

**EPA STAR GRANTS PROGRAM & TRIBAL SCIENCE COUNCIL**  
**October 14, 2009, Webinar Summary**

**Alaska Tribal Berry Resources and Human Health Under the Cloud of Climate Change**

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**Overview**

Dr. Mary Ann Lila led the presentation on “Alaska Tribal Berry Resources and Human Health Under the Cloud of Climate Change,” the second webinar to be conducted under EPA’s STAR Research Grants Program/Tribal Science Council webinar series this year.

Dr. Lila presented an overview of her research team’s project, which is investigating the potential health and medical benefits of wild berries to Alaska Natives in three coastal communities. Wild Alaskan berries produce beneficial biological compounds in response to the stresses they undergo during growth in the harsh climate. Dr. Courtney Flint discussed the social and behavioral science aspects of the project, which focused on gathering information about the perceptions and behavior of Native Alaskans and the role berries play in their communities. Dr. Gary Ferguson provided a local perspective on the importance of berries to the culture of the three communities. The webinar concluded with a question-and-answer session and general comments.

The overall purpose of the research project was to investigate the powerful antidiabetic properties of native wild berries (salmonberries, bog blueberries, blue huckleberries, and blackberries/crowberries/mossberries). Berries are a rich part of many Alaska Native people’s tribal resources. The team worked with students and community members in three Alaskan coastal communities to look at the role of these berries in the lives, lifestyle, and culture of each community.

**Research Methodology**

The project was conducted within a transdisciplinary methods development paradigm, combining biological and social sciences, community participation, and integrated inquiry. The biological science included field screening of the berries under the Screens-to-Nature (STN) program to measure health benefits and help the students and elders learn first-hand how the chemistry of wild berries makes them healthy for humans. Laboratory analyses on mice also indicated that berries reduce diabetes symptoms in humans.

Using biological and social sciences as its basis, the project was conducted within a Community Based Participatory Research (CBPR) framework. CBPR involves collaboration that equitably includes community members, organizational representatives, and researchers in the project. For this project,

research consisted of key informant interviews, site visits, secondary data and laboratory validation, the STN program, household surveys, ongoing communication, and student-led interviews. These tools were used to assess the following in each community: traditional knowledge, health, subsistence, resource use, plant science and the bioactivity of berries; community actions and decisionmaking; environmental change; youth-elder interface; and risk perceptions. Students conducted interviews and surveys to find out how berries are valued and used in the communities, and to understand local observations and concerns about them.

The integrated inquiry explored the beliefs of Native Alaskans on:

1. Environmental stress, berries, and health benefits
2. The issue of climate change and environmental contamination
3. Community/environmental health and risk
4. Traditional Ecological Knowledge (TEK)
5. Implications for community wellness

### **The Communities**

The three participating communities are located along three distinctive coastal areas of Alaska. Each one has a complement of berries that is keyed to the health and economic benefits of the community. Berries are important for food, physical activity, sharing with family and friends, and keeping traditions alive. They are eaten in a variety of ways and stored for winter. Berries generally are considered healthy, but specific benefits are not very well known in the communities. Each community has concerns about diabetes, cancer, and unhealthy diets.

#### Snapshots of the three coastal communities

1. Seldovia
  - Coastal community in southern Alaska
  - Population: about 430 and declining; approximately 30% Alaska Native (2000 data)
  - Median income for White households: \$49,583; median income for Alaska Native households: \$16,250
  - Only community in the study with commercial operations for growing, processing, and selling berries (economic benefit)
2. Akutan
  - Located in the middle of the Aleutian Islands
  - Population: about 75 in the village and 650 in the nearby seafood plant area; stable; 95% Alaska Native (2000 data)
  - Median household income: \$33,370
  - Southernmost of the three sites
  - “Carpets” of berries are located everywhere in this community
3. Point Hope
  - Whaling community located at the northern tip of Alaska above the Arctic Circle
  - Population: approximately 679, with a high birth rate (2000 data); approximately 90% Alaska Native

- Median household income: \$63,125

### **Climate Impacts**

Community members noted both positive and negative aspects of global warming on berry growth. The positive aspects included a longer growing period, more vegetative growth, and warmer temperatures. The negative impacts included increased competition from other plants and warmer winters, which could decrease stresses on the berries. Stress is defined as the harsh environmental conditions under which the berries grow (e.g., how 11 hours of light or cold affect berry growth). Berries produced under stress offer enhanced health benefits to humans.

