The “Message Box”:

A tool for effective communication in and out of science

Diese Flasche wurde über Bord geworfen

am ten 18

in ° ′ Breite

und ° ′ Länge von Greenwich

vom Schiffe: Heimath: Kapitän:

auf der Reise von nach

Der Finder wird ersucht den darin befindlichen Zettel, nachdem die auf umstehender Seite gewünschten Angaben vervollständigt sind, an die

Deutsche Seewarte in Hamburg

zu senden oder auch an das nächste deutsche Konsulat zur Beförderung an jene Behörde abzugeben.

Message in a bottle, released Indian Ocean 1886, beached Western Australia 2018

Developed by Nancy Baron, COMPASS.

The Graduate School Experience

The mind is slow in unlearning what it has been long in learning.

Lucius Annaeus Seneca (ca. 60 CE)

Peter Paul Rubens, *The Death of Seneca (ca. 1615)*

Prepare for reprogramming.

Deployment of a neuralyzer by Agent K, *Men in Black* (1997)

Know thy audience!

Does this support my agenda? Do my constituents care?

What will it cost - time, effort, money? Who supports this?

How does this fit our agenda?

Is it groundbreaking? It is robust? How does it affect my work?

Is it news? Will it sell? Is it a good story?

Does this fit within our portfolio?

How does this affect safety/health, livelihoods and natural resources?

The "So What?" Prism. Adapted from *Escape from the Ivory Tower: A Guide to Making Your Science Matter*, by Nancy Baron (Island Press, 2010).

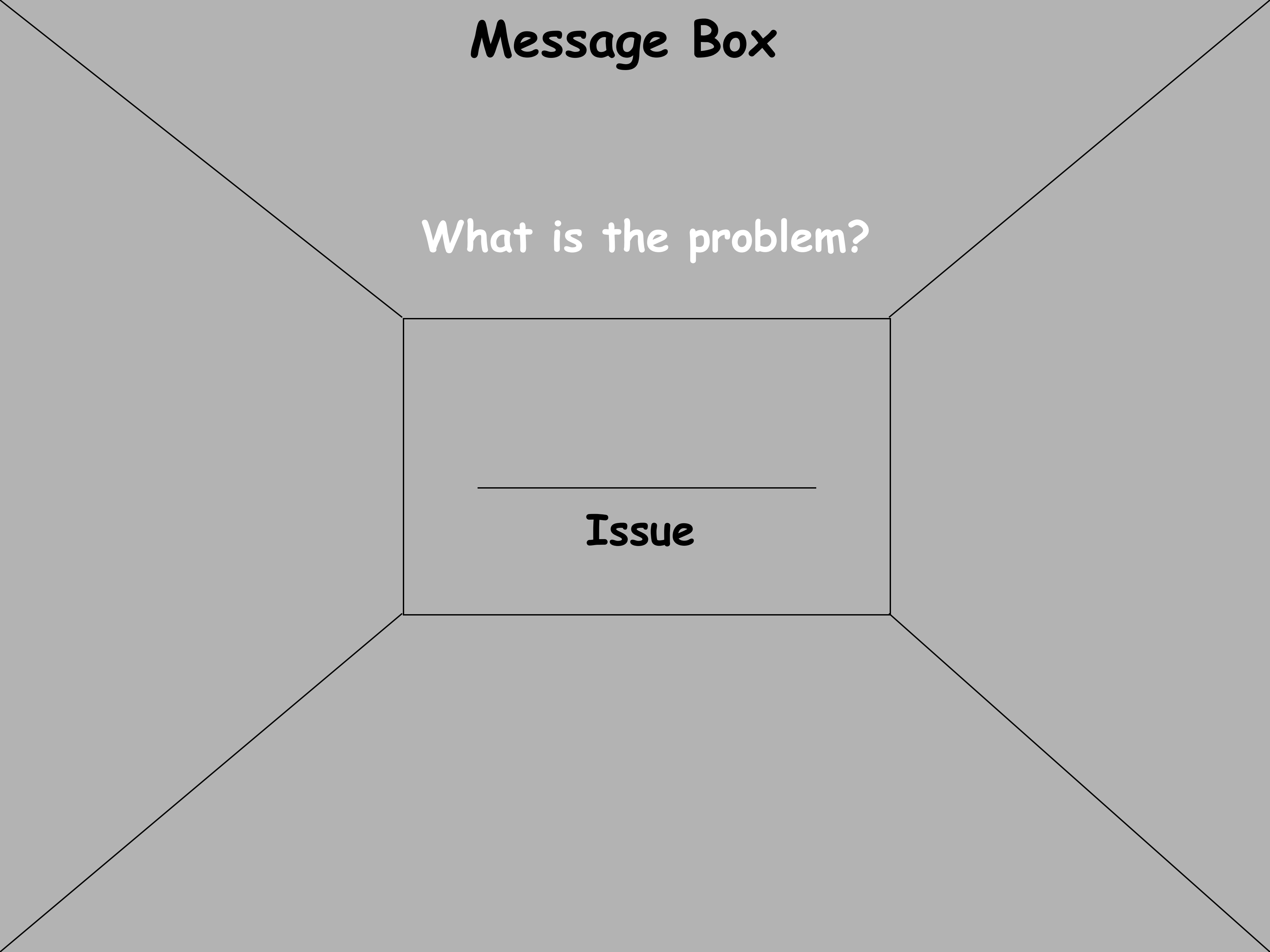
Why use a message box?

