6-monthly progress report to IMOS-AATAMS for receiver pool

27th May 2009

# What size do Marine Protected Area Sanctuary Zones need to be in order to protect the Near-Threatened Western Blue Groper and Harlequin Fish?

Carefully releasing a male western blue groper fitted with an internal acoustic transmitter. Photo: S. Bryars

**Project title:** What size do Marine Protected Area Sanctuary Zones need to be in order to protect the Near-Threatened Western Blue Groper and Harlequin Fish?

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**Project background:**

The Western Blue Groper (*Achoerodus gouldii*) (WBG) and Harlequin Fish (*Othos dentex*) (HF) are iconic fish species that inhabit shallow (<60 m depth) reefs from south-western Western Australia (WA) to eastern South Australia (SA). The WBG grows to 1.7 m length and is a protogynous hermaphrodite (i.e. it changes sex from female to male), with adult females being a green colouration and adult males being blue. Sexual maturation occurs at around 0.6 m length and an age of ~15 years with some WBG living for over 70 years (Shepherd & Baker 2008). Within SA, juveniles inhabit sheltered reefs with an ontogenetic movement of sub-adults and adults to more wave-exposed reefs (Shepherd & Brook 2007). Once at these locations, sub-adults and adults form social groups of one adult male, one to two adult females and several sub-adult females. Adults are thought to be highly site-attached, and adult males are territorial (Shepherd 2003). The HF grows to 0.75 m length, but little else is known about its biology. Being a member of the Serranidae family which includes gropers and cods, it is likely that the HF is slow-growing and long-lived (a separate investigation is currently underway to determine some of these characteristics). Nonetheless, the HF is rare across much of SA with only a few 'hot-spots' of increased abundance, and it is thought that numbers have declined in the past 20–30 years. The HF is also thought to be highly site-attached, but this is yet to be quantified.

As adult WBG and HF are inquisitive and will approach divers, they are both highly vulnerable to spearfishing. Indeed, numbers of adult WBG declined to such an extent in parts of central SA during the 1960–70's, that the species was fully protected in that region in 1980 under the *South Australian Fisheries Act 1982* (now the *Fisheries Management Act 2007*). Capture by recreational and charter boat line-fishers also represents a threat to the ongoing existence of WBG and HF in SA. Furthermore,

both species are highly susceptible to barotrauma when caught from depths >20 m, thus decreasing post-release survival rates. The known life-history characteristics of WBG and the suspected characteristics of HF make them intrinsically vulnerable to over-fishing (Cheung et al. 2005, 2007).

Within SA, WBG and HF are of conservation concern, with repeated calls by community groups for their full protection. The WBG is currently fully protected within the central part of SA under the *Fisheries Management Act 2007*. Baker (2008) recommended that WBG be listed as *Vulnerable*, Harlequin Fish (HF) be listed as *Near Threatened* under the *SA National Parks & Wildlife Act 1972*, and that both species be Fully Protected under the *Fisheries Management Act 2007*.

As the adults of both WBG and HF are highly vulnerable to fishing and are site-attached, the creation of a no-fishing 'sanctuary zone' within a Marine Protected Area (MPA) is likely to be an effective conservation tool. Nineteen regions across SA are currently designated for MPA's by 2010, with at least 12 of these regions overlapping the known range of adult WBG and HF. By designing the sanctuary zones to include adult WBG and HF, it is anticipated that at least some of the spawning stock will be protected so that recruits will be supplied back to the sanctuary zones and/or to other non-sanctuary zone areas. However, in order for the sanctuary zones to be effective, it is imperative that the zones are sufficiently large to include a large proportion of the home ranges and spawning areas of adult WBG and HF, and thus protect them from fishing at and near the zone boundaries. Acoustic telemetry is an effective way to determine the size of home ranges and site fidelity through tagging and tracking of these species.

**Project aims:**

- To determine the home ranges, site fidelity and habitat use of adult western blue groper and harlequin fish.
- To recommend spatial areas and habitat types needed for the adequate protection of adult western blue groper and harlequin fish within Sanctuary Zones of South Australia's planned system of Marine Protected Areas.

