REPORT OF THE WORKSHOP ON REMOTE OPTICAL AND ACOUSTIC MAPPING (ROAM)

MAY 20 AND 21, 1988; MONTEREY, CA

This report summarizes a workshop on remote optical and acoustic mapping (ROAM) held in Monterey, CA on May 20 and 21. The purpose of the workshop was to evaluate the state of the art in this field to provide advice to the Navy on technology needed to implement the real-time assessment of the distribution, diversity and dynamics of the biota of the oceanic water column.

I. Presentations

The workshop began with a series of reviews of existing or developing technologies by individuals who are active in the respective areas.

Acoustic Technology

Dual beam systems...Greene

Multiple frequency systems...Holliday/Pieper

Acoustic Doppler Current Profilers...Flagg/Smith

Acoustic Tomography...group

Acoustic tracking systems...Carey

Passive listening systems...group

Optical Technology

Bioluminescence research...Case/Widder

Three-dimensional image analysis...Hamner

Low light video systems...Hamner

Spectral analysis...Price

Range-gated video systems...group

Electronic Technology

Electromagnetic sensing...Kalmijn

II. Caveats

The presentations demonstrated the potential advances that are possible, but two problem areas plague both optical and acoustic techniques.

1. Deploying sensors and instruments where they need to is a logistical problem that frequently determines the success of a particular sensor application.

2. Extracting information from data cheaply and quickly a tremendous problem is, and the masses of data we can expect from any of the systems we have discussed will overload our primitive data processing and management systems.

III. Conclusions from the Presentations

1. The principal short-term need of optical and acoustic instrumentation deployed at or beneath the sea surface, is gear development. Recent advances in both optical and acoustic technology have shown promise for increasing the scope and resolution of these types of instrumentation. However, additional focused gear development is necessary before these advances can be fully exploited in oceanic biology.

2. Intermediate-term progress in real-time assessment will require the integration of optical and acoustic technologies.

3. The long-term need of optical and acoustic methods is the development of routine procedures for handling of a large volume of data and the development of analytical and interpretive procedures that exploit existing methods for presenting and visualizing data.

IV. Future Needs

After discussions of existing or developing systems, the groups discussed what is needed to make the next step and accomplish real-time assessment of the distribution, diversity and dynamics of water column biota. The discussion identified three fundamental requirements:

1 - species recognition

2 - resolution of spatial distribution patterns

3 - measurement of temporal distribution dynamics

Traditionally, acoustical methods have been used for biomass assessment, but with little or no capability for real-time or delayed species recognition. Optical methods on the other hand allow for species recognition but have not been broadly applied to patterns of distribution or quantitative assessments. Acoustic and optical methods provide complementary information which, when integrated, offer the greatest promise for significant progress in research.

V. Summary

At the present time the most productive area for technological emphasis by the Navy would be to promote the interface and integration of acoustic and optical systems. In general, researchers have expertise and resources in only one of these technologies. As a result, up to

the present there have been only desultory attempts at combining the methods. By fostering gear development, field research, and analysis procedures, which bring together the two technologies ONR will make a significant contribution to the development of "next generation" methodologies for assessing the biota of the water column.

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The purpose of this summary is to provide advice to the Navy with regard to the technological needs of the oceanographic community, to implement the real-time assessment of the distribution, diversity and dynamics of the biota of the oceanic water column.

The important distinctions here are not between optical and acoustic methods, but between satellite, sea-surface and sub-surface deployments of instrumentation.

The long-term needs of satellite-based ocean research appear today to be chiefly those of processing enormous volumes of data. In contrast, the principal short-term needs for both optical and acoustic instrumentation deployed beneath the sea surface, is gear development. Recent advances in both optical and acoustic technology have shown real promise for increasing the scope and resolution of these types of instrumentation.

With the goal of assessing the biota of the oceanic water column, we can identify three fundamental needs: 1) species recognition; 2) resolution of spatial distribution patterns; 3) measurement of temporal distribution dynamics.

Traditionally, acoustical methods have been used for biomass assessment, with little or no capability for real-time species recognition. Optical methods on the other hand allow for species recognition but have not been broadly applied to patterns of distribution. Acoustic and optical methodologies provide complementary types of information which, when integrated, offer the greatest promise for significant progress in research.

At the present time the most promising area for technological emphasis by the Navy would be to promote the interface and integration of acoustic and optical systems. In general, researchers have expertise and resources in only one of these technologies. As a result, there have been only desultory attempts at combining the methods. By fostering field research programs which bring together the two technologies ONR could make a significant contribution to the development of "next generation" methodologies for assessing the biota of the water column.