- Talking points for an interview
- Explain “what you do” to a non-scientist
- Frame an op-ed piece
- Frame a press release for a new paper
- Frame a reporter contact letter for a new paper
- Provide a storyboard for your web site
- Serve as a framework for a public lecture
- Provide the narrative for a scientific paper (?!)

Message Box

Issue

Message Box



What is the problem?

____

Issue

Message Box

What is the problem?

So What?

____

Issue

Message Box

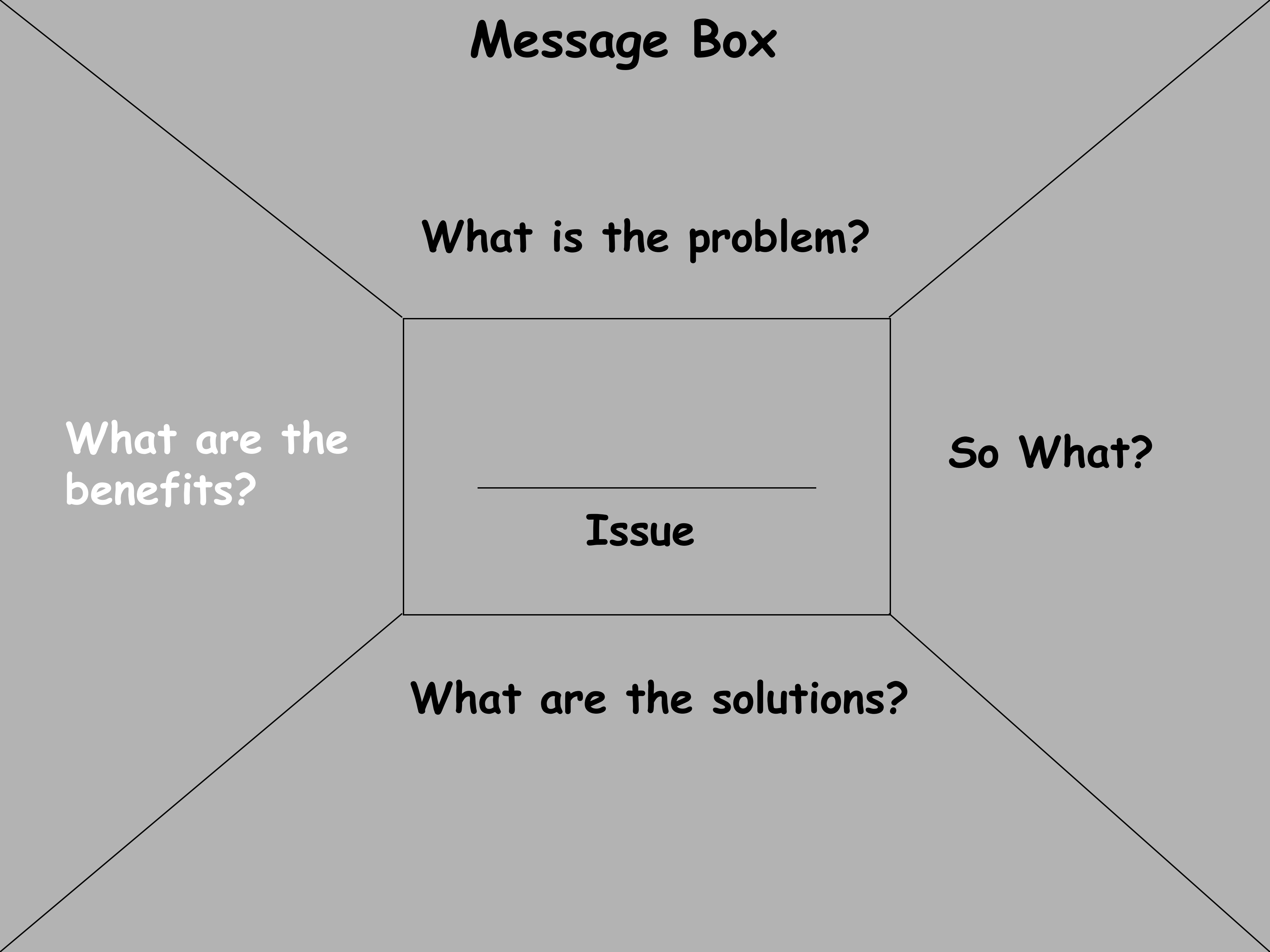
What is the problem?