**Progress to 01/05/2009:**

*Equipment*

Six VR2W receivers on loan from AATAMS were obtained during November 2008. Eighteen V13-1H transmitters and two V13P-1H transmitters were purchased from VEMCO during January 2009. The transmitters had a minimum and maximum delay of 110 and 250 seconds, respectively, with a nominal delay of 180 seconds. A range testing tag with a nominal delay of 5 seconds was also purchased.

*Deployment*

A diver survey was first conducted during December 2008 in the Western River Cove region on northern Kangaroo Island to ascertain its suitability as a study site. Pairs of divers searched for ~30-40 minutes for the 2 species at 6 different sites. However, the region was lacking in numbers of adult blue groper and only one harlequin fish was observed. It was decided to move the study area ~30 km to the west at Harveys Return where large blue groper are regularly reported.

The deployment of the six AATAMS receivers was undertaken during a second trip between the 19th and 21st of January 2009. Range testing was conducted at the Harveys Return site (Fig. 1), and was used to determine a space interval of 200 m between receivers due to the reduced detection rate from 300 m in good environmental conditions (i.e., 10 knots wind, good underwater visibility, and lack of precipitation during range testing; Fig. 2). The 200 m interval between receivers was also chosen to take into account the known behaviour of WBG and HF which tend to hide in caves and crevices, potentially reducing detections. The acoustic receivers were deployed on sand approximately 50-100 m offshore from the edge of the coastal reef in 12–18 m depth (Fig. 2). Receivers were taped, anti-fouled and affixed to a 1.65 m long star-dropper with cable ties. Star-droppers were driven into the sand to at least 0.6–0.8 m depth using a hammer.

*Tagging*

A total of 20 fish were captured and implemented with an acoustic transmitter (Table 1, Fig. 2). Three adult WBG (Fish Nos. 1-3) were tagged on the 20th and 21st January 2009, with a further 12 WBG (Nos. 4-15) tagged on the 16th to 19th February 2009 (Figs. 2, 3; Table 1). During deployment and tagging, several unsuccessful attempts were made to capture harlequin fish using both baited fish traps, and hook and line. With five transmitters still remaining, it was decided to tag five bluethroat wrasse (*Notolabrus tetricus*) on the final day of the tagging trips (Table 1). The bluethroat wrasse is a common reef species, which is closely related to the western blue groper (Family Labridae) and will provide an interesting species comparison. In addition, bluethroat wrasse can also suffer from localised depletion due to fishing and are another species that will potentially benefit from sanctuary zone protection within marine parks.

