



MULTIMEDIA RESEARCH

33 BROWNS LANE • BELLPORT, NY 11713 • (631) 286-8925

Summative Evaluation of
Earth & Sky NOAA-Sponsored Radio Shows

Report for
Earth & Sky, Inc.

by
Barbara N. Flagg, Ed.D.
Director, Multimedia Research

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TABLE OF CONTENTS

Introduction	1
Method	1
Research design	1
NOAA programs	2
Procedure	2
Post-questionnaire	3
Sample	3
Appeal of NOAA <i>Earth & Sky</i> Shows	4
What was liked	4
What was not liked	5
Appeal statements	6
Clarity of NOAA <i>Earth & Sky</i> Shows	7
Learning Impact of NOAA <i>Earth & Sky</i> Shows	8
Most important to know about Whales	8
How human activities influence whales	9
What scientists have done to lessen human impact on whales	10
Methods and technologies	11
Knowledge of Whales	11
Behavioral Impact of NOAA <i>Earth & Sky</i> Shows	12
Behavioral impact	12
General impact	13
Recall of NOAA Sponsorship	13
Discussion	14

INTRODUCTION

Earth & Sky (E&S) is a short-format science radio series airing daily on more than 1,000 commercial and public radio stations and translators in the U.S. as well as on satellite and Internet radio outlets. The series is also widely heard beyond U.S. borders. Produced by a small non-profit, Earth & Sky, Inc. of Austin, TX, the series is hosted by Deborah Byrd and Joel Block and consists of 90-second programs on a wide variety of topics mostly drawn from environmental sciences, earth sciences and astronomy. In the previous three years, the National Oceanic and Atmospheric Administration (NOAA) has supported the development, broadcast and Internet archiving of 72 shows covering topics based on NOAA data and research findings. This report presents a summative evaluation assessing the appeal and learning impact on listeners of a small subset of *Earth & Sky* NOAA shows.

METHOD

Research Design

The summative evaluation utilized an online survey with a posttest-only control group experimental design (see Table 1). In this study, adults across the nation were randomly assigned to a treatment group and a control group. Random assignment permits us to omit a pretest that might predispose participants to listen for certain content in the shows. During two weeks of weekdays, the treatment group listened to nine daily NOAA shows focused on the topic of whales, while the control group listened to nine shows about Antarctica. On the tenth day, both groups answered the same online survey questions.

Table 1. Research Design for *E&S* NOAA Shows Summative Evaluation

	Listeners randomly assigned to group:	
Listening Days	Treatment Group listens to NOAA whale shows:	Control Group listens to Antarctica shows:
M	<i>Satellites used to track whales in Arctic</i>	<i>Will Antarctica shrink or grow as climate warms?</i>
T	<i>Major ecosystem shift in Arctic seas</i>	<i>Will global warming make Antarctica icier?</i>
W	<i>Experts study dialects in blue whale songs</i>	<i>Global warming cools parts of the Earth</i>
T	<i>Expert calls killer whales "sentinel species"</i>	<i>Lakes under Antarctic ice linked to sea level rise</i>
F	<i>Remember "save the whales?" We haven't yet.</i>	<i>Twin GRACE satellites monitor changes in gravity</i>
S/S	-	-
M	<i>Shipping lanes moved to save whales</i>	<i>Signs of huge Antarctic meteorite impact found</i>
T	<i>Eskimos can continue 2,000-year whale hunt</i>	<i>Penguin oasis depends on marine plants</i>
W	<i>Survival odds slim for stranded marine animals</i>	<i>Small temperature changes, big effects on life</i>
T	<i>Strategies for luring lost whales back to sea</i>	<i>More on unprecedented melt in West Antarctica</i>
F	Completion of online survey	

NOAA Programs

The NOAA-sponsored *E&S* programs cover a wide variety of topics: for example, weather phenomena like drought and hurricanes, climate change, ocean life, coral reefs and wetlands. Programs focusing on whales were chosen for the treatment group because this was a frequently covered topic in the NOAA show list, and nine 90-second shows permitted a reasonable exposure such that changes in knowledge in one content area might be measurable.

The *E&S* programs for the control group focused on Antarctica, because this was also a frequently covered *E&S* topic, not sponsored by NOAA, and nine shows were available.

