The performance of Vemco V7, V9 and V16 transmitters and VR2 receivers under varying environmental conditions

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INTRODUCTION

The use of acoustic telemetry systems to monitor behavior, migration, and survival of aquatic animals is increasing rapidly. Acoustic systems offer many advantages over more traditional mark and recapture methods. However, performance of acoustic equipment can vary dramatically depending on environmental conditions. Proper selection and design of an acoustic tagging and monitoring program requires understanding of how performance varies in different habitats and under varying wind, current, and water conditions. We present data characterizing the maximum detection range of Vemco transmitters of variable power output and the percent of transmissions received over increasing distances by Vemco VR2 receivers. Tests were conducted in a calm lake and a slow moving river. These results can be applied to the configuration and placement of receivers.

OBJECTIVES

What is the effective range (>80%) for the three kinds of transmitters (tags) in different habitats?

Is there variation in detection rates among the same kind of tag?

Does tag depth in the water (near surface or near bottom) affect detection rates?

METHODS

Each tag type (V7, V9 and V16) was tested separately.

Three of each type of tag were tested simultaneously.

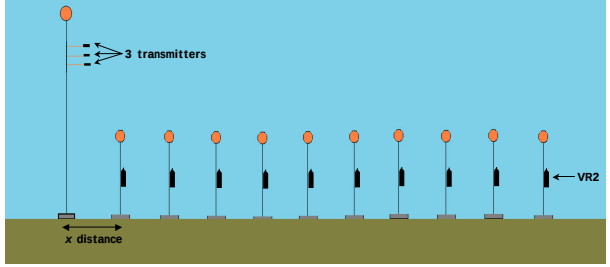
Tags pinged at a fixed 30 sec rate, and were staggered by 10 sec.

Tags were placed at the desired depth.

Tests ran from 10-30 mins.

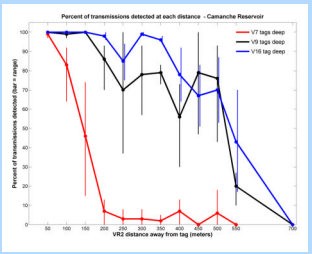
Current speed, wind speed, waves, water temperature profiles, depth and tilt of VR2s and boat traffic were recorded.

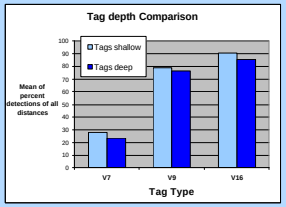
Transmitter and Receiver Array

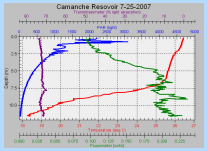


Calm lake – Camanche Reservoir

Conditions:
wind speed = 10knts
waves = 0.2m
Current = 0.1m/s
Bottom depth = 11m
Thermocline at 7m
Methods:
Tag depth = shallow or deep
VR2 depth = 2m above bottom
Test duration = 15mins







Effective range (>80% detections)

V7 – about 100m

V9 – 200m, but >70% out to 500m

V16 – 350m, but >60% out to 500m

Variation among tags of each type (error bars)

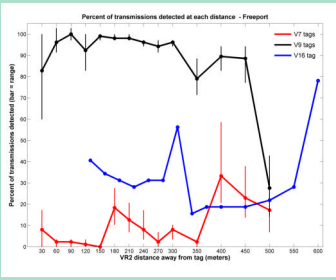
All tag types showed variation (error bars)

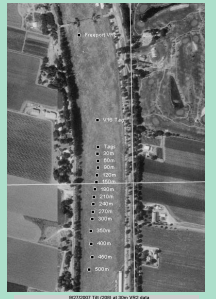
Effect of tag depth on detection rate

No significant differences, despite thermocline

Slow moving river – Sac. R. Freeport

Conditions:
wind speed = 5knts
waves = 0.1m
Current = 0.3m/s
Bottom depth = 6m
No thermocline
Methods:
Tag depth = middle, 3m
VR2 depth = 0.5m above bottom
Test duration = 15mins





Effective range (>80% detections)

V7 – undetermined, detections increased with distance!

V9 – 450m

V16 – undetermined, detections increased with distance!

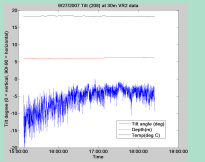
Variation among tags of each type

V7 – high variability (inconsistent results for 3 tags)

V9 – low variability (consistent results for 3 tags)

V16 – only one tag used

Riprap banks may be creating echoes which propagate sound (good and bad)



Transmitter Specifications

Manufactured by Vemco in July of 2007.

69kHz frequency, coded (8 pings = ID code)

Type	Dia. x Length (mm)	Weight (g. in air)	Power (decibels 1m)
V7-4L	7 x 20.5	1.75	136
V9-2L	9 x 28	4.80	142
V16-5L	16 x 95	35.4	153

CONCLUSIONS

The calm lake with its free-field environment produced results that are consistent with those expected, except that the V16 tags were not much better than the V9s.

There was a thermocline in Camanche but it did not affect detections between tags positioned shallow and deep. A future test needs to be done in an estuary with a pycnocline, as this would have a much higher density difference than a thermocline.

Results at Freeport were very good for the V9 tags, however the V7s and V16 showed an odd pattern in detections with increasing distance. These tags had a bimodal pattern, with very low detection rates at near distances, higher at medium, low again, the highest at far distances. It is possible that detection rates may have been even higher beyond the farthest receiver.

The Freeport results may have been caused by the relatively narrow channel with steep riprap banks. This environment may be propagating the signals, causing them to overlap at some distances (multi-pathing) and extending their range at far distances.