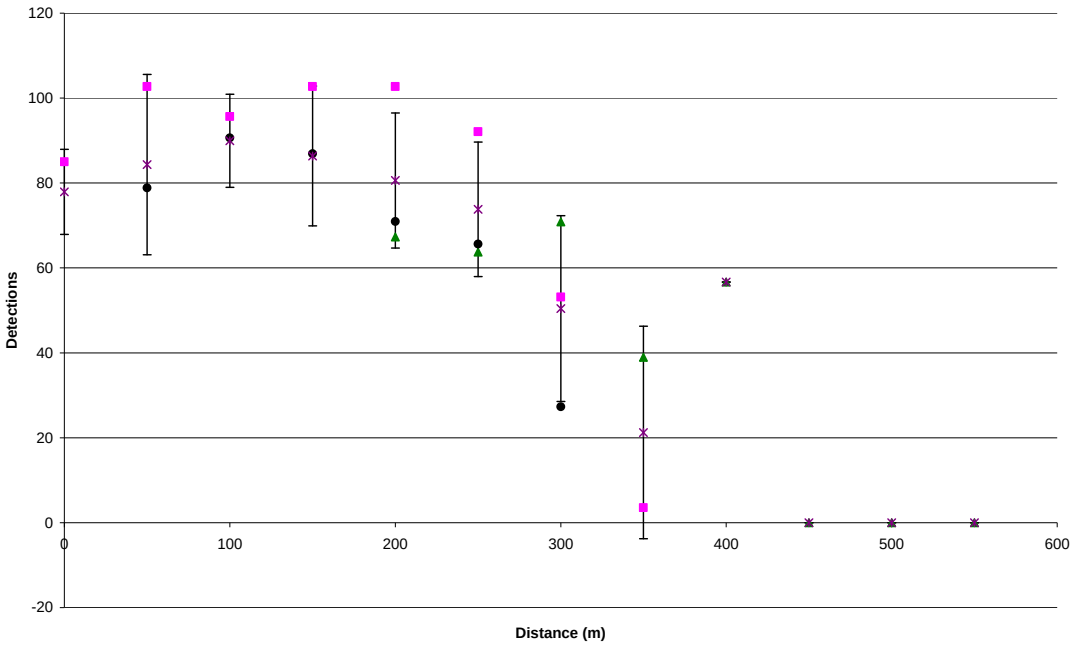


**Figure 1.** Detections versus distance away from receivers during range testing on 19th January 2009 at Harveys Return. Different coloured symbols represent different receivers. The black crosses depict means (± standard deviation) from the different receivers.

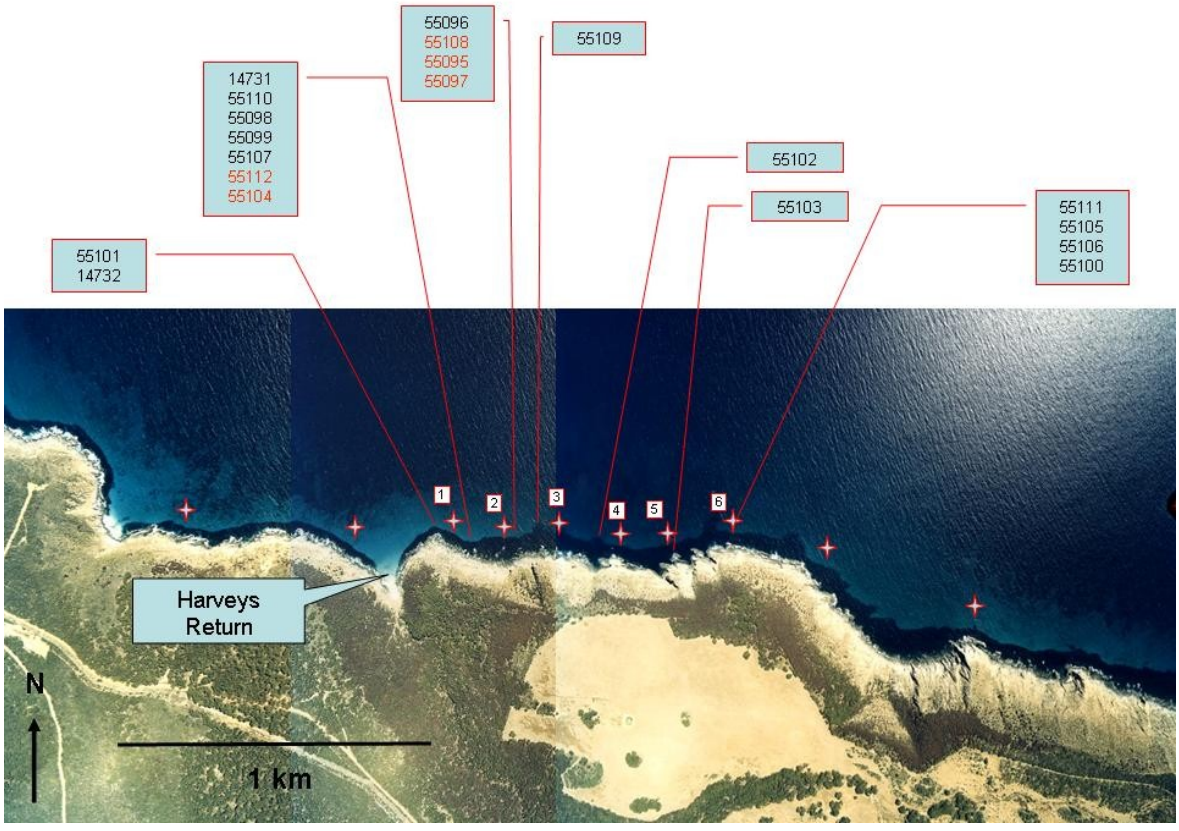


**Figure 2.** Approximate locations of 10 receivers and 20 fish tagged at the study site on NW Kangaroo Island. See Table 1 for details of transmitter codes. Black codes denote western blue groper and red codes denote bluethroat wrasse. Receivers 1-6 were deployed on 19-20/01/2009. The additional four receivers located either side of receivers 1-6 were deployed on 29/04/2009.

