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PILOT VISUAL SURVEY OF ORFORD REEF, OREGON

Bill Miller, Oregon Department of Fish & Wildlife, Marine Resources Program
Arlene Merems, Oregon Department of Fish & Wildlife, Marine Resources Program
Hal Weeks, Shoals Marine Laboratory, Cornell University

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INTRODUCTION

Oregon's nearshore environment and the living marine resources that depend upon it have been subject to increasing pressures for several years. Emphasis and effort on nearshore fisheries has increased with reductions in offshore fishery opportunities and the development of the live-fish fishery. Recently, nearshore hypoxic events have been observed off the central Oregon coast (2002 -- 2006) resulting in localized mortality of some marine species. These events are under active investigation by oceanographers and ecologists from Oregon State University, with collaboration from the Oregon Department of Fish and Wildlife (Barth, pers. comm., Chan, pers. comm., Freeland, et al. 2003, Huyer 2003, Grantham, et al. 2004). The relationship of these events to human-induced environmental change is not known.

Rocky reef habitats represent a focal point for these concerns as fishing pressures can be intense, and habitat is both limited and subject to degradation. A community of commercially and recreationally valuable species are found primarily, or only, on nearshore rocky reefs or other rocky substrate. These include species such as greenlings and lingcod (Family Hexagrammidae), quillback rockfish (*Sebastes maliger*), China rockfish (*S. nebulosus*), black rockfish (*S. melanops*), and blue rockfish (*S. mystinus*). In addition, nearshore rocky reefs are utilized by juveniles of other species more frequently fished further offshore such as canary rockfish (*S. pinniger*) and yelloweye rockfish (*S. ruberrimus*). Many of these species have not been quantitatively assessed, yet are subject to substantial fishing pressure. Growing understanding of fish-habitat associations will contribute to broader goals of monitoring and protecting important habitat areas, improving nearshore fish stock assessments, and improving research design. We are particularly interested in the question of whether nearshore fish abundance and distribution can be predicted by seafloor characteristics.

BACKGROUND

In 2006, the Marine Habitat Project conducted a pilot ROV survey on Orford Reef. This reef lies to the southwest of Cape Blanco, and is the principal fishing location for commercial fishing vessels from Port Orford harvesting nearshore species. The reef was surveyed with sidescan sonar in 1995 by the Geologic Survey of Canada covering 54 km^2. A multibeam sonar survey yielding detailed bathymetric information was performed under ODFW contract by SeaVisual Consulting that covered 42 km^2 (Fox et al. 1999).

Previously, fishes in shallow waters of Orford Reef had been surveyed using SCUBA gear (Fox et al. 1996, Miller et al. 1997). These surveys were components of studies of the kelp resource of Orford and neighboring reefs conducted from 1996 through 1999 (Fox et al. 1999).

METHODS

We used a remotely operated vehicle (ROV), Phantom HD2+2 manufactured by Deep Ocean Engineering (D.O.E), for the Orford Reef Pilot Survey (Fig 1).

Fig. 1. Phantom ROV configured for Orford Reef Pilot Survey

For our work at Orford Reef, we took seventeen circular plots that were randomly selected and stratified by depth from previous work done by Fox, et al. (1999), (Fig. 2). We eliminated five of the plots due to hazards to navigation for the support vessel and ROV.   The remaining twelve plots were stratified by depth, five 0-30 m., four 30-60 m., and three greater than 60 m. We selected one box from each depth strata and created a 500 m. by 1000 m. box. The orientation of the boxes within the circular plots were determined, the day of the survey, based on weather and sea conditions. There were eleven possible lines per box. Each line ran the width of the box and was spaced 100 m apart. We selected four lines randomly for each box.

The digital video record of each transect is reviewed by two people simultaneously to more effectively spot all fish that come into the field of view. All fish are identified to species, or else to the lowest taxonomic group possible. The groups that we use are comprised of nineteen species and seven generalized groups.

We use a substrate classification system described in Fox, et al. (1998), with a few modifications to speed the review process.