So What?

Issue

What are the solutions?

Message Box



What is the problem?

What are the benefits?

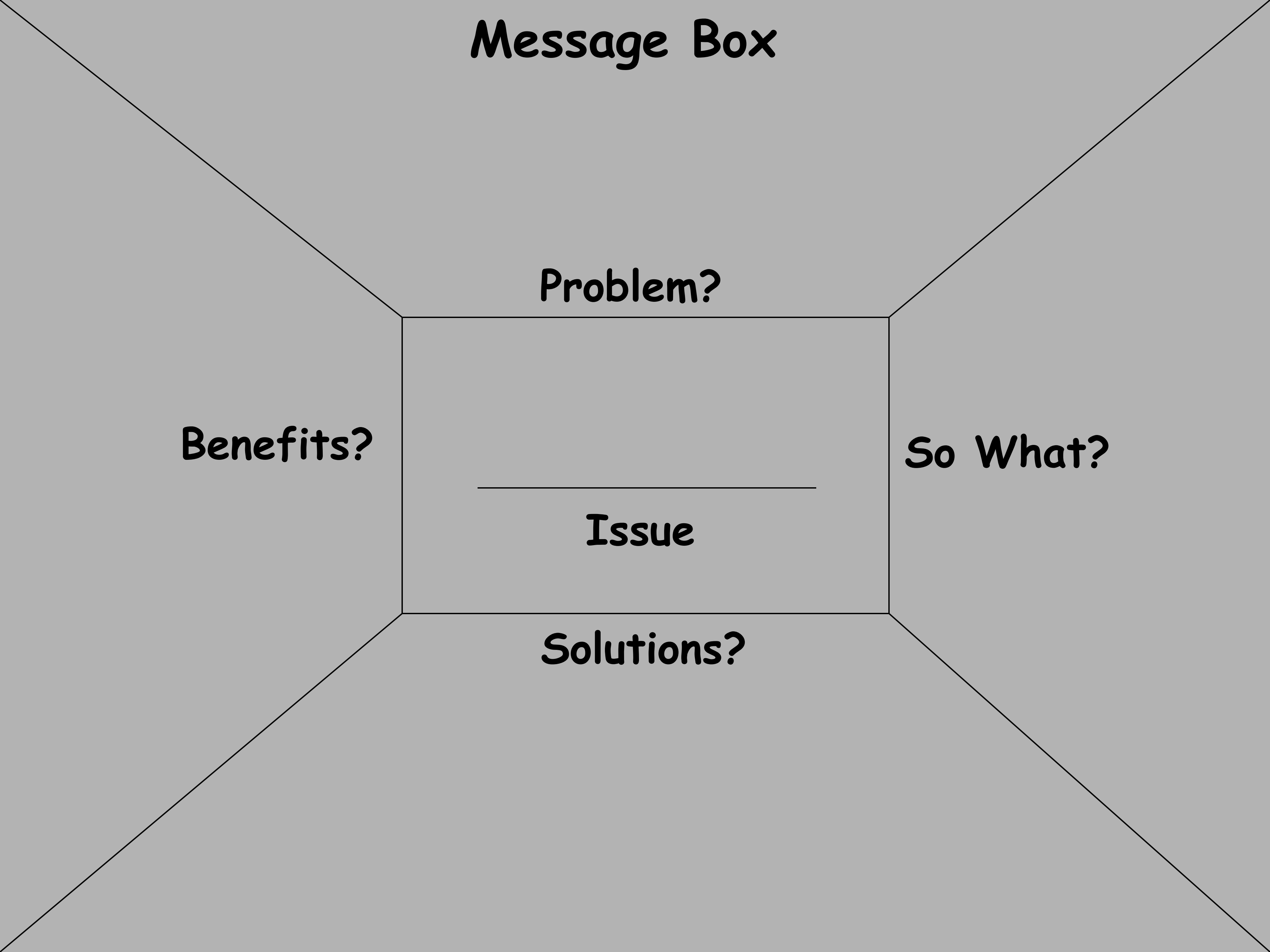
So What?

____

Issue

What are the solutions?

Message Box



Problem?

Benefits?

So What?

Issue

Solutions?