**Table 1.** Summary of the 20 fish tagged within the receiver array. WBG = western blue groper, BTW = bluethroat wrasse. Fish Nos. 4 and 7 have pressure-sensor tags.

| Fish no. | Species | Length (mm) | Colour/Sex | Transmitter code |
|---|---|---|---|---|
| 1 | WBG | 810 | Blue | 55102 |
| 2 | WBG | 840 | Blue | 55101 |
| 3 | WBG | 740 | Green | 55103 |
| 4 | WBG | 710 | Green | 14731 |
| 5 | WBG | 810 | Green | 55110 |
| 6 | WBG | 715 | Blue | 55096 |
| 7 | WBG | 970 | Blue | 14732 |
| 8 | WBG | 690 | Blue | 55111 |
| 9 | WBG | 800 | Green | 55105 |
| 10 | WBG | 990 | Blue | 55106 |
| 11 | WBG | 1080 | Blue | 55100 |
| 12 | WBG | 1120 | Blue | 55109 |
| 13 | WBG | 950 | Blue | 55098 |
| 14 | WBG | 800 | Green | 55099 |
| 15 | WBG | 740 | Green | 55107 |
| 16 | BTW | 345 | Male | 55108 |
| 17 | BTW | 315 | Male | 55095 |
| 18 | BTW | 320 | Male | 55097 |
| 19 | BTW | 225 | Female | 55112 |
| 20 | BTW | 270 | Female | 55104 |