Procedure

Participants were recruited for the evaluation of *Earth & Sky* at twelve sites across the nation listed below:

Western U.S.	Mid U.S.	Eastern U.S.
Portland, OR	St. Paul, MN	Harvard, MA
Sacramento, CA	Chicago, IL	Boston, MA
Denver, CO	Austin, TX	Long Island, NY
Boulder, CO		Philadelphia, PA
		Miami, FL

Field coordinators at each site recruited from 8 to 12 adults, 18 years and older, with equal gender distribution, and 20% minority representation. In addition to these demographic requirements, each recruited participant had to be a public radio listener and interested in hearing science news but not to the extent of actively seeking out science news through subscriptions to science magazines, e-newsletters, blogs or other publications. The goal was to gather representatives of the less science-attentive public radio listening audience. Additionally, the recruited participants had to have an email account, access to the Internet, and be able and willing to listen daily to 90-second audio files during the two week period of the evaluation. Recruits were told that the study was an evaluation of 90-second daily *Earth & Sky* radio shows but were not told the content of the shows or about the sponsorship of NOAA.

The 100 recruited participants were randomly assigned, stratified by gender, to either the treatment group or the control group. Participants were not aware of the group to which they were assigned.

Daily over a period of nine weekdays, each group received an emailed note from *E&S* with either a URL link to that day's show or an MP3 attachment of the show. Because of logistical difficulties both with email delivery and with *E&S*'s Internet server, the distribution technique changed in the middle of the study from a URL link to an attachment. It was stressed to participants that daily listening was important to mimic the typical *E&S* listening experience; 14% of the total sample reported missing a day but catching up quickly on the next day. On the tenth day, all participants completed an online post-questionnaire. Upon completion, an honorarium of a \$30 gift certificate was emailed.

Post-Questionnaire

The self-administered web-based post-questionnaire was the same for both treatment and control groups. The survey included questions on demographic and background variables; program appeal and clarity; post-listening behavior; and knowledge of scientific methods, whales and Antarctica. The treatment group answered whale questions first followed by Antarctica questions, and the control group's order was reversed. Recognizing that participants might be hesitant to answer questions referring to content that they were not exposed to, the questionnaire explained that there were other people who listened to a set of shows on content different from their shows and that they should try to answer the content questions as best they could.

Sample

The treatment and control groups included 50 participants each who completed the post-questionnaire. However, when asked how many of the nine shows they actually listened to, thirteen participants in the treatment group and nine in the control group reported that they did not listen to all nine programs for a variety of reasons unrelated to the programs' content. These participants were dropped from the data set as not complying with the required protocol, yielding 37 in the treatment group and 41 in the control group.

The treatment and control samples do not differ statistically in their demographic and background characteristics, as presented in Table 1. Both groups have slightly more women than men, with equivalent age distributions. Minorities comprised approximately one-quarter of each sample. Both samples have similar distributions of educational levels and interest in hearing about current science news. Note that two-thirds of both samples 'never hear' *Earth & Sky*.

Table 1. Demographic and Background Characteristics

Classification Variables		Control Group % of N = 41	Treatment Group % of N = 37
Gender	Male	49%	46%
	Female	51%	54%
Age		Range: 23-79 yrs Mean = 42.5 yrs Median = 40 yrs	Range: 25-73 yrs Mean = 44.6 yrs Median = 46 yrs
Race/Ethnicity	White, not of Hispanic origin	71%	78%
	Minority	29%	22%
Highest level of education	High school graduate or less	0%	5%
	Some college or technical	7%	11%
	College graduate	46%	41%
	Courses or degrees beyond college	46%	43%
Frequency of hearing "Earth & Sky"	Hear it at least weekly	0%	5%
	Hear it every once in a while	32%	30%
	Never hear it	68%	65%
Interest in hearing about current science news generally	Very interested	46%	49%
	Somewhat interested	54%	51%
	Not particularly interested	0%	0%
	Not at all interested	0%	0%

APPEAL OF NOAA *EARTH & SKY* SHOWS

Listeners of the NOAA whale shows were asked what they liked most and what they did not like about the *E&S* shows.