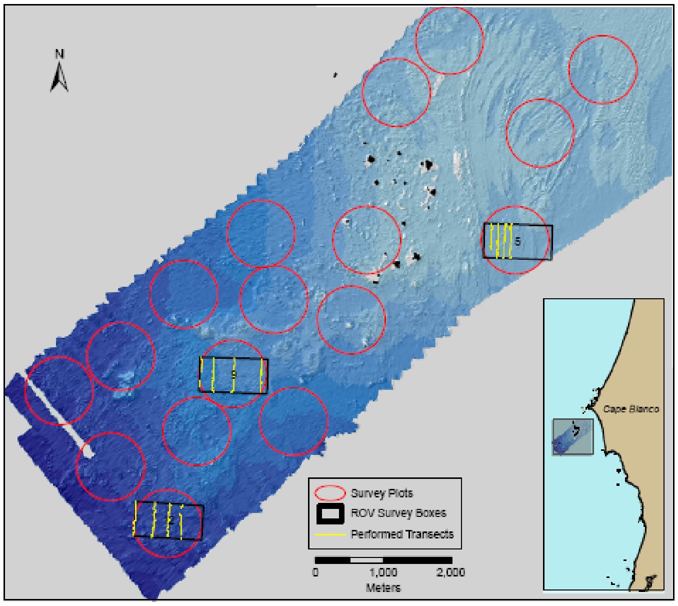


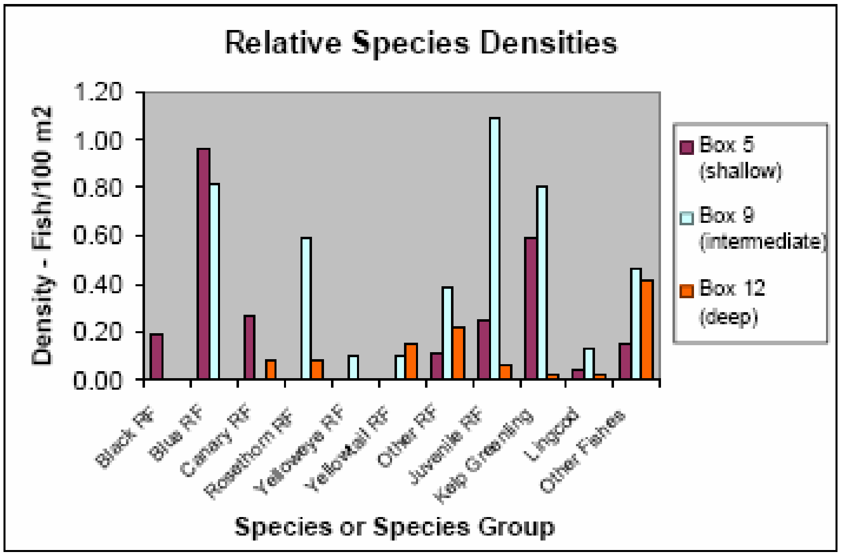
Fig 2. Location of Orford Reef Survey Boxes

RESULTS

We successfully surveyed four randomly selected lines (500 m each) in each of three boxes on May 20 and September 25 and 26, 2006. Strong and persistent winds through the summer of 2006 prevented at-sea operations between May and late September. On each of the effective survey days, we found that vessel travel between Port Orford and Orford Reef and four survey lines fully consumed a contracted nine hour vessel-day.

We observed ten rockfish species and at least nine other fish species during our survey. Blue rockfish (*Sebastes mystinus*) and kelp greenling (*Hexagrammos decagrammus*) were the two most abundant species observed. Both were found only in the shallow and intermediate depth boxes. The greatest numbers of fish species, individual fishes, and fish density were observed in the intermediate depth box with an average depth of 51 meters. In addition to blue rockfish and kelp greenling, rosethorn rockfish (*S. helvomaculatus*) were particularly abundant there. The lowest number of species, individual fish and density were observed in the deepest box (averaging 86. m depth).

Benthic habitat in each surveyed box was composed principally of boulder and bedrock. Cobble, gravel and sand were proportionately much less prevalent. The relative proportion of bedrock decreased with depth, while the relative proportion of rock pieces of smaller sizes increased with depth. For example, survey Box 5 was dominated by bedrock, either as bedrock alone (54%) or bedrock mixed with boulder, cobble or gravel. In aggregate, bedrock was found in 76% of the surveyed area. Survey Box 9 was dominated by large and small boulders (71% in aggregate), with bedrock as a much less significant habitat type (18% in aggregate). Survey Box 12 was only 12% bedrock and 29% large and small boulder, while gravel, cobble and sand represented 51% of the typed habitat.