Message box fundamentals for communicating with non-science audiences:

- Limit yourself to one or two messages (four max!)

- Messages should be simple (but *not* simplistic). Simple = capable of being explained in 1-2 sentences.

- Messages are *ideas* you are trying to convey (*not* soundbites!)

- Messages are *reinforced* by soundbites, phrases, statistics, stories/anecdotes

nature

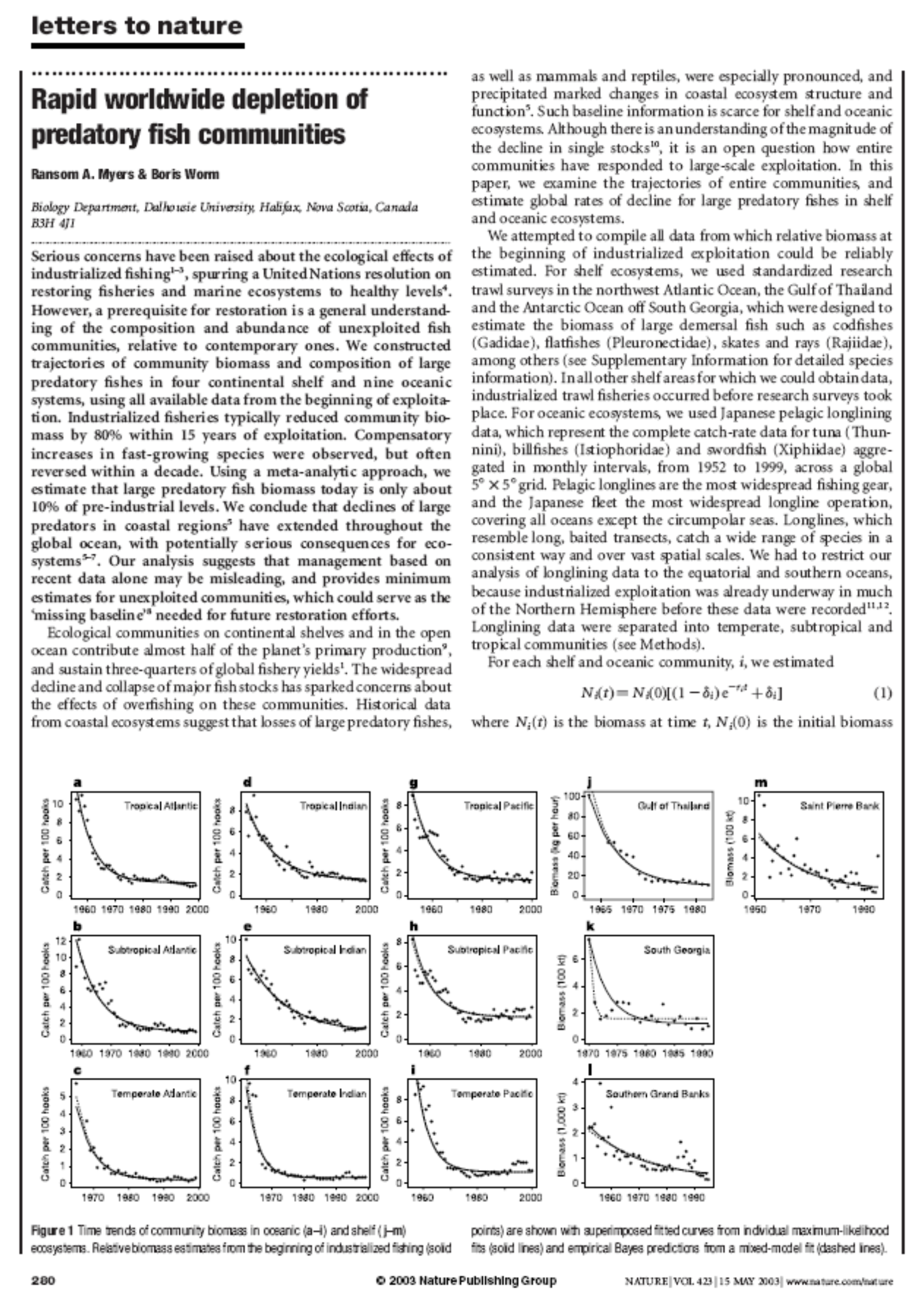
Net losses

Industrialized fishing hits fish stocks

Financial markets

Jupiter's moons

Functional genomics



Rapid worldwide depletion of predatory fish communities

Ransom A. Myers & Boris Worm

Biology Department, Dalhousie University, Halifax, Nova Scotia, Canada B3H 4J1

Serious concerns have been raised about the ecological effects of industrialized fishing[1–3], spurring a United Nations resolution on restoring fisheries and marine ecosystems to healthy levels[4]. However, a prerequisite for restoration is a general understanding of the composition and abundance of unexploited fish communities, relative to contemporary ones. We constructed trajectories of community biomass and composition of large predatory fishes in four continental shelf and nine oceanic systems, using all available data from the beginning of exploitation. Industrialized fisheries typically reduced community biomass by 80% within 15 years of exploitation. Compensatory increases in fast-growing species were observed, but often reversed within a decade. Using a meta-analytic approach, we estimate that large predatory fish biomass today is only about 10% of pre-industrial levels. We conclude that declines of large predators in coastal regions[5] have extended throughout the global ocean, with potentially serious consequences for ecosystems[5–7]. Our analysis suggests that management based on recent data alone may be misleading, and provides minimum estimates for unexploited communities, which could serve as the 'missing baseline'[8] needed for future restoration efforts.

Ecological communities on continental shelves and in the open ocean contribute almost half of the planet's primary production[9], and sustain three-quarters of global fishery yields[1]. The widespread decline and collapse of major fish stocks has sparked concerns about the effects of overfishing on these communities. Historical data from coastal ecosystems suggest that losses of large predatory fishes, as well as mammals and reptiles, were especially pronounced, and precipitated marked changes in coastal ecosystem structure and function[5]. Such baseline information is scarce for shelf and oceanic ecosystems. Although there is an understanding of the magnitude of the decline in single stocks[10], it is an open question how entire communities have responded to large-scale exploitation. In this paper, we examine the trajectories of entire communities, and estimate global rates of decline for large predatory fishes in shelf and oceanic ecosystems.

