167 BRUV’s were dropped. Of these, 27 drop sites contain moray eel activity (Figure 1). For each survey, cameras were deployed around the outskirts of common dive sites around the three Gili Islands; Gili Air, Gili Meno and Gili Trawangan at depths ranging from 4.5 m – 21.6 m with an average of 10.9 m. Using a custom made BRUV, one GoPro Hero3 was mounted on a metal frame held down with lead weights. A bait cage secured out in front of the metal frame was filled with 1kg of mackerel before each BRUV drop. BRUV surveys run for approximately 1 hour each.

[1] Barley, S., Mehta, R., Meeuwig, J. and Meekan, M. (2015). To knot or not? Novel feeding behaviours in moray eels. *Marine Biodiversity*, 46(3), pp.703-705

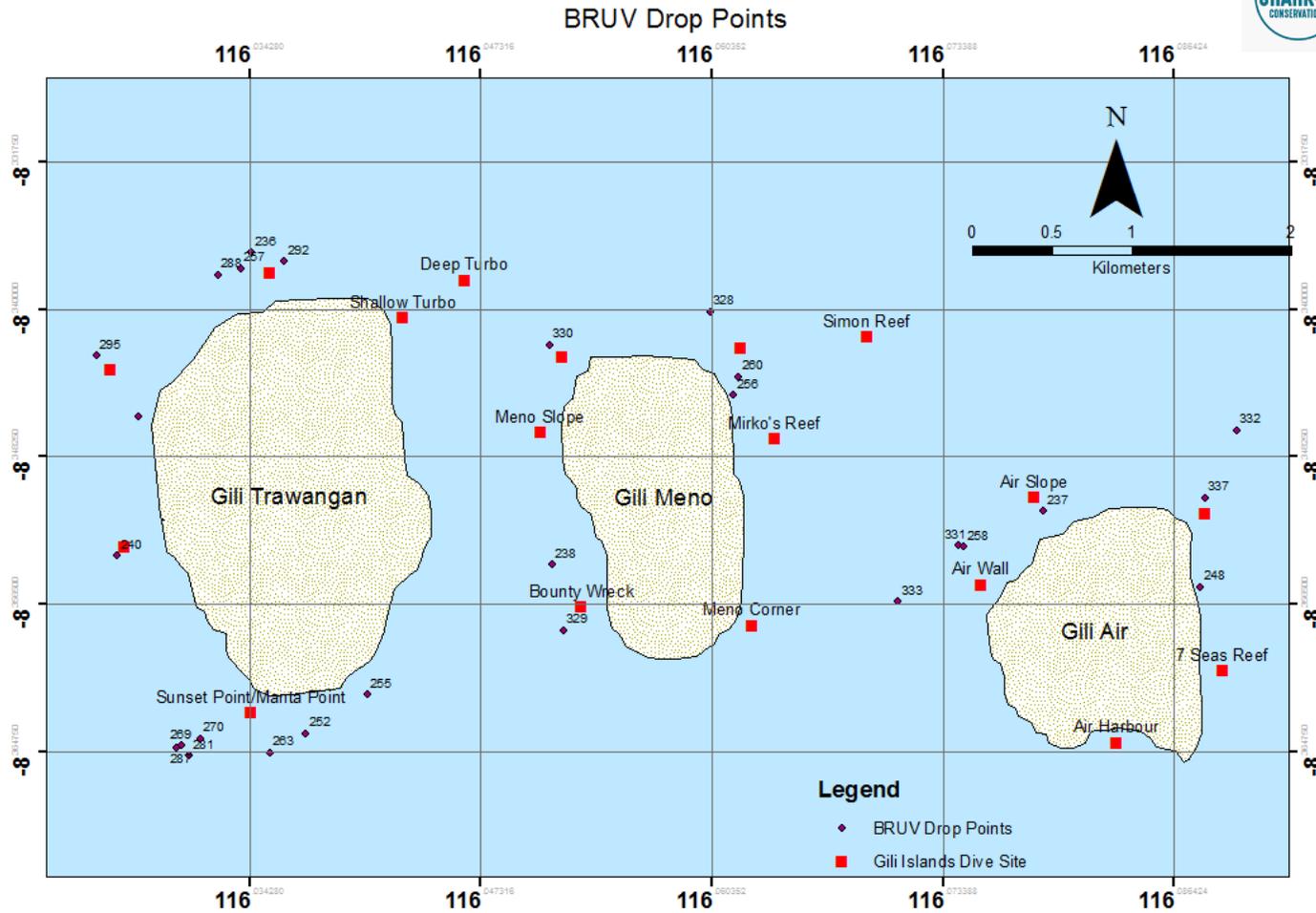


Figure 1. BRUV drop points that contain moray eel activities.