The research study found that the communities' perceptions of the impacts of climate change were somewhat uncertain. Environmental contamination and the impacts of climate change were voiced clearly in Point Hope, moderately in Akutan, and to a lesser extent in Seldovia.

### **The Screens-to-Nature Program**

As an educational tool, the Screens-to-Nature program teaches local communities how to conduct simple assays in the field to understand the biological components of their natural resources, and to use that information to further their economic interests and promote a model of sustainability with these resources within their own communities.

Students collected berries in the field and returned to their classroom to investigate the bioactive properties of the berries that produced health benefits. The students also interviewed elders in the community to gain an understanding of the cultural and traditional importance of berries to the communities.

In the hands-on STN sessions, students and elders extracted a small amount of material from the different types of berries to measure their properties relative to human health. The purpose of the STN sessions was to engage the students and elders actively in the process of demonstrating the potential health benefits of the berries.

While many types of STN technologies currently are available, the STN technology used in this project tested for amylases and amylase inhibitors; proteases and protease inhibitors; and antioxidants. The following screens were conducted:

- 1) Antioxidant screen (benefits for reducing risks of chronic diseases such as cancer, diabetes, heart disease, Alzheimer's disease, and Parkinson's disease): using plant extracts, a very simple colorimetric assay (color change was noted if the antioxidant was present) allowed students to see which berries had the most impact and how powerful their benefits were.
- 2) Dual assay for protease and protease inhibition (benefits for treating HIV/AIDS, parasitic diseases, and metabolic disorders): placing berry extract on X-ray film and checking to see if the extract burned a hole through the film, indicating the presence of the protease activity. Additionally, when placing the berry extract in conjunction with a known protease, a lack of a clear area in the film indicated inhibitory potential.

- 3) Amylase inhibitory activity (inhibits the process of breaking starch into sugar): a simple colorimetric assay was done to indicate the relative ability of berries to inhibit Metabolic Syndrome.

At this point in the webinar, Dr. Lila voiced two major challenges to science education in Tribal communities:

1. There is seemingly a real disconnect between the wisdom of the elders, who know about the health protective properties of the berries and traditional foods, and the students, who often appear not to care as much about traditional knowledge and are more interested in fast food.
2. The problem with teaching science around the world, in general, is that science doesn't bring fame or fortune. Dr. Lila pointed out, however, that although the teenagers pretended not to care, when the results came in they expressed interest. "I didn't know my berries were antidiabetic," one girl said. Maybe, Dr. Lila said, that teenager would then want to try the berries that grow in her grandmother's plot. That would be progress: seeing the impact of using basic science principles to achieve our overall goal.

### **Social and Behavioral Science**

Dr. Flint's research team worked to engage the local Alaska Native population to assess their overall opinions and perspectives on their communities, including the risks and challenges they face from climate change, environmental contamination, threats to subsistence resources, as well as their concerns about their health and the vitality of their local economies. The focus remained, however, on both the actual and perceived roles that berries play in their communities in respect to culture and tradition. Dr. Flint explored previous technical assessments of the Alaska communities, initially asking the following: "What risks do people in these communities face?" Existing assessments emphasize risks related to: Arctic climate change; environmental contamination/threats (from mining, Asia, radiation left over from Cold War, etc.); natural resource stress; Alaska Native health risks; behavioral health risks (drugs, alcohol, and suicide); and loss of traditional knowledge and practices.