We attempted to compile all data from which relative biomass at the beginning of industrialized exploitation could be reliably estimated. For shelf ecosystems, we used standardized research trawl surveys in the northwest Atlantic Ocean, the Gulf of Thailand and the Antarctic Ocean off South Georgia, which were designed to estimate the biomass of large demersal fish such as codfishes (Gadidae), flatfishes (Pleuronectidae), skates and rays (Rajiidae), among others (see Supplementary Information for detailed species information). In all other shelf areas for which we could obtain data, industrialized trawl fisheries occurred before research surveys took place. For oceanic ecosystems, we used Japanese pelagic longlining data, which represent the complete catch-rate data for tuna (Thunnini), billfishes (Istiophoridae) and swordfish (Xiphiidae) aggregated in monthly intervals, from 1952 to 1999, across a global 5° × 5° grid. Pelagic longlines are the most widespread fishing gear, and the Japanese fleet the most widespread longline operation, covering all oceans except the circumpolar seas. Longlines, which resemble long, baited transects, catch a wide range of species in a consistent way and over vast spatial scales. We had to restrict our analysis of longlining data to the equatorial and southern oceans, because industrialized exploitation was already underway in much of the Northern Hemisphere before these data were recorded[11,12]. Longlining data were separated into temperate, subtropical and tropical communities (see Methods).

For each shelf and oceanic community, i, we estimated

$$N_i(t) = N_i(0)[(1-\delta_i)e^{-r_i t} + \delta_i] \qquad (1)$$

where $N_i(t)$ is the biomass at time t, $N_i(0)$ is the initial biomass

Figure 1 Time trends of community biomass in oceanic (a–i) and shelf (j–m) ecosystems. Relative biomass estimates from the beginning of industrialized fishing (solid points) are shown with superimposed fitted curves from individual maximum-likelihood fits (solid lines) and empirical Bayes predictions from a mixed-model fit (dashed lines).

Problem?

*Large-fish biomass declined by >90% across the global ocean (baseline pior to industrial exploitation – 10X more large fish)
*Initial declines very rapid and poorly documented; thus management tends to underestimate decline
*Species composition has undergone large changes too
*The entire ocean has been transformed, no "blue frontier" remains
*Changes uniform from tropics to poles, from shores to open ocean

Global overfishing

Issue

Benefits?

*Among the last free-ranging large animals on earth
*Most valuable wild animals on earth
*Huge economics benefits
*Important ecological roles
*Lions & tigers of the sea
*Large land mammals, then freshwater fish, then coastal fish – now everything else!

So What?

*Fisheries will suffer and maybe collapse
*This will have big ecosystem consequences (but we don't know exactly what will happen)
*Populations and species may go extinct

Solutions?

*Reduction of fishing pressure will help recovery
*Reduce fishing effort (but hard to control because fishing pressure increases)
*Reduce quota (but hard to achieve and on its own almost always insufficient)
*Develop more marine reserves (many promising examples, almost always halt declines)

Problem?

Overfishing has removed 90% of large fish globally

So What?

This threatens survival of sensitive species, viability of fishing, and functioning of ocean ecosystems

Global overfishing

Issue

Benefits?

