ATO Maritime Programs

Maritime warfare today is fast and lethal.
It is especially so in the littoral environment, where enemies are much closer and their identities harder to sort out among throngs of neutrals and friendlies.
The challenges of littoral warfare are, in fact, somewhat similar to those of urban warfare-a historic strength and area of interest for ATO.

What are the operational imperatives in the littoral?
A major one is the rapid kill of anti-access defense.
To do this, we are going to have to deploy networked systems that are persistent and pervasive throughout the littoral-agents with precision and volume effects.

In the conflicts of the future, we will also want to deploy smaller, cheaper, and more expendable assets.
Instead of putting billion dollar platforms at risk, we want to dispatch assets that cost $100's or even 10's of thousands.
This will require sensors that are far more penetrating and versatile than anything we can field at the present.

We want these systems to be unmanned or lightly manned.
And when we do have send in our people, we will want to do so with impunity.

These are tall orders that run smack up against the limits of current technology.

We can see those limits illustrated here, as the numbers and complexity of our agents increase.
One way to transcend these limits is to turn to new, disruptive technologies.

New networked approaches will have to include independently intelligent and collectively effective mobile agents which can function as a system in a non-hierarchical way.
They must have the ability to be self-configuring and adaptive to the changing behavior of the enemy.

This means getting away from the model of funneling information back to a mother ship for interpretation and action.
It means moving toward low-power, enduring, mobile vehicles, as well as low-power, multi-modal sensing and signal processing.
Above all, it means a network.

Anup mentioned the human immune system as a model network.
Let me suggest another biologically based model: the ant.
Lewis Thomas, writer and scientist, writes in The Lives of a Cell that an individual ant is "like a ganglion on legs."
But "four ants together, or ten, encircling a dead moth on a path, begin to look more like an idea."
With a dense mass of thousands of ants, "you begin to see the whole beast, and now you observe it thinking, planning, calculating.

It is an intelligence, a kind of live computer."

An ant colony can only function if the actions of its individuals are coordinated by chemical signals.
So, too, will our intelligent agents work in harmony only if we can provide a reliable and secure network to link them.

With this as background, I'll review several broad areas of promising future inquiry.

Take Anti-Submarine Warfare.
The current model for ASW is based around multiple platforms equipped to detect, classify, localize and track or prosecute a target.

We presently find ourselves struggling to squeeze the last decibel out of the sonar equation using large aperture arrays and complex signal processing techniques which are becoming increasingly expensive and burdensome to operate.
Add to these, the new dangers of working in the shallow littoral.

ATO seeks to seed the littoral with many intelligent agents that can communicate with each other, localize the target, maneuver, and see the mission through, from detection to prosecution.
If we can achieve this, we can hold the enemy continuously at risk.

Our challenge is this-Can we trade complex, expensive systems on single, high-value platforms for a network of simpler, less expensive platforms that create real synergies from group behavior?
We want to use semi-autonomous assets with rather limited on-board intelligence-like an ant-and field these agents as smart, mobile, long-endurance sensors that can operate independently within the network.

Can these agents self-organize without having to resort to a hierarchy with inherent point vulnerabilities?
Can our components employ a common communications and networking scheme?
Can an ASW sensor, deployed one hundred nautical miles offshore, be interoperable with an unmanned ground sensor deployed by a US Marine 200 miles inland?

These are the kinds of questions we want to take on and we will need your research and technology ideas to answer them.

We need breakthroughs in mine counter-measures.
The traditional sonar mine detection problem has four steps-detection, discrimination, classification, and identification.
The natural temptation has been to develop a killer sonar, a revolutionary increase in the resolution that will boost the last three steps.

Perhaps it is asking too much to use the same sensor to discriminate, classify, and identify.

With a fleet of mobile sensor, that is UUVs, the functionalities can be optimized separately.

This is the idea behind DARPA's Circular Synthetic Aperture Sonar program; a fleet of small UUVs circling the target for a total picture, and then tagging or neutralizing the mine.
We intend to demonstrate a 10-fold increase in sweep rates, and improve our mine identification capability using ATR to 95 percent.
To cut through the clutter, however, we will need your best ideas.

