



# Long-term benefits to Indigenous communities of extractive industry partnerships: Evaluating the Red Dog Mine

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## ABSTRACT

Mining, and oil and gas companies developing resources on land historically occupied and used by Indigenous peoples have faced criticism for offering few benefits to local communities while inflicting environmental damage. The Red Dog Mine – a joint venture between Teck Resources, Inc. and the NANA Regional Corporation – has often been cited as an example for developing extractive industries in a way that does benefit Indigenous communities. The mine is located in an economically impoverished region in Northwest Alaska that has few other wage-earning opportunities for the largely Inupiat population. Although the mine has brought demonstrable financial benefits to the region, questions persist about its long-term benefits to local communities. This paper assesses a suite of long-term benefits of the Red Dog mine, based on findings from unique 14-year panel dataset. The paper focuses on the direct effects of the mine on the individual Indigenous workers of the region. Specifically, the analysis addressed the following set of questions: How does employment at Red Dog affect workers' mobility and long-run earnings? How long do most local residents hired to work at the mine keep these jobs? What percentage of the mine workers live in the communities in the region, and what percentage of the total payroll do local workers receive? The findings illustrate the strengths and limitations of partnerships between Indigenous organizations and extractive industries, and offer insights relevant to Indigenous communities across the arctic and around the world as they plan development of local resources.

## 1. Introduction

### 1.1. Extractive industry development and Indigenous communities

Since the 1990s, mining companies have become increasingly aware of the need to consider social outcomes (Hunter et al., 2015). Minerals extraction poses special problems for areas such as the Arctic, Australia, and the Amazon, where local Indigenous livelihoods are based on dispersed use of the land. Development can disrupt hunting, herding, and gathering livelihoods even if environmental impacts are minimized. The concept of *social license to operate* (SLO) has emerged as a concept to denote broad social acceptance by a community for the company to conduct its activities (Raufflet et al., 2013). The increasing ability of Indigenous groups worldwide to assert their rights regarding how natural resource development affecting their communities is conducted has required mining companies to change aspects of their operations to obtain a SLO (Langton, 2013; O'Faircheallaigh, 2013; O'Faircheallaigh and Corbett, 2005). Although research on the SLO process has grown, less attention has been paid to evaluating the social benefits communities

have received (Karakaya and Nuur, 2018). Mining operations have been associated with short-term improvements in job opportunities, incomes, poverty rates, and infrastructure in Indigenous communities (Bowes-Lyon et al., 2009; Davison and Hawe, 2012; Hunter et al., 2015; Loeffler and Schmidt, 2017; Nguyen et al., 2018); however, little is known about longer-term consequences.

Our research analyzes the long-term benefits of extractive industry operations under a SLO using a unique 14-year panel dataset of local residents hired to work at the Red Dog Mine in Northwest Alaska. We use this dataset to explore dynamics of employment, income, and mobility of these individuals, and compare the trajectories to those of a panel of their peers who never worked at the mine. We found that the patterns did indeed differ even ten years and more after the initial hire. The benefits to local residents, although lasting and significant given the limited opportunities in the region, accounted for a relatively modest share of total employment and earnings generated by the mine.

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## 1.2. Study region: The Northwest Arctic Borough

The Alaska Native Claims Settlement Act of 1971 (ANCSA) created 12 for-profit regional corporations that would hold mineral rights to lands selected by shareholder beneficiaries: Alaska Natives who lived in or had historical ties to the region (43 U.S.C. 1601 et seq.). One of the regional corporations, the Northwest Alaska Native Association (NANA), represents the 11 predominantly Inupiat villages of the Kobuk Census Area. These same villages joined together in 1986 to incorporate the Northwest Arctic Borough<sup>1</sup> (NWAB) (Fig. 1). The 2010 NWAB population of 7,523 is 87% Alaska Native, with communities ranging in size from 122 residents (Deering) to over 3,000 (Kotzebue) (U.S. Census figures). Borough population increased 23% from 1990 to 2010, although overall net migration has been negative in recent years (Sandberg, 2018; Shanks, 2009). Many residents continue to engage in a mixed cash-subsistence economy (Magdanz, 2012). The cost of living is higher than most other areas of Alaska, with food costing 69% and gasoline costing 25% more than the Alaska average (Fried, 2018). Unemployment rates are high (16.3%) compared with the neighboring areas (Fried, 2018), and the 2013–2017 average poverty rate among Alaska Native NWAB residents was 29% (American Community Survey estimates). Although the largest sector in terms of employment is public administration, the share of local government in NWAB employment (36%), though large, is lower than many other regions in rural Alaska (Shanks, 2009).