Protection of large predatory fish will maintain economic and ecological values

Solutions?

Reduce fishing pressure by lowering quotas, modifying fishing gear, and implementing reserves

Beyond Predictions: Biodiversity Conservation in a Changing Climate

Terence P. Dawson,[1] Stephen T. Jackson,[2] Joanna I. House,[3] Iain Colin Prentice,[3,4,5] Georgina M. Mace[4,6]*

Climate change is predicted to become a major threat to biodiversity in the 21st century, but accurate predictions and effective solutions have proved difficult to formulate. Alarming predictions have come from a rather narrow methodological base, but a new, integrated science of climate-change biodiversity assessment is emerging, based on multiple sources and approaches. Drawing on evidence from paleoecological observations, recent phenological and microevolutionary responses, experiments, and computational models, we review the insights that different approaches bring to anticipating and managing the biodiversity consequences of climate change, including the extent of species' natural resilience. We introduce a framework that uses information from different sources to identify vulnerability and to support the design of conservation responses. Although much of the information reviewed is on species, our framework and conclusions are also applicable to ecosystems, habitats, ecological communities, and genetic diversity, whether terrestrial, marine, or fresh water.

Alarming predictions about the potential effects of future climate change are prompting policy responses at local to global levels (*1*, *2*). Because greenhouse gas emissions to date commit Earth to substantial climate change in the coming decades (*3*), the potential for loss of biodiversity, termination of evolutionary potential, and disruption of ecological services must be taken seriously. Averting deleterious consequences for biodiversity will require immediate action, as well as strategic conservation planning for the coming years and decades. But how good are our current predictions, and how fit are they for conservation planning purposes?

To date, assessments of climate-change impacts on biodiversity have largely been based on empirical niche (or climate-envelope) models (*4*). For most species, these models indicate large geographic displacements and widespread extinctions. However, niche models are best suited to identifying exposure to climate change, which is only one aspect of vulnerability. Assessing biodiversity consequences of climate change is a multifaceted problem, requiring consideration of all aspects of vulnerability: exposure, sensitivity, and adaptive capacity (*5*) (see Box 1). Additional sources of evidence include observations of responses to climate changes (both past and present), experiments, and mechanistic (process) modeling based on ecophysiology and population biology. These studies show a range of natural coping mechanisms among populations exposed to climate change, with diverse consequences for resilience at local to global scales. The capacity to cope depends on both intrinsic factors (species biology, genetic diversity) and extrinsic factors (rate, magnitude, and nature of climatic change). Integration of multiple approaches and perspectives is needed for more accurate information about which species and habitats, in which places, are likely to be most at risk, as well as how conservation managers can leverage adaptive capacities in natural systems to maximum advantage. There is a wealth of knowledge upon which to draw.

How Reliable Is the Current Generation of Predictions?

Climate-change impacts on biodiversity, both positive and negative, are already manifest in recent widespread shifts in species ranges and phenological responses (*6*, *7*). Although human land use remains the main driver of present-day species extinction and habitat loss (*8*), climate change is projected to become equally or more important in the coming decades (*9*, *10*). Assessing the biodiversity consequences of climate change is complicated by uncertainties about the degree, rate, and nature of projected climate change (*11*), the likelihood of novel and disappearing climates (*12*), the diversity of individual-species responses to a broad suite of interacting climate variables (*6*), and interactions of climate-change effects with other biotic factors (e.g., competition, trophic relationships) and stressors (land use, invasive species, pathogens, pollutants) (*13*, *14*).

Syntheses of climate change and biodiversity

for
an
on
eli
Th
tw
pa
da
cia
the
cir
sp
sc
to
ha
int
pr
for
ass

Box 1. Vulnerability in the context of climate

Vulnerability is the extent to which a species or popula
genetic loss, or extinction owing to climate change. Vulne
is positively related to vulnerability), sensitivity (positive
related).

Exposure refers to the extent of climate change likely to
depends on the rate and magnitude of climate change (
frequency, and other hazards) in habitats and regions occu
exposure to climate change are based on scenario project
models and applied in niche models.