According to statistics cited by Dr. Flint, one of the key risks for the Alaska Native population is the increase in diabetes prevalence. Dr. Flint showed a chart comparing the percent increase in diabetes prevalence among Alaska Natives to the total U.S. population (1990–2005). Diabetes prevalence rose close to 75 percent in the U.S. population, but the increase in Alaska Natives exceeded 120 percent, including an increase of more than 500 percent in the 24–34 age group.

Dr. Flint's research team used an integrated inquiry approach that included interviews and surveys. The questions asked and the responses received are listed below.

#### Local risk perceptions varied among the three communities

- *Climate change*: In Akutan, change was observed (cooling), but the local risk perception was low; in Point Hope, the change observed was high, and the local risk perception was high; and in Seldovia, there were divergent views on climate change, and local risk perception was low.
- *Environmental contamination*: Local risk perception was moderate in Akutan, high in Point Hope, and low in Seldovia.

- *Threats to subsistence resources:* Local risk perception was low in Akutan, high in Point Hope, and moderate in Seldovia.
- *Health concerns:* Local risk perception was moderate in Akutan and Seldovia and was high in Point Hope.
- *Behavioral risks:* Local risk perception was low in Akutan, high in Point Hope, and moderate in Seldovia.
- *Loss of traditional knowledge and practices:* Local risk perception was low in all three communities.

### Interviews and surveys

The students interviewed the elders because it was felt that they would feel more comfortable talking to the children instead of researchers from the outside. Dr. Flint followed up with her own interviews. Comprehensive surveys were mailed to members of the community, but because it was whaling season in Point Hope, the response rate was relatively low. Interviews were conducted with 11 people in Akutan, 24 in Point Hope, and 30 in Seldovia, and survey response rates of 52.7 percent, 16 percent, and 36.1 percent, respectively. Survey responses are listed below.

### **Survey Responses**

#### General

##### *Top two favorite berries:*

- Akutan: blueberries and salmonberries
- Point Hope: salmonberries and blueberries
- Seldovia: blueberries and salmonberries

##### *Why do you pick berries?*

- Akutan: (1) for personal or family food; (2) to be outside; (3) for fun; (4) for traditional reasons
- Seldovia: (1) for personal or family food; (2) to be outside; (3) for health/medicinal purposes; (4) for fun
- Point Hope: (1) for personal or family food; (2) to be outside; (3) to be with family and friends; (4) for traditional reasons.

##### *How do you eat berries?*

- With milk and/or sugar
- Jams and jellies
- Plain/raw, “just the way they are”
- With cereal, cool whip, or ice cream
- Agutuk (Eskimo ice cream with caribou fat or seal oil)
- In desserts, pudding, muffins, cakes, and pies
- In sauce with oil

### Health Benefits

*Do you agree or disagree with these statements about possible health benefits of berries?*

1. “Berries contain many vitamins.” All three communities agreed/strongly agreed with this statement.
2. “Berries can help with a balanced diet.” Port Hope and Seldovia residents agreed/strongly agreed.
3. “Berries can prevent diabetes.” Only Port Hope residents agreed/strongly agreed with this statement.
4. “Berries are good for your digestive system.” Port Hope and Seldovia residents agreed/strongly agreed.
5. “Berries can help lower blood sugar levels.” (N/A)
6. “Berries can protect you from infection.” (N/A)

In all three communities, tribal health issues were linked to loss of traditional way of life and decreased emphasis on subsistence resources and foods

#### *Local Perspectives on Health*

- Akutan/Seldovia: Moderate concerns about health (diabetes, cancer, alcoholism) linked to behavior and diet, but not environmental risks.
- Point Hope: Strong concerns about cancer, diabetes, obesity, and dental health tied to environmental risks (lead, radioactivity, and mining) and behavioral changes (junk food diet, lack of activity). Some concern about drugs and alcohol.

#### *Perceived Threats to Berries*

- Seldovia: (1) climate change; (2) other – access, logging, seasonal variations.
- Akutan: (1) loss of traditional knowledge; (2) climate change; (3) soil contamination; (4) other – effects of seasonal fluctuations.
- Point Hope: (1) climate change; (2) radioactive contamination; (3) mining; (4) waste disposal and incineration; (5) loss of traditional knowledge; (6) other – oil/gas spills.