Results

There are three Muraenidae species observed from 27 BRUV footages, snowflake eel (*Echidna nebulosa*), giant moray (*Gymnothorax javanicus*), and black spotted moray (*Gymnothorax favagineus*). The behaviour observations of those three species on BRUV footages are summarized in the Table 1.

Table 1. Observation on moray eel behaviour from BRUV.

Site Number	Species	Description of movement	Duration	Closest Dive Site	Depth (m)	Seabed type
240	<i>E. nebulosa</i>	Swimming a short distance from the bait but does not approach or attack.	36 seconds	Reserve	4.5	Coral bed
263	<i>E. nebulosa</i>	Swims near to the bait but does not approach or feed from the bait.	28 seconds	Sunset Point	8	Coral bed
255	<i>G. javanicus</i>	Taking small bites at the bait cage but doesn't break through bait cage. Seen again later, taking bites and wrapping its entire body around the bait bag.	15 seconds - 57 seconds	Sunset Point	7.2	Coral bed
257	<i>G. javanicus</i>	Attacks the bait and finds the small opening in the cage so concentrates its attack on this area. Grips the bait bag tightly in its jaws and strongly shakes the bag from side to side which causes the visibility to rapidly decrease due to displaced sand and fish fragments.	55 seconds	Halik	7.2	Coral bed
257	<i>G. javanicus</i>	Circles near to the bait before taking some bites	63 seconds	Halik	7.2	Coral bed

		from outside of the bait cage. It is seen using its tail as leverage, however most of this encounter is partly off screen so only its tail can be seen				
257	<i>G. javanicus</i>	Swims close to the bait cage but does not attack it, instead it takes some dead fish from the sea floor and swims away with it.	44 seconds	Halik	7.2	Coral bed
292	<i>G. javanicus</i>	Approaches from rocky reef, cautiously approaches bait (takes 50 seconds to reach bait over short distance (20 metres). Attacks bait cage, dislodges one fish which falls to seabed and then it retrieves this piece to consume, out of view of the camera. It looks like the eel is using its powerful jaw and neck muscles to manipulate the bait bag (Figure 2). A giant moray eel is seen in the corner of the screen later in the same video clip but does not approach the bait.	77 seconds	Halik	7	Coral bed
269	<i>G. javanicus</i>	Swims past the bait but does not approach it.	4 seconds	Sunset Point	21.6	Coral bed
337	<i>G. favagineus</i>	Approaches the bait from across the reef. Does not	138 seconds	Han's Reef	14.5	Coral bed

		<p>immediately attack the bait but swims in tight circles around the bait as if using smell rather than its sight to detect the bait. It does this for nearly two minutes before attacking the bait. It then immediately extracts a large fish chunk from the small opening in the bait cage, whilst using its tail to anchor itself to the reef floor (Figure 3).</p>				
337	<i>G. favagineus</i>	<p>Approaches the bait cage and makes a wide circle around it. It then swiftly attacks the bait and has its whole head and jaws inside the bag (Figure 4) to extract the fish without too much manipulation of the bait cage. It swims away and a minute later a black spotted eel attacks the bait, removing a piece of fish, again by inserting its whole head inside the bait. In the same video clip a black spotted eel attacks the bait bag for a third time, again by putting its head inside the bait cage.</p>	<p>50 seconds - 68 seconds - 81 seconds -</p>	<p>Han's Reef</p>	<p>14.5</p>	<p>Coral bed</p>



Figure 2. *G. javanicus* is trying to break the bait cage using its jaw.