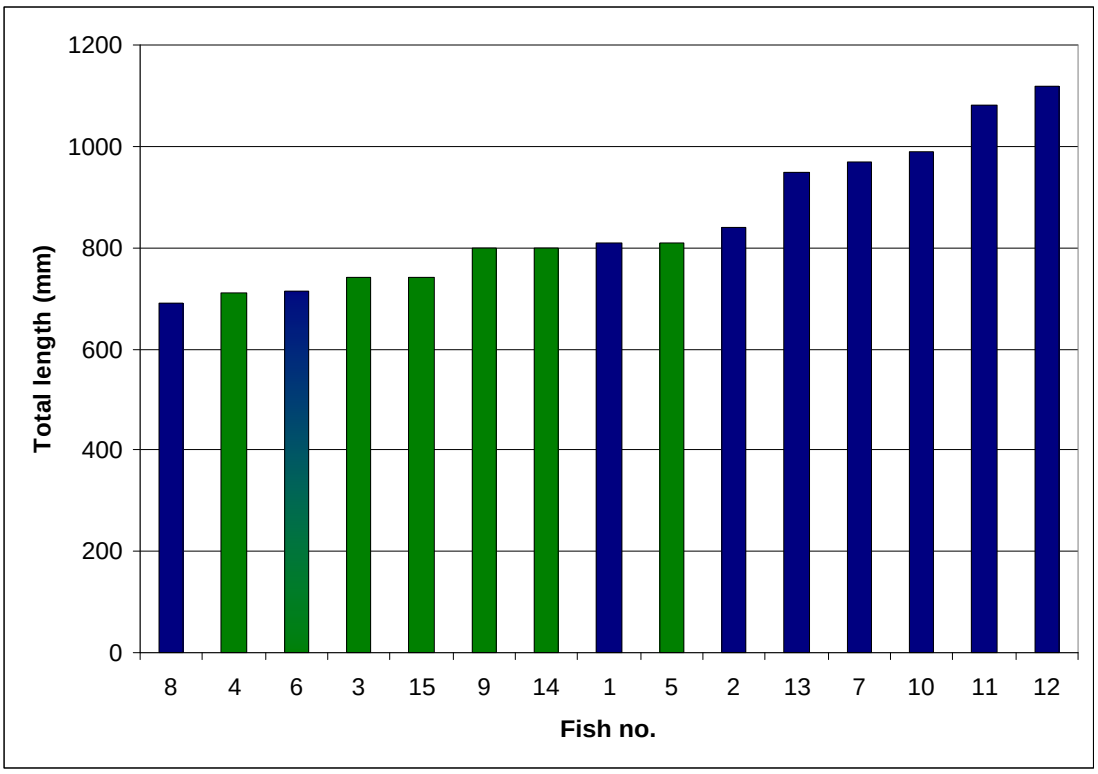


**Figure 3.** Size distribution of the 15 western blue groper tagged for the tracking study (fish are arranged from smallest to largest; colour is a good indication of sex: green = female, blue = male, Fish No. 6 was possibly in the process of changing sex).

*Download of AATAMS receivers and deployment of additional receivers*

The six AATAMS receivers were recovered, downloaded, and serviced on the 28th April 2009. Unfortunately, the battery of Receiver 2 had stopped prematurely on 4th February; <1 month after deployment. Furthermore, additional testing with a new battery showed that this receiver was faulty and was not detecting any transmitters. The other five receivers were re-deployed and a spare VR2W receiver loaned from Adelaide University was used to replace the faulty one.

Four additional receivers loaned from Adelaide University were deployed on 29th April 2009 at distances of ~400 and ~800m from each end of the existing array (Fig. 2). The total length of the array is now ~3.4km.

*Preliminary results*

Over the 3–month period since the first fish were tagged, a total of 194,753 detections have been recorded (Fig. 4).

At the time of downloading, 17 of the 20 fish were still present within the array (Fig. 4). These 17 fish have been displaying a distinct diurnal pattern whereby they are regularly detected during the day but rarely detected at night (Fig. 5). Examination of depth data from the two fish with pressure-sensor transmitters indicates that these fish are not moving offshore (and thus out of the receiver array) at night. Nor is there any evidence that fish are moving alongshore (east or west) out of the array at night. Thus, it is most likely that the fish are hiding in caves and crevices during the night where they aren't detected by the receivers.

Examination of individual receivers indicates that spatial usage of the reef by each fish was non-uniform (Fig. 6). In many cases, the distribution of detections was related to the location of fish capture. For example, the distribution of detections for Fish Nos. 2 (transmitter 55101) and 7 (transmitter 14732) are skewed to the west where they were captured, while the distribution of detections for Fish Nos. 8 (transmitter 55111) and 10 (transmitter 55106) are skewed more to the east where they were captured (Fig. 6). Some fish had more spatial usage of the reef than others. For example, Fish Nos 17 (tag 55095), 18 (transmitter 55097) and 20 (transmitter 55104) were not detected in the eastern part of the array, whilst many other fish were detected throughout the array (Fig. 6).