#### *Climate-Berry Observations*

- Need right amount of sunshine and water
- Need enough rain (but not too much)
- If too cold, berries don’t grow/ripen
- Warm summer is good for berries
- Hot/dry summer is not good; dries out berries
- Winter snow is important for moisture
- Early freeze, berries don’t ripen

#### *Observations on Climate Change*

- Point Hope: Climate change observed and seen as major risk.
- Akutan: Mixed observations (cooling, warming); uncertainty about impacts.
- Seldovia: Mixed reactions, little articulation of risk; observations of summer cooling trend; climate change viewed as cyclical, not a continuous warming trend or global warming.

### *Local Perspectives on Berries*

- Berries are very important to each community.
- Sharing berries is an important tradition.
- Berry picking is valued for outdoor fun and for health reasons as well as for food.
- Women have traditionally picked berries, but a few men do pick berries in each community.
- Access to berries is a concern in Seldovia, where there is a commercial operation for berry processing.
- Selling berries is not part of the Point Hope or Akutan experience.
- Seasonal fluctuations affect berry quality and abundance (moisture/sun, winter weather, frost timing).

### *Observations on Quality of Life*

#### Point Hope

- Top factors: honoring traditions and cultural heritage; community supporting each other
- Serious problems: lack of youth activities, coastal erosion

#### Akutan

- Top factors: clean and safe environment; availability of basic needs
- Serious problems: housing, loss of traditional knowledge

#### Seldovia:

- Top factors: clean and safe environment; community supporting each other
- Serious problems: employment opportunities, outmigration

### **Scientific Analysis of the Berries**

Dr. Lila provided data detailing the results of the scientific analyses of the berries and outlined the team's top findings: The amylase-inhibiting activity of berries slows down the process of turning starch into sugar (i.e., it has an important impact on diabetes, which is a major problem in the community); berries contain varying levels of antioxidants; and protease inhibitors in berries may help fight HIV/AIDS, parasitic diseases, and metabolic disorders.

Specifically, the results of the STN analyses showed:

- The Alaska berries have good antioxidant activity and can prevent or slow down the breakdown of starch into sugar in the blood.
- The Alaska berries contain large amounts of anthocyanins (ANCs) that help prevent cardiovascular disease, cancer, diabetes, and eye degeneration.
- The Alaska berries contain proanthocyanidins (PACs), which help fight infection, act as an antioxidant, and prevent obesity and diabetes. The amounts found in the Alaskan berries were higher than amounts found in berries from the lower 48 states and in other Arctic regions.
- Salmonberries were the most active in keeping fat cells in their immature form so they can't gather fat. Both moss/crow/blackberries and blueberries were most beneficial in keeping the cells from accumulating fat—up to 20% in some cases. These berries can actually help prevent obesity by altering fat cells' growth and function.

- The Alaska berries lowered blood sugar levels in mice, as good as or better than Metformin, a known antidiabetic drug.
- The bioactive chemistry develops as the fruit ripens, providing more powerful health properties.

Dr. Lila went on to provide more detailed, complex scientific data. The analysis of the A-type PACs found in berries indicated that all berries contained at least a single A-type PAC; some structures were found to be species-specific; and most of these were novel results that had never been described in association with these berries before. The *Pref-1* bioassay (*aka*: how to keep fat cells immature, not ‘fat’) found that the high levels of the *Pref-1* protein found in the berries could potentially offset the amount of mature adipose tissue present, which is the form that accumulates triglycerides. The Oil Red O assay (*aka* lipid [fat] accumulation assay), which measures the amount of triglycerides (TG) accumulated by mature fat cells, indicated that the Alaskan berries *should* substantially decrease TG levels in mature fat cells and keep lipids from accumulating.