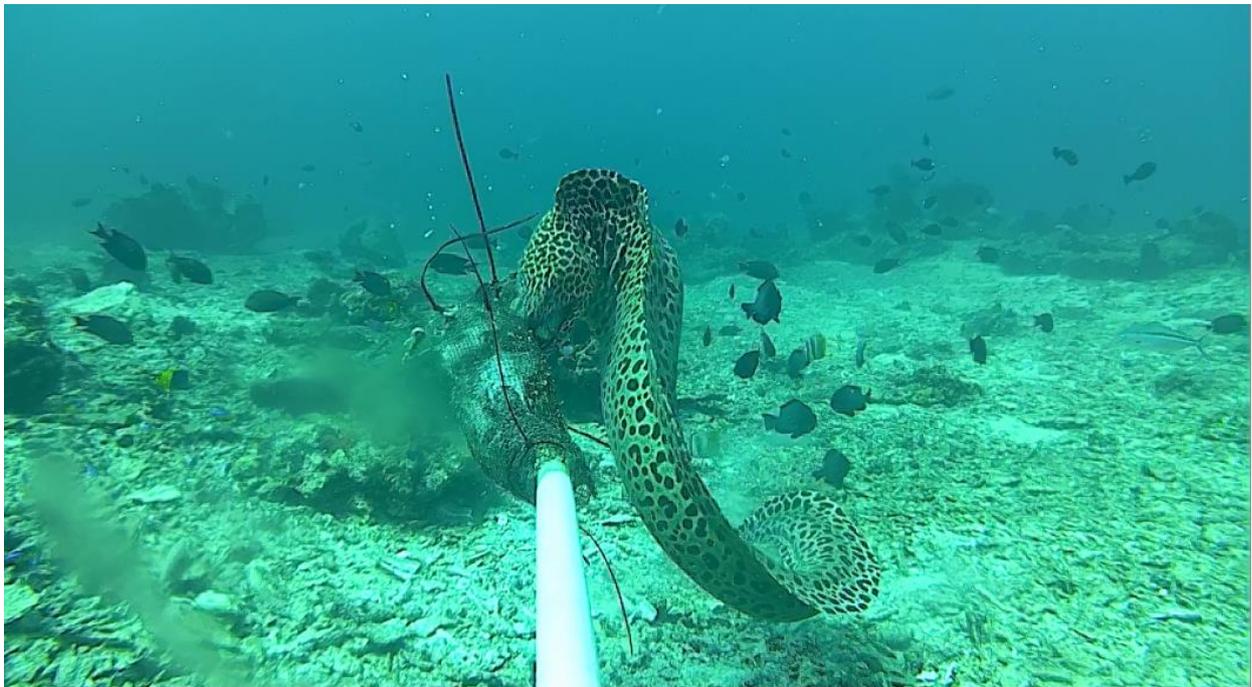


Figure 3. *G. favagineus* using its tail to anchor itself to the reef floor.

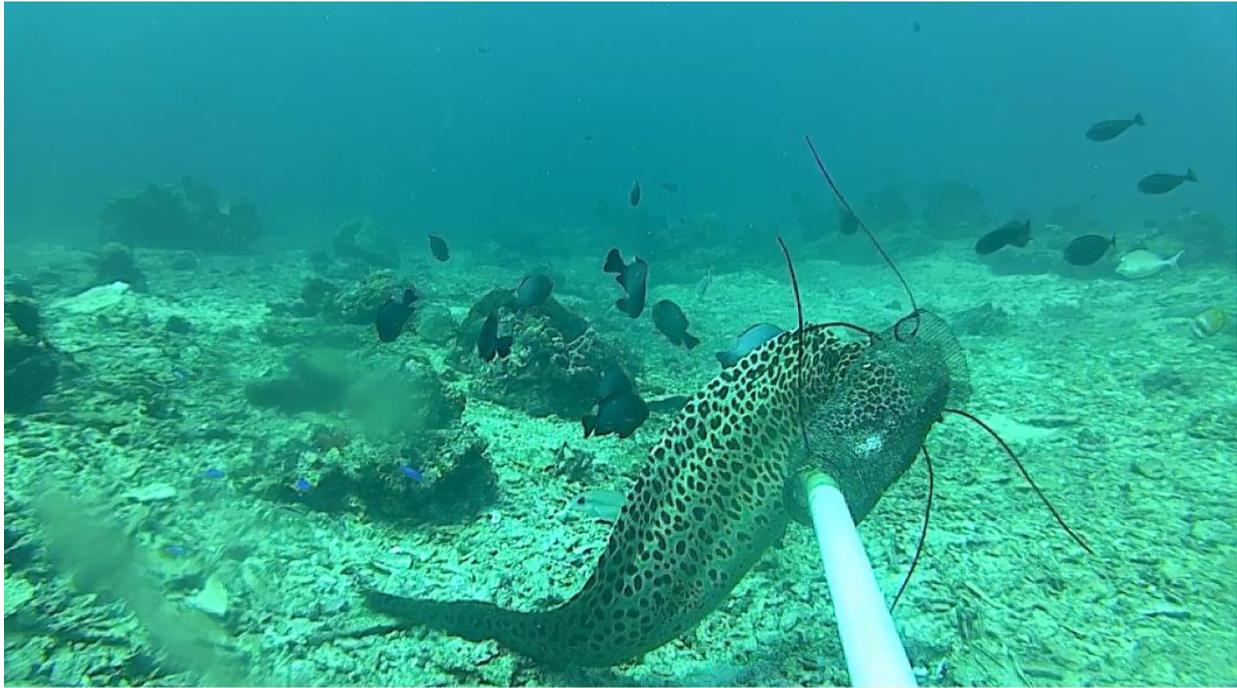


Figure 4. *G. favagineus* has its whole head and jaws inside the bait cage to extract the fish.

Conclusion

Feeding behaviour patterns of moray eels from the videos seems to depend on species and size of the individual. *E. nebulosa* does not approach the bait in any of the video clips. Amongst the *G. javanicus*, the larger individuals have a more aggressive tactic to manipulating the bait bag, namely by shaking it from side to side, whereas the smaller *G. javanicus* took a gentler approach and nibbled small fragments that were poking through the mesh bag. *G. favagineus* had an entirely different approach where they located the gap in the bait bag and attacked this directly to extract large whole pieces of fish bait.