What was liked about *E&S* shows

"I enjoyed the topics which brought in concerns I have regarding global warming and sea life. I was happy to hear of a possible sanctuary near Boston and the change in shipping lanes to accommodate the whale. The Eskimos being able to continue to whale was good news also. I could list other facts I learned, but I can say overall that hearing some good news was welcome along with the hard facts. The voices were pleasant and the length of the show was short but very packed with information. I looked forward to checking in with "my" Earth and Sky each day."

Listeners were asked to write what they liked most about the *E&S* shows they listened to. These open-ended responses were sorted by keyword and key phrase into categories. Presented below are the percentages of the treatment sample (N = 37) and illustrative responses for each category obtaining more than 10% of the sample. Listeners liked that the shows are informative, interesting, concise and to the point. They liked the production quality and the expert interviews.

- 54% liked that the shows are informative; e.g.,
Subject matter – it told me new information about something that I knew little about.
Informative.
The shows were very informative and interesting. I learned a lot about whales and the issues impacting them.
I liked that it was about climate changes and how it's affecting a specific species in specific ways. Some reports also talked about solutions under study, which made me feel a little more hopeful.
- 35% liked that the shows are concise and to the point; e.g.,
I liked that they were concise.
They were short and to the point.
They were short and concise. A lot of information in a short amount of time.
It was short/brief, but succinct and complete.
- 30% found the shows interesting; e.g.,
The content was very interesting.
I found the information interesting.
Interested in hearing about whales.
- 30% liked the production quality; e.g.,
Block & Byrd for Earth & Sky, very memorable language. Byrd's voice is well suited to radio.
The tone of the hosts. They sounded informed and friendly.
Well presented, good format.

- 11% enjoyed the hearing from experts; e.g.,
I liked the balanced tone of the shows and the selection of knowledgeable scientists for interview.
The discovery that there are people and organizations that devote major time and energy to protection of wildlife and the environment.
- 11% liked the theme of the shows¹; e.g.,
I liked listening to multiple episodes all related to a single topic (whales).
I liked the thematic nature of the shows.

What was not liked about E&S shows

“That there was a lot of introduction and closing material in the short amount of time allowed. My curiosity was just getting engaged when it was over.”

Listeners were asked to write what they did not like about the *E&S* shows they listened to. These open-ended responses were sorted by keyword and key phrase into categories. Presented below are the percentages of the treatment sample (N = 37) and illustrative responses for each category obtaining more than 10% of the sample. The main complaint about *E&S* is that it is too short with too little detail.

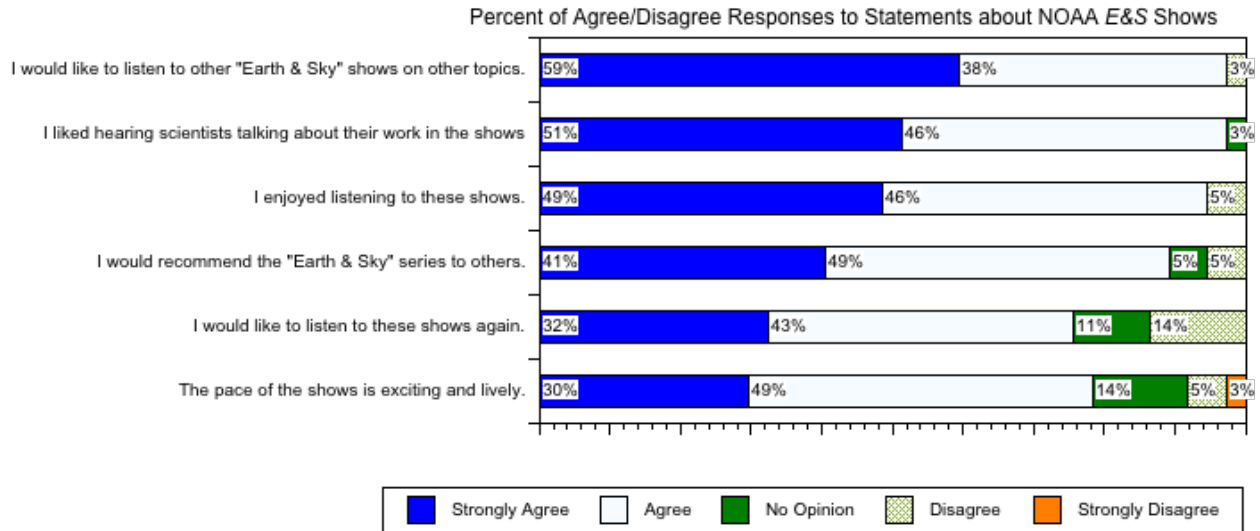
- 35% felt the shows are too short with too little detail; e.g.,
The time frame was too short, and it could have been double the current time and I would have still tuned in to listen.
More info would have been good.
The very short nature of each broadcast. I barely started to connect with the theme and it was over.
Too short – not enough information.
- 22% wanted more variety beyond the theme of whales (the thematic focus is an artifact of the research study’s design).
Too much on one topic. Whales, whales and more whales. I would like more diversity.
I didn’t necessarily like that they were all on the same general topic of global warming and marine life.
- 11% commented on the production quality; e.g.,
I’m not crazy about music in the background.
The hosts had no personality. It could have been more fun to listen to if they were more personable.