The field and STN results were followed up on a smaller scale using a diabetic mouse model. Obese mice were maintained on a high-fat diet to induce obesity, insulin resistance, and diabetes. They underwent 4-hour food restriction, treatment by gavage, and subsequent blood glucose monitoring up to 8 hours. The results showed that wild blueberries and mossberries were very effective in lowering blood glucose levels within 6 to 8 hours and were more effective than Metformin.

Dr. Lila summarized the findings as followed:

- Berries’ bioactive composition (ANCs and PACs) intensified at northern extremes.
- *Pref-1* levels were enhanced by berries, but not necessarily by PACs or ANCs.
- PAC content correlated with inhibition of lipid deposition.
- Significant hypoglycemic activity of berries due to the presence of ANCs (i.e., eating berries regulated blood sugar levels).

Furthermore, both the phytochemistry and bioassays validated the TEK of the elders, who felt vindicated that science proved what they already knew.

To conclude her presentation, Dr. Lila offered the following quote to explain the significance and importance of TEK to this project:

“It is important to differentiate between situations where a community’s TEK is adapting to new environmental and economic conditions and where TEK is being lost due to a disruption of transmission or population loss. Just because land use activities have changed or decreased does not necessarily mean that a community’s TEK is deteriorating.” (Menzies and Butler, 2006, p. 8)

### **A Cultural Perspective**

Dr. Ferguson discussed the cultural perspective of the research project, stating his work with the Alaska Native Tribal Health Consortium is centered on a multidisciplinary, holistic approach that addresses mind, body, and spirit. Citing the core business statement of the Division of Community Health Services for the Alaska Native Tribal Health Consortium, Dr. Ferguson said, “Our programs

support hands-on education, increasing skills, and providing capacity-building at a community level, with the goal of having sustainable programs that promote wellness and prevent disease. We believe that the community has the ability to heal itself when provided culturally-based education, nurturing, and support.”

Dr. Ferguson said his group focuses on lifestyle interventions. He discussed the importance of understanding that environmental factors may lead to obesity, which is a significant problem in Alaska communities. Dr. Ferguson said that Hippocrates’ quote, “Let foods be your medicine,” can be used as a guiding principle when viewing the traditional foods of a community as a way to look at disease prevention and promote wellness.

Dr. Ferguson reported mortality statistics from the “Alaska Tribal Health System Showcase—Promising Health Practices: 2006,” which showed that heart disease and diabetes are the leading causes of death, but high glucose (pre-diabetes) is a contributing factor to both of them. He pointed out that Alaskan culture is changing from a subsistence-based to a cash-based economy. There is a major difference between traditional food and fast food out of the freezer, which is high in saturated fat and sugar. Eating habits have also changed (e.g., increase in portion sizes), especially in Alaska Native youth, who are most at risk.

Many factors prevent the subsistence lifestyle. Dr. Ferguson sees a major goal in empowering front-line communities by giving them the information they need to educate and support their communities. He noted that *Alaska Magazine*, as well as other media outlets, had already run articles reinforcing the benefits of subsistence foods and lifestyle. Dr. Ferguson noted the influence of Western culture on Alaska Native youth and the high cost of fuel in the communities as two additional factors altering the cultural landscape.

Dr. Ferguson cited the example of mossberries, which traditionally are considered a medicine. Alaska Native youth need to be taught how to pick and use these berries. The elders already know this, but the information has to be handed down to the children.

Dr. Ferguson said wellness already exists in the community and increasing the presence of traditional foods must be considered from all angles, including bringing traditional foods into schools and community gatherings, and working with government organizations such as FDA to share these vital resources that are right outside the back door. Dr. Ferguson concluded by saying that healthy communities take community ownership, utilize community resources, promote an environment of wellness, and reinforce what’s already available.

## Questions and Comments

**Nigel Fields:** Is there a model to identify stress? How can we identify what changes occurred over time?

**Dr. Lila:** We’d like to look at the changes over time. The berry growers use pesticides and fertilizers, so these berries don’t undergo the same stress as wild berries do.

Commercially grown berries may look better, and are bigger, but they aren't as nutritious. We asked, "What exactly were three different communities' experiences with different environmental impacts?"