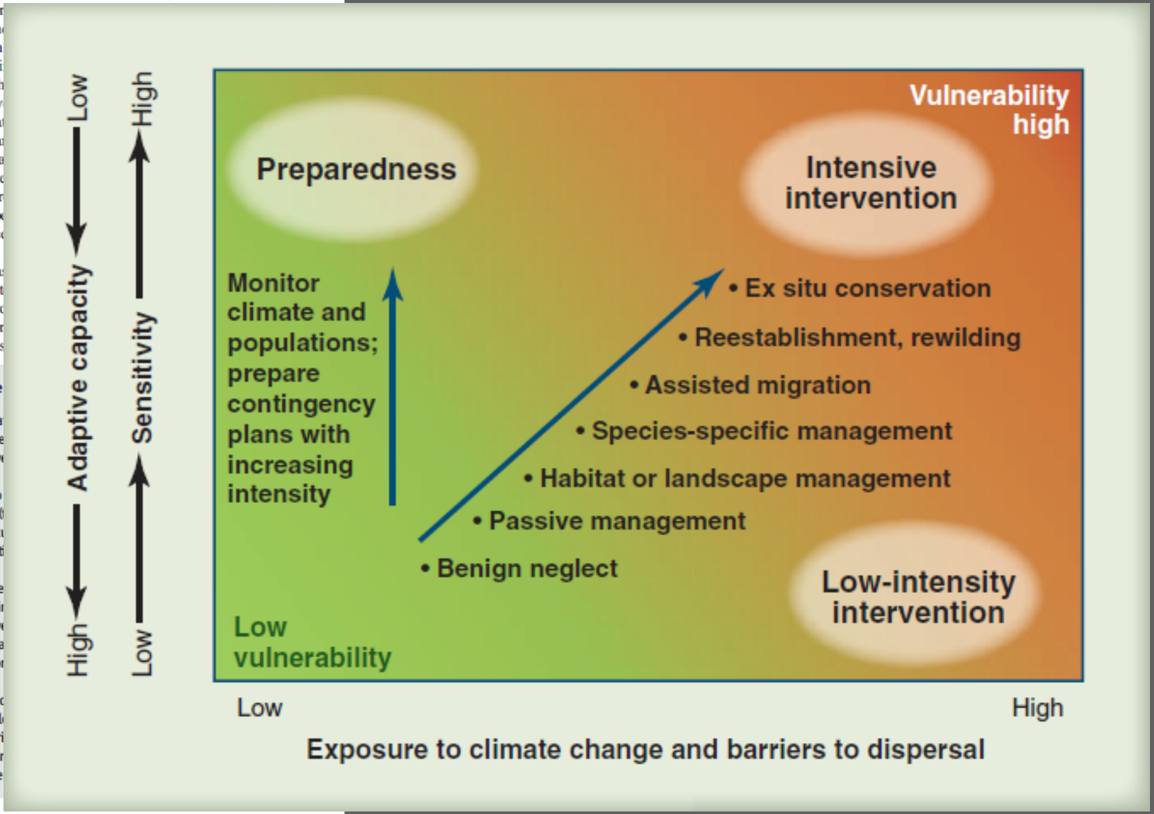
Sensitivity is the degree to which the survival, persiste
species or population is dependent on the prevailing cli
likely to undergo change in the near future. More sensitive
survival or fecundity with smaller changes to climate varia
including ecophysiology, life history, and microhabitat pr
observational, and modeling studies.

Adaptive capacity refers to the capacity of a species o
change by persisting in situ, by shifting to more suitabl
suitable regions. Adaptive capacity depends on a vari
plasticity, genetic diversity, evolutionary rates, life histor
Like sensitivity, these can be assessed by empirical, obse

---

[1] School of the Environment, University of Dundee, Dundee DD1 4HN, Scotland, UK. [2] Department of Botany, Program in Ecology, and Berry Biodiversity Conservation Center, University of Wyoming, Laramie, WY 82071, USA. [3] QUEST, Department of Earth Sciences, University of Bristol, Bristol BS8 1RJ, UK. [4] Grantham Institute for Climate Change and Division of Biology, Imperial College London, London SW7 2AZ, UK. [5] Department of Biological Sciences, Macquarie University, North Ryde, NSW 2109, Australia. [6] Centre for Population Biology, Imperial College London, Ascot SL5 7PY, UK.

*To whom correspondence should be addressed. E-mail: g.mace@imperial.ac.uk



Climate change & biodiversity

Issue

Problem?

Assessment of biodiversity vulnerability relies on a single, incomplete approach: exposure

So What?

Estimates of vulnerability are likely to be inaccurate, leading to failures and wasted resources in conservation

Solutions?

Integrated vulnerability assessment, using multiple sources of evidence, incorporating climate sensitivity and adaptive capacity

Benefits?

More effective management strategies; more efficient use of conservation resources

Records of ecological responses to past climate change indicates many species can cope with climate change.