¹ The daily focus on whales is an artifact of the study design. Typically, *Earth & Sky* content varies more widely.

Appeal of *E&S*

Listeners of the whale shows rated their level of agreement with several statements about show appeal. The chart below presents ratings for six agree/disagree statements about appeal of *E&S*.

- Almost all listeners would like to listen to *E&S* shows on other topics (97%), liked hearing scientists talking about their work (97%), and enjoyed listening to these shows (95%).
- Nine out of ten listeners (90%) would recommend the *E&S* series to others.
- Eight out of ten found the pace of the shows exciting and lively (79%).
- Three-quarters would like to listen to these shows again (75%).

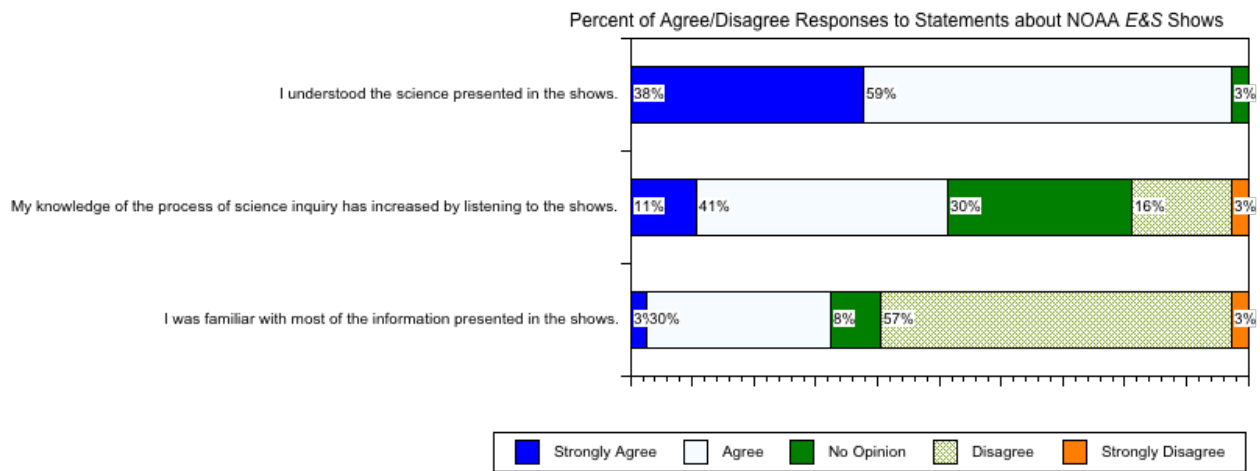


CLARITY OF *EARTH & SKY* NOAA SHOWS

Listeners of the NOAA whale shows were asked to rate their level of agreement with several statements about the information presented in the shows.

The chart below presents ratings for three agree/disagree clarity statements.

- 97% of listeners understood the science presented in the shows.
- 52% felt that their knowledge of the process of science inquiry was increased by listening to the shows.
- 33% were familiar with most of the information presented in the shows, indicating that most listeners felt they were being exposed to new information.