## 1.3. The Red Dog Mine

Although mineralization in the area around the Red Dog mine had long been known (Mowatt et al., 1991), the Red Dog deposit was unclaimed when ANCSA, which gave Alaska Native corporations the right to select 44 million acres (18 million hectares) of unreserved federal lands, was signed into law. NANA's Indigenous shareholders initially did not support mineral development, fearing it would harm traditional subsistence resources and livelihoods. However, after discussions with mining companies and a shareholder referendum indicated that most

felt the Red Dog mine could be developed in a way that protect the traditional activities, NANA selected and received title for the deposit from the federal government (McLean and Hensley, 1994). Corporate Indigenous ownership of the land allowed NANA to negotiate a development agreement that included provisions to bring economic opportunity to the region and protect subsistence, as well as share revenue with NANA.

In 1982, NANA signed the Development and Operating Agreement for Red Dog that gave Cominco (now Teck Resources, a Canada-based company with operations in Canada, Chile, Peru, and the United States) the right to build and develop the mine. In return, NANA received \$1.5 million, plus an additional \$1 million every year until the mine went into production (McLean and Hensley, 1994). Once production began in 1989, NANA received a royalty of 4.5% of net smelter returns. After Teck recovered its capital investment in 2007, NANA shared in the net proceeds of the mine, the profit share began at 25% and was to increase every 5 years until NANA and Teck shared equally in the profit. As of 2017, NANA's share of the net proceeds had increased to 35% (Teck, 2017a).

In addition to financial provisions, the agreement with Teck gave NANA a management role, establishing a 12-person committee equally split between NANA and Teck to oversee all mining activities. The agreement also included shareholder hire preferences, mechanisms for shareholder training and promotion, and preference for contracting to NANA-owned companies. These provisions, implemented by a joint committee to oversee employment matters at the mine, aimed at achieving a goal of 100% shareholder employment by at the mine by 2001 (McLean and Hensley, 1994). The agreement also established a committee of elders from the two communities closest to the mine (Teck representatives are ex-officio members), to address environmental and subsistence issues. According to the NANA-Teck agreement, the Elders have the power to shut down the mine in certain situations if they see a threat to subsistence (McLean and Hensley, 1994).

In 2018, Red Dog was the world's second largest producer of zinc and a large global producer of lead (Basov, 2016). It is an open-pit mine located just over 100 miles north of the Arctic Circle, and 50 miles (80 km) from the Chukchi Sea (Fig. 1). Ore is mined year-round and trucked to a dedicated port, where it is stockpiled and shipped to Teck's smelter in British Columbia between July and October when the port is ice-free. No villages are connected to the mine road. The company pays for air travel for mine workers from the 11 NWAB communities and Anchorage to work on a variety of schedules, with two weeks at site and two weeks off being most common. The mine has reserves to operate through 2031, and is exploring nearby deposits to continue operations after that time (<https://www.teck.com/operations/united-states/operations/red-dog/>).

Although the project has not achieved the goal identified in the NANA-Teck Agreement of 100% shareholder hire by 2001, the approximately 55% shareholder (Indigenous) hire is high by global standards (Loeffler, 2014; Loeffler and Schmidt, 2017). In 2013, Teck employed 480 workers at Red Dog. On-site contractors, mostly NANA Lynden and NANA Management, Indigenous-owned businesses, employed another 130 workers. Of these 610 employees, 57% of them were NANA shareholders i.e., Native Alaskans with historical ties to the region. Including direct and induced effects (secondary jobs), the mine supplied 715 jobs to communities in the region in 2013 (McDowell Group, 2014). In 2017, direct shareholder employment at the mine, excluding contractors was 254, or 57% of mine employees (Teck, 2017b).