**Q:** Did you look at meteorological parameters?

**Dr. Lila:** This research was limited specifically to the antioxidant chemical properties of the berries. In our next round of research, we would like to have weather stations in place.

**Dr. Flint:** We were mining the information that was available to us in the communities. We can use the traditional knowledge about what kind of year leads to a certain abundance of berries, along with climate projections, and triangulate that to see what effects climate change has on the berries. We have the traditional knowledge and now we need longer-term data.

**Janice Wilson:** What kind of effect does it have when the berries are eaten with sugar or fats and lard?

**Dr. Lila:** Agutuk is a traditional food that mixes the berries with caribou fat, white fish, and Crisco. We found that the Alaska Native people still received health benefits from the mixture. Berries are able to counteract the diet they are served with. We focused on the berries and not the diet. This issue needs further research.

**Dr. Flint:** When the kids started thinking about the health benefits of the berries, they even questioned how the berries mixed with sugar. It was great to see them making the cognitive connections.

**Dr. Ferguson:** A recent study shows that if Agutuk is fixed in the traditional way, with seal or salmon oil, it is super power-packed with omega-3 fatty acids that actually prevent diabetes. Agutuk contains a lot of calories, though, so it should be eaten in moderation.

**Lon Kissinger:** You mentioned that the protease inhibitors in berries might be helpful against the HIV virus. Has there been any testing of these protease inhibitors? Do berries have similar actions to other proteases?

**Dr. Lila:** There have been many generic studies, but clinical studies are lacking. A great number of *in vitro* tests have shown efficacy, but this connection hasn't been fully explored.

**Erin Myers:** Did other issues around food security come up in your interviews with elders, youth, and community members in terms of traditional foods and not just berries? What about long-term adaptation planning, if climate change is going to pose a problem on traditional foods.

**Dr. Flint:** It came up in Port Hope, our northern community. But in all the communities, our conversations were always very holistic in discussing the environment and food as a part of it. As for adaptation, long-term planning wasn't very explicit; it didn't come out loudly and clearly. There was a lot of concern and anxiety, but no formal planning. We've almost raised more questions than we've answered. There are many more things to pursue.

**Nigel Fields:** How would you reduce the uncertainty in variables in future research?

**Dr. Flint:** We were onto a good methodology. The drop-off/pick-up methodology worked well. For next steps, we know the survey was too long, but we received many comments indicating

it was good and relevant. We were also dealing with varying rates of literacy. An Alaska partner who can be present in the community is essential because doing this from a distance made it very difficult to carry out this project. Better coordination is necessary, but we have to remain adaptive and flexible, because what worked in one community didn't necessarily work in another. Our survey was eight pages long, fairly dense, and very exploratory, but now we know precisely what data we need and could do a secondary wave and focus on just a few key issues. The bottom line is that the dialogue, the interviews, and the qualitative research can't be beat for getting the rich information. In these communities, participant observation, spending time building relationships, and the ongoing conversations were far better than just quantitative methods for really understanding what is going on and the richness of what the communities have to share. The mixed methods program worked very well.

**Ukallay Saaq Okleasik's Comments:**

The understanding of youth and culture is not as cut and dried as your observations indicate. Indigenous people would respond differently than mice in a lab. A lot of it has to do with the school system and colonization, and the recognition that Western society has been very unsupportive. The cultural bias of researchers making observations has to be taken into consideration.

**Dr. Lila:** We agree, and we've heard this from others.

**Dr. Flint:** It would be easy to overlook the power balance of traditional knowledge and science. That's something we thought was very important and a local review would be beneficial. That's why we thought having the kids talk to the elders was paramount.

The phenomenon of climate change in the Arctic is very real due to the geography and geology of our soils. That's why you probably saw the differences in Seldovia and Akutan. Those areas have geological lift because additional water is causing the land to rise, but the permafrost in the north tends to make the land erode and sink. Coastal erosion plays a big part in the lifecycle of the berries.