LEARNING IMPACT OF NOAA *EARTH & SKY* SHOWS

Most important to know about whales

Respondents described what they felt is most important for people to know about whales. Six categories fully describe the data set:

1. Human activity (whaling, overfishing, pollution, climate change) has a significant impact on whales' health and well-being
2. Whales must be respected and protected as part of the planet's ecosystem
3. Whales are intelligent
4. Whales are mammals
5. Whales migrate
6. Don't know

Each category was coded dichotomously according to whether or not an open-ended response fit into the category. A respondent could describe more than one category in their response. Table 2 presents the percent of treatment and control group respondents falling into each category. The control group was significantly more likely than the treatment group to say that it is most important for people to know that whales are mammals;² otherwise, there were no significant differences between the groups.

Table 2. Category Percentages for What is Most Important for People to Know about Whales

Category	Treatment Group	Control Group
Human activity (whaling, overfishing, pollution, climate change) has a significant impact on whales' health and well-being	51%	34%
Whales must be respected and protected as part of the planet's ecosystem	46%	34%
Whales are intelligent	5%	12%
Whales are mammals	0%	29%
Whales migrate	0%	10%
Don't know	3%	12%

² Fisher Exact test = 0.0002. Fisher Exact Test is a non-parametric statistic used with categorical data to assess the statistically significant difference between two groups of small samples.

How Human Activities Influence Whales

Respondents listed as much as they could about how human activities influence whales. The NOAA shows suggested the following possibilities: Collisions with ships; changes in climate impacts migration patterns; whaling and overfishing; and chemical contaminants in the ocean.

Six categories fully describe the data set or open-ended responses:

1. Collisions with ships
2. Whaling and overfishing
3. Chemical contaminants; pollution
4. Climate change influencing migration, beaching, or food sources
5. Sound, Sonar
6. Helping beached or disoriented whales (a positive influence)
7. Don't know

Each category was coded dichotomously according to whether or not an open-ended response fit into the category. A respondent could describe more than one category in their response. Table 3 presents the percent of treatment and control group respondents falling into each category. The treatment group was significantly more likely than the control group to say that humans influence whales in collisions with ships;³ indeed, two-thirds (62%) of the whale show listeners put this idea forward compared with 2% of the control group; otherwise, there were no differences between the groups.

Table 3. Category Percentages for How Human Activities Influence Whales

Category	Treatment Group	Control Group
Collisions with ships	62%	2%
Whaling and overfishing	62%	68%
Chemical contaminants; pollution	43%	56%
Climate change influencing migration, beaching, or food sources	41%	39%
Sound, Sonar	14%	27%
Helping beached or disoriented whales	8%	0%
Don't know	8%	12%

³ Fisher Exact test ≤ 0.0001

What Scientists have done to Lessen Human Impact on Whales

Respondents listed as much as they could about what scientists have done to lessen human impact on whales. The NOAA shows suggested the following possibilities: Changing shipping lanes to lower whale strikes; responding to whale beachings; guiding disoriented whales back to the ocean; monitoring populations and migrations; making data-based recommendations to control whaling and hunting; and raising awareness through public education.

Six categories fully describe the data set or open-ended responses:

1. Changing shipping lanes to lower whale strikes
2. Responding to whale beachings
3. Guiding disoriented whales back to the ocean
4. Monitoring populations and migrations
5. Making data-based recommendations to control whaling and hunting
6. Raising awareness through public education
7. Controlling sonar use
8. Don't know

Each category was coded dichotomously according to whether or not an open-ended response fit into the category. A respondent could describe more than one category in their response. Table 4 presents the percent of treatment and control group respondents falling into each category. The treatment group (89%) was significantly more likely than the control group (54%) to be able to describe something that scientists have done to lessen human impact on whales. The treatment group was significantly more likely to mention changing shipping lanes to lower whale strikes⁴, guiding disoriented whales back to the ocean⁵, and responding to whale beachings⁶.