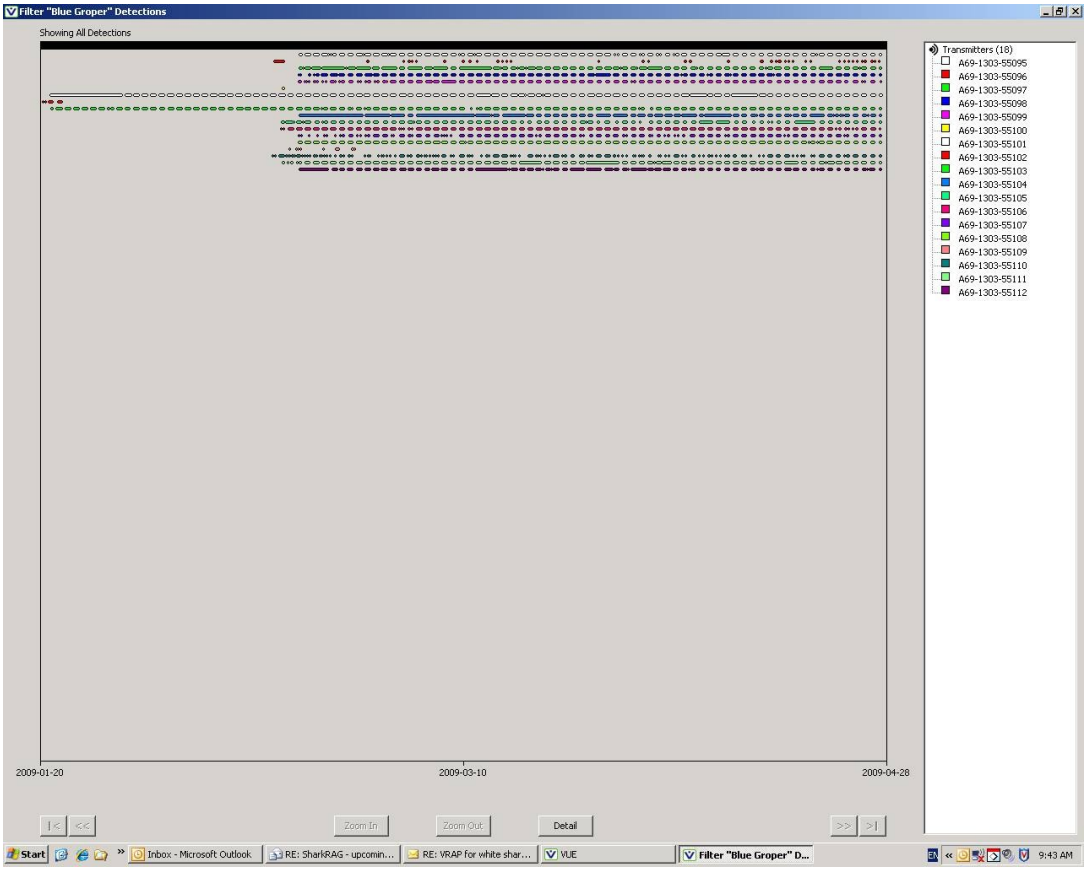


**Figure 4.** Detections from Fish Nos. 1-3, 5-6, and 8-20 summarised across all 6 receivers between 19th January and 28th April 2009. Note that the 2 fish with pressure sensor transmitters (4, 7) are not plotted. See Table 1 for fish codes and details.

Whilst diving during 28th to 30th April 2009, several of the tagged fish were observed swimming about within the receiver array (Fig. 7).

*Next download*

The 10 receivers currently in place will now be left until October 2009, when they will be retrieved and the fieldwork completed. The AATAMS pool receivers will then be returned to IMOS-AATAMS.