MANAGEMENT IMPLICATIONS

The 2006 Orford Pilot ROV survey had three fundamental objectives. First, could we safely and effectively launch, retrieve and operate the ROV from a small commercial fishing vessel? Second, what was a realistic level of survey coverage that could be accomplished in a full working day? And third, to collect preliminary information on fishes of Orford Reef. We feel that we successfully accomplished each of these objectives.

Because Oregon's nearshore generally, and high relief rocky reefs in particular, are areas not covered by traditional trawl surveys used as a basis for developing quantitative estimates of fish abundance, there is interest in developing alternative methodology that can provide comparable quantitative information for high relief rocky habitats. One underlying motivation for this pilot survey was to preliminarily investigate whether this was a realistic expectation. The interpretation, and management use of visual survey results must take into account possible changes in fish behavior in response to the lights or sound of the survey platform. (Trenkel et al 2004) Some species, such as cabezon, are cryptic and tend not to move when approached by the ROV. Consequently, without attraction or repulsion, there is a potential for underestimating species such as this based only on unaltered behavior patterns. These considerations strongly suggest that results of visual surveys are best used as an index of relative abundance unless adequate calibration studies are performed.

Using visual surveys as a relative index of abundance can allow comparisons of fish density over time, or between different locations of comparable habitat qualities. The intensity of observations needed to detect differences between differing times or locations will be a function of variability in survey operations, environmental factors, as well as any actual differences in density. Survey operations should be standardized and varied as little as possible.

LITERATURE CITED

Fox, D., A. Merems, J. Golden and M. Amend. 1996. 1996 Kelp/Reef Habitat Assessment, Coastal Zone Management Section 309 Final Grant Report, Contract No. 96-52. Newport OR: Oregon Department of Fish and Wildlife Marine Resources Program, 61 pp.

Fox, D., M. Amend, A. Merems, B. Miller and J. Golden. 1998. 1998 Nearshore Rocky Reef Assessment. Coastal Zone Management Section 309 Final Report, Contract No. 99-020. Newport, OR: Oregon Department of Fish and Wildlife, Marine Resources Program, 53 pp.

Fox, D., M. Amend and A. Merems. 1999. 1999 Nearshore Rocky Reef Assessment. Coastal Zone Management Section 309 Final Contract Report, Contract No. 99-072. Newport OR: Oregon Department of Fish and Wildlife Marine Resources Program, 40 pp.

Freeland, H.J., G. Gatien, A. Huyer and R.L. Smith. 2003 Cold halocline in the northern California Current: an invasion of subarctic water. Geophysical Research Letters. 30(3): 1141, doi: 10.1029/2002GL016663, 2003.

Grantham, B.A, F. Chan, K.J. Nielsen, D.S. Fox, J.A. Barth, A. Huyer, J. Lubchenco and B.A. Menge. 2004. Upwelling-driven nearshore hypoxia signals ecosystem and oceanographic changes in the northeast Pacific. Nature. 429: 749 – 754.

Huyer, A. 2003. Preface to special section on enhanced subarctic influence in the California Current, 2002. Geophysical Research Letters. 30(15): 8019, doi: 10.1029/2003GL017724

Miller, B., D. Fox, A. Merems and M. Amend. 1997. Kelp/Reef Habitat Assessment. Coastal Zone Management Section 309 Final Grant Report. Contract No. 97-52. Newport OR: Oregon Department of Fish and Wildlife Marine Resources Program, 40 pp.

Trenkel, V.M., P. Lorance and S. Mahevas. 2004. Do visual transects provide true population density estimates of deepwater fish? ICES Journal of Marine Sciences. 61: 1050- 1056.

Arlene Merems
Oregon Department of Fish & Wildlife
Marine Resources Program
2040 SE Marine Science Drive
Newport, OR 97365
541.867.0300 ext 246
email: *Arlene.R.Merems@state.or.us*