Table 4. Category Percentages for What Scientists have done to Lessen Human Impact on Whales

Category	Treatment Group	Control Group
Changing shipping lanes to lower whale strikes	62%	2%
Making data-based recommendations to control whaling and hunting	41%	34%
Guiding disoriented whales back to the ocean	32%	0%
Monitoring populations and migrations	22%	12%
Responding to whale beachings	11%	0%
Raising awareness through public education	11%	17%
Controlling sonar use	5%	5%
Don't know	11%	46%

⁴ Fisher Exact test ≤ 0.0001

⁵ Fisher Exact test ≤ 0.0001

⁶ Fisher Exact test = 0.046

Methods and Technologies

Treatment respondents were asked in an open-ended question to list methods and technologies used by scientists in the shows to gather images, collect data or come to conclusions. In the nine whale shows, the mentioned methods included satellite transmitter tracking; counting, sightings and visual surveys; blubber analysis; and recording of whale sounds. Close to half (46%) of the NOAA listeners noted the recordings of whale sounds, and 41% described a tagging and tracking method. One-third (32%) mentioned counting, sightings or visual surveys; whereas 19% recalled tissue analysis, and 16% described using sound to move whales from one place to another. One-quarter (24%) of listeners could not recall any of the methods or technologies used.

Knowledge of Whales

Respondents were asked a series of true-false-don't know questions to establish their specific knowledge of the programs' whale content. All statements were randomly ordered for each respondent.

- Indicate whether each statement is true, false, or you don't know.
 - F: Blue whale songs sound the same no matter what part of the world's oceans they are in.
 - T: North Pacific right whales are near extinction.
 - F: Man-made chemicals are not found in large ocean animals like whales.
 - T: Climate changes affect whale migration patterns.
 - T: Whales are mammals.

Each correct answer received one point, and "don't know" responses were scored as incorrect, with a potential total of 5 points for this content test. The treatment group who listened to nine shows about whales produced a mean score of 4.3 (SD = 0.87), and the control group who listened to nine shows about Antarctica produced a significantly lower mean score of 3.5 (SD = 1.1).⁷ Thus, the whale shows significantly increased listeners' knowledge of the topic measured by the five statements.

⁷ $t(74) = 3.393, p = 0.0011$.

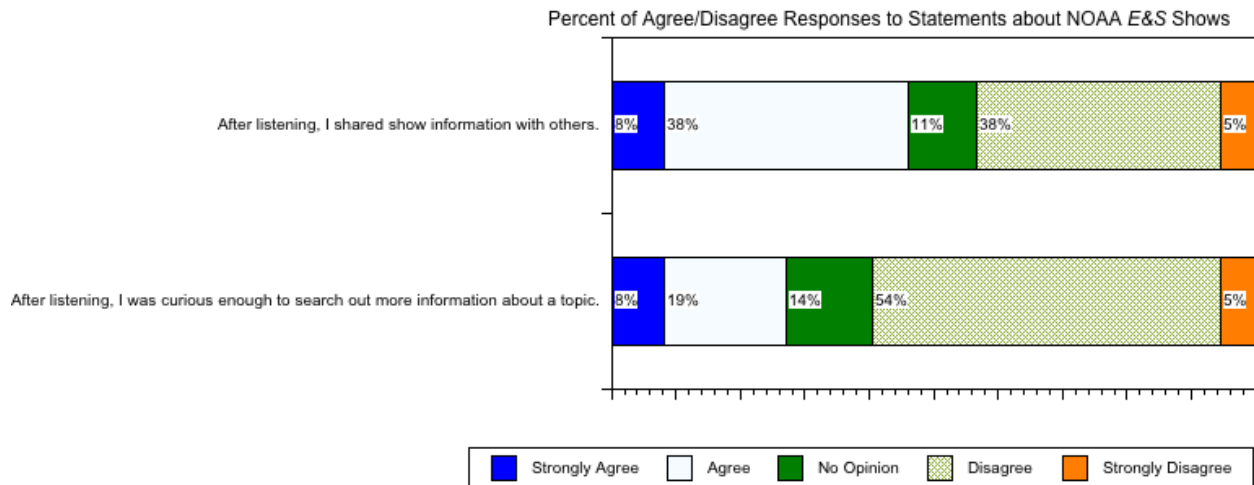
BEHAVIORAL IMPACT OF *EARTH & SKY* NOAA SHOWS

“I did not consider myself interested in science until listening to the broadcasts. There are areas of science which do not interest me (physics, outer space), but topics like climate change and changes in the patterns of animals do.”