If we understand mechanisms by which species cope with climate change, we can leverage natural adaptive capacity in conservation efforts

Integration of approaches:

- Observation and monitoring
- Ecological experiments
- Fossil record of responses to past changes
- Models of ecological and evolutionary processes
- Climate-envelope models (status quo)

Flu vaccine: Limited supply, can't vaccinate everyone, so we identify the most vulnerable populations first and treat them

- Low adaptive capacity &/or high sensitivity (very old, very young, sick people)
- High exposure (medical professionals, teachers, social workers)

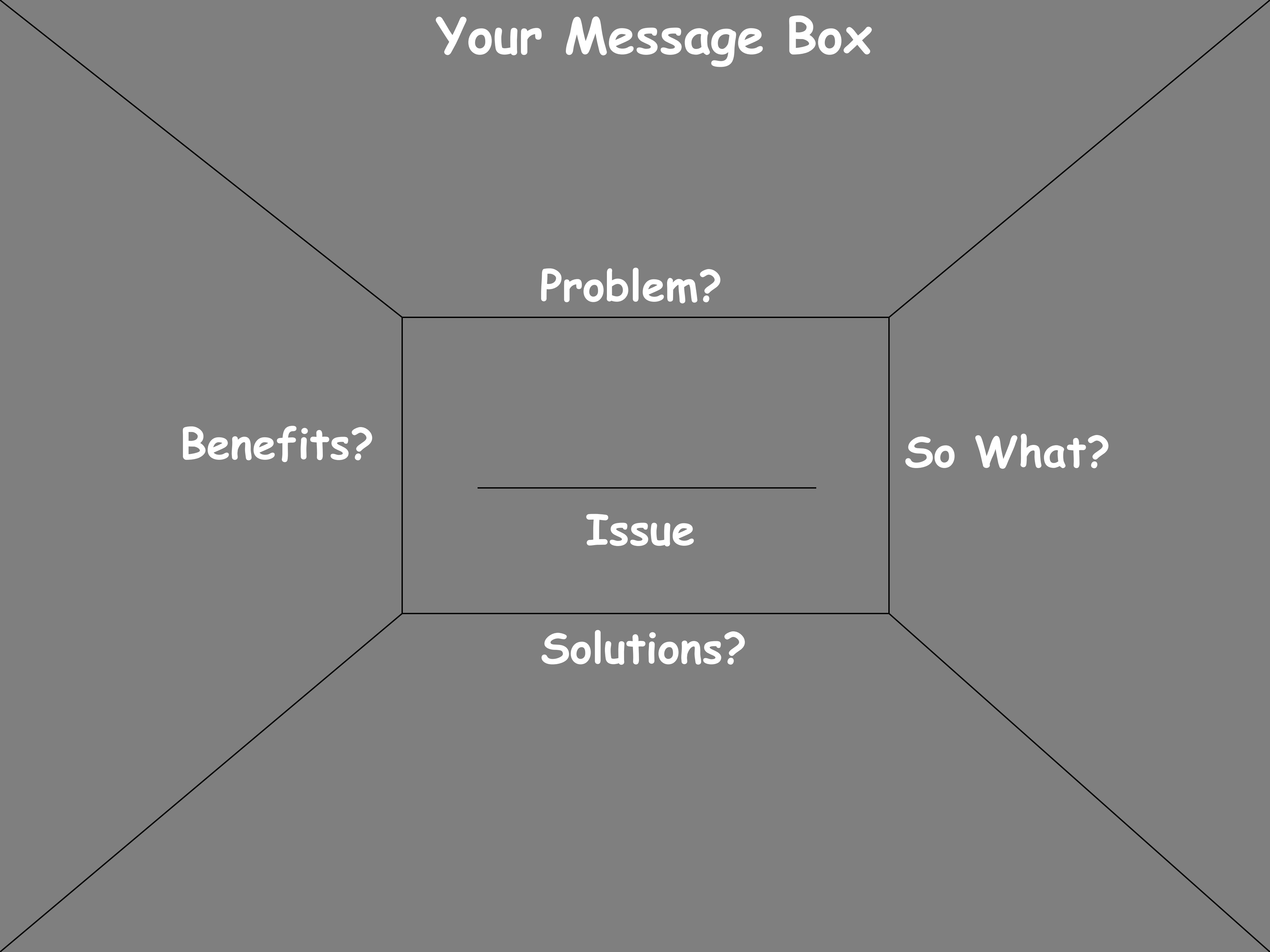
Deficiency in assessing climate-change vulnerability for species

- Exposure assessment good (most species have high exposure)
- Sensitivity and adaptive capacity: unutilized potential

Multiple stressors: climate change X habitat loss X exploitation X invasives

- We can increase resilience and buy time by reducing non-climate stressors

Your Message Box



Problem?

Benefits?

So What?

Issue

Solutions?

Be prepared to support your message:

- Facts close at hand
- Statistics (keep simple and use sparingly)
- Examples
- Metaphors
- Stories and anecdotes (but don't overdo it)
- Other experts