Technologies that would advance our work here-and elsewhere-include Real-Time Scene Understanding, and Intelligent Decision Algorithms, possibly with Abductive Inferencing techniques, Tomographic Imaging Spotlight SAS, as well as Benthic or Pelagic Tagging Techniques, and other ways to use cascaded UUVs.
That's the mission.

Thus far, I've been talking about an evolution when hostilities have clearly arisen.
A sustained presence is much more likely to be a game breaker if the battlespace is ours to begin with.
What if we could persist in our knowledge long before the forces arrive? Surveillance systems, both stationary and mobile, will be needed in salt- and freshwater littorals to give us environmental and situational intelligence that may be critical to the operational plan.
This can be a lifesaver for those early entry force components such as the SEALs and the Marines.

ATO is looking at biomimetics to imitate the longevity and sensitivity of marine organisms, allowing us to monitor ocean environments, at all times and everywhere.

We want research that gives us ability to deploy such sensors based on sustainable, microbial fuel cells-generating energy from the methane extracted from plankton, much like baleen whales.

These devices would generate continuous power in ocean and freshwater regions-without servicing or inspection for at least a decade.

To make this Sustained Presence a reality, we need to leverage your ideas and research in the location and characterization of methane seep, methane hydrates, and thin-layer phyto and zooplankton concentrations in the water column.
We are interested in your research in many areas, ranging from microbial genome and species determination, to microbial metabolism modeling, dynamic electro-chemical product tagging and monitoring, as well as electrode material and catalyst technologies.

Such sensors will help reduce the need to place our people at risk.

But when we do send in people, as I said earlier, we will want to do so with impunity.

This is the idea behind ATO's Electric Curtain program, already well under way.
Electric Curtain is developing an anti-torpedo defense that utilizes pressure shock waves to destroy incoming torpedoes.
When a torpedo is detected, an array of transducers steers and focuses the shock wave energy, essentially creating a killing field of overpressure that destroys the torpedo when it comes within this field.

The Electric Curtain would require no conventional ammunition and would leverage the power of electric ships.

While we are not soliciting proposals for Electric Curtain, I mention it to stimulate your thinking.
We are interested in other disruptive technologies we can bring to bear in defending our assets in the littoral.

The graph I showed at the outset dramatized the need for disruptive technologies.
But we also want you to think about creative ways to leverage big gains by "turbo-charging" platform investments with emerging technologies.
Let me cite two programs well underway that might inspire you to propose similar applications.

The Navy, Marines and Air Force still use the EA-6B Prowler as a standoff means to suppress enemy air defenses.
A Vietnam War-era craft, it is currently on its third set of wings, with legacy electronics.

The electromagnetic coupling between its copper wires limits performance.
DARPA is addressing this and other deficiencies by developing high dynamic range laser modulators and receivers that are the equivalent of conventional copper connectors.
The result?
A new signaling infrastructure that allows the plane's exciters, receivers and amplifiers to perform multiple tasks simultaneously.

By taking commercial telecom technology, we have made a revolutionary change, one that allows the EA-6 to adapt to shifting enemy patterns literally "on the fly."

How about lighting?
Most people would not think of lighting as a DARPA issue.
The history of modern naval warfare shows that if you destroy a ship's electrical system, you've crippled or destroyed it - even if it's still afloat.

This is what happened with the HMS Sheffield in the Falklands War.
An Exocet missile brought the ship's aluminum frame into contact with both seawater and electricity-the perfect combination for catastrophic combustion.

ATO's High Efficiency Distributed Lighting, or HEDLIGHT, reduces these risks by replacing a ship's copper wire with fiber optics.
As with the application of photonics in the Prowler, HEDLIGHT will allow changes in electrical distribution, making ship functions safer and more adaptable under attack.

I've spoken of many things here, from disruptive technologies to unconventional applications of newly-emerged technologies.
Throughout, however, there is a single theme.

ATO strives to see the Navy and its maritime mission in non-traditional terms.

We seek ideas, from across disciplines, and from people who previously might never have considered their ideas to have maritime applications.

We need to leverage all technologies...

From the ingenious application of existing commercial technologies-

From terrestrial industries to the littoral environment-

And from disciplines as far-flung as biomemitics and optics.

In short, ATO's maritime work is not a field of inquiry; it's a way of thinking.

ATO is asking you to consider a way of thinking, of problem-solving, that cuts across all fields of science and technology.

Thank you.