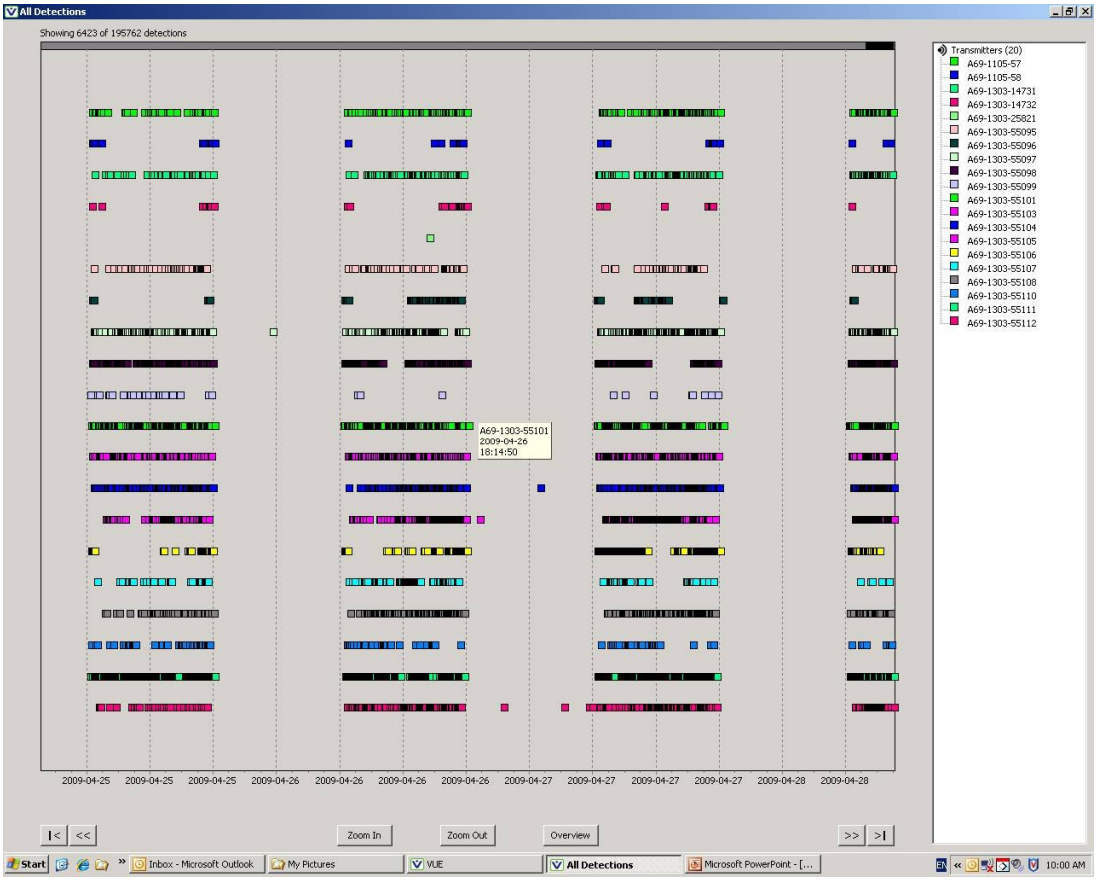


**Figure 5.** Detections from Fish No's 2-10 and 13-20 summarised across all 6 receivers between 25/04/2009 and 28/04/2009. Note that the 2 fish with pressure sensors (4, 7) each have two lines of detections (at top of this graph), and that the detection for A69-1303-25821 is most likely a false detection. See Table 1 for fish codes and details.

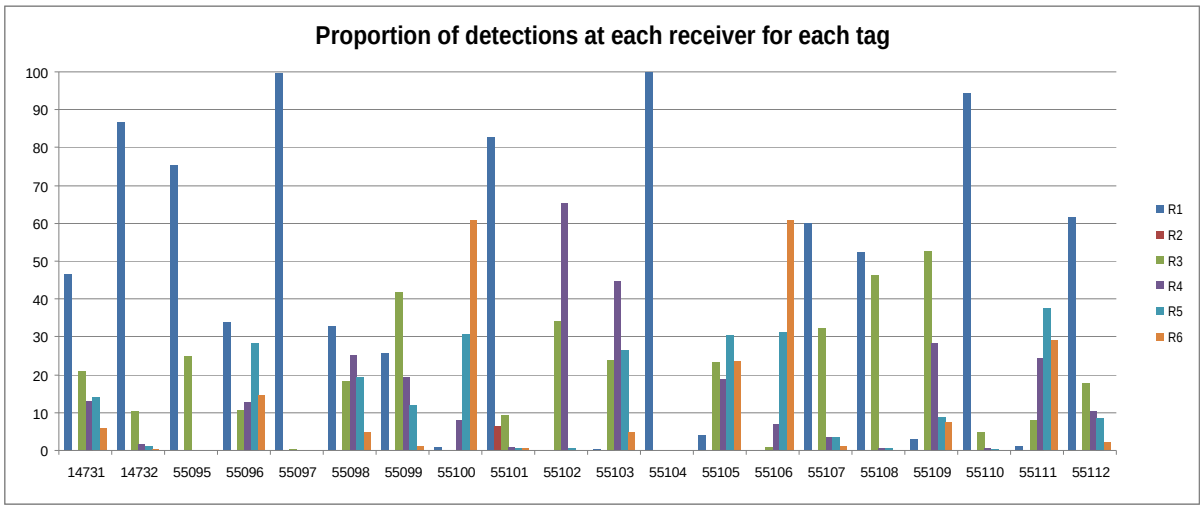


**Figure 6.** Proportion of detections at each receiver for all 20 fish between 19th January and 28th April 2009. Receivers 1-6 are arranged on the graph from west-east. Note that receiver 2 stopped detecting on 4th February 2009. See Table 1 for fish codes and details.

**Figure 7.** A western blue groper (above) and a male bluethroat wrasse (below), each with external dart tags visible, photographed within the receiver array on 29th April 2009. The presence of external tags indicates that these fish have internal transmitters. Photos: S. Bryars