Behavioral impact

Listeners of the NOAA shows rated their level of agreement with several statements about the impact of the shows. The chart below presents ratings for two agree/disagree statements about post-listening behavior.

- 46% of listeners reported sharing show information with others after listening.
- 27% of listeners searched out more information about a topic that they heard in the *E&S* NOAA shows.



General impact

Listeners of the NOAA whale shows were asked to comment further about any impact that listening to the shows had on them:

- 16% said the shows increased their interest and curiosity; e.g.,
I'd be more interested now in hearing what some of the ongoing trends are in the future.
Although I was already interested in the preservation of wildlife, I have been encouraged to continue to hope for better times ahead.
- 14% felt that the shows increased their awareness and knowledge of whales and global warming; e.g.,
It heightened my awareness of how much research is being done on whales as well as the variety of the research topics.
I am now more aware of the environmental impact that boats and other human activities have on marine life.
It gave me a better appreciation for the impact of global warming and other issues that impact the health of whale population.
- 8% reported sharing the information with others; e.g.,
I tuned in with my family when possible, and it was a pleasant time to share together. I will actually miss not having them appear in my inbox.
I felt they were clear enough that even my children could understand them. I spoke with them about the show or let them listen.

RECALL OF NOAA SPONSORSHIP

Listeners of the NOAA whale shows were asked to recall which government agency sponsored the *E&S* programming. To avoid an order effect, the multiple-choice response alternatives were presented in a different random order for each respondent. Almost all of the whale listeners recognized that NOAA was the sponsor of the shows:

- 92% NOAA: National Oceanic and Atmospheric Administration
- 3% NASA: National Aeronautics and Space Administration
- 3% NSF: National Science Foundation
- 3% No idea

DISCUSSION

In the previous three years, 72 90-second *Earth & Sky* radio shows have been produced under sponsorship of the National Oceanic and Atmospheric Administration. The impact of these shows was explored with a posttest-only experimental design comparing a treatment group that listened to nine daily NOAA shows focused on the topic of whales and a control group that listened to nine daily non-NOAA shows about Antarctica. Participants were randomly assigned to groups, which did not differ on the variables of gender, age, ethnicity, education, frequency of hearing *Earth & Sky*, and interest in hearing about current science news generally. Two-thirds of both groups ‘never hear’ *Earth & Sky*, so our study results generalize to adults who are interested in current science news but who are mostly not familiar with *E&S* programming.

Sponsorship. Almost all (92%) of the whale listeners recognized and recalled that NOAA was the government agency sponsor of the nine *E&S* shows.

Appeal. Listeners liked that the whale *E&S* shows are informative, interesting, concise and to the point. They liked the production quality and the expert interviews. Almost all listeners, enjoyed listening to these shows, liked hearing scientists talking about their work and would like to listen to *E&S* shows on other topics. Nine out of ten listeners would recommend the *E&S* series to others. Eight out of ten found the pace of the shows exciting and lively. Three-quarters would like to listen to these shows again. The main complaint of one-third of the listeners was that the shows are too short with too little detail.

Clarity. One-third of the listeners were familiar with most of the information presented in the shows, indicating that most listeners were being exposed to new information. Almost all of the sample said that they understood the science presented in the shows, and one-half felt that their knowledge of the process of science inquiry was increased by listening to the shows. So listeners felt they understood and learned new information, which is confirmed by the questions directly assessing their learning.

Learning Impact. Listening to the shows significantly increased listeners’ factual knowledge of whales when compared to the control group, who did not listen to these shows. Additionally, listeners were significantly more likely than the control group to report that humans influence whales in ship collisions and that scientists have lessened human impact on whales by changing shipping lanes, by guiding disoriented whales back to the ocean, and by responding to whale beachings. Listeners also recalled the scientific methods used, including recordings of whale sounds; tagging and tracking; counting, sightings or visual surveys; and whale tissue analysis.

Behavioral Impact. Almost half of listeners reported sharing show information with others after listening, and one-quarter searched out more information about a topic that they heard in the *E&S* shows. For a 90-second daily radio show exposure, this is a strong impact on behavior.

This study reveals that the NOAA *Earth & Sky* shows are very appealing and understandable and significantly increase listeners’ knowledge of whales and of scientists’ research about whales.