The Red Dog mine makes payments in lieu of taxes to the NWAB through an agreement that is periodically renewed and renegotiated. In 2013, the \$11 million paid by Red Dog, including a \$2.4 million payment directly to the school district, accounted for 89% of the borough's general fund revenue. The annual payment was increased in 2017 to \$20–26 million, depending on the mine profit (NWAB-Teck, 2017), corresponding to \$11,000–14,000 per NWAB household.

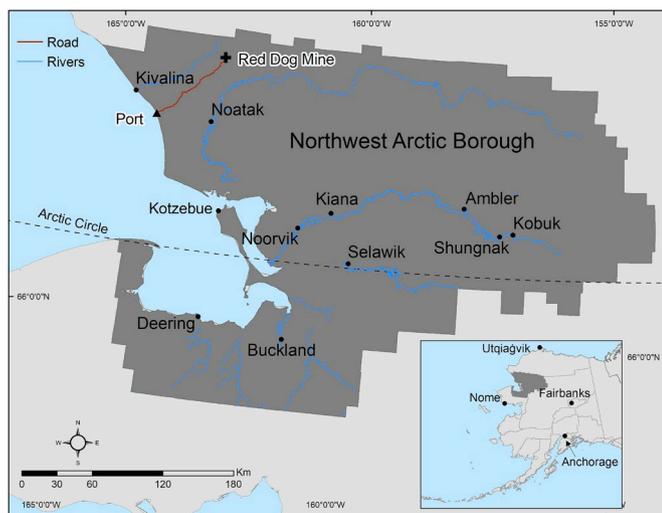


Fig. 1. Northwest Arctic Borough with communities and Red Dog mine. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

<sup>1</sup> Alaska boroughs are county-level governments that also provide public education through a unified borough school district.

#### 1.4. Research questions

NANA has a responsibility to support its Indigenous shareholders whether or not they live in the northwest arctic region. However, shareholders who have moved out of the region – typically to urban areas of Alaska – have many alternative income-earning opportunities relative to residents of the remote NWAB. This research investigates the degree to which residents of the NWAB participate in employment and earnings from the Red Dog mine, while documenting the average job tenure, earnings, and mobility of local mine workers. We specifically address the following five research questions: (1) what percentage of mine workers live in the communities in the region, and (2) what percentage of the total payroll do local workers receive; (3) how long do NWAB residents remain working at Red Dog, and (4) how does employment at Red Dog affect workers' longer-run earnings and (5) residential mobility, whether or not they remain working at the mine?

In Alaska, there has been a public discussion of whether acquiring well-paid jobs at remote development sites leads workers to leave the region. A tribal health corporation cited the potential for increased outmigration in opposing development of a large gold mine in another rural region in the state. The corporation argued that while the Indigenous people of the region were impoverished, employment at the mine would cause workers to move to the more urban areas of Alaska, taking their earnings with them and draining resources in the small villages (MacArthur, 2016).

Numerous studies have documented that employment at the Red Dog Mine and similar remote extractive projects in Alaska pay much more than most other jobs available locally (Loeffler, 2014; McDowell Group, 2014). However, little research has been done on whether the training and work experience allow the worker to continue earning more after he or she leaves the extractive industry job. The transferability of earnings potential is especially important if job tenure at the mine is relatively brief.

## 2. Approach

We examined the long-term effects on wages, job tenure, and migration patterns for men and women who lived in the NWAB when hired to work at Red Dog. For this study, “long-term” refers to the 10–14 year period for which data were available, as discussed below. We worked with NANA Regional Corporation to acquire data for the study, but neither NANA nor Teck played any role in the study design, analysis and interpretation of data; or editorial content.

### 2.1. Data sources

A major challenge to addressing questions about long-term effects of employment in a remote resource extraction establishment is the lack of data that can both identify employers by work site and track individual workers over time. For this study, we combined two large state databases of individual records to create a unique panel data set to address the five research questions. The Alaska Department of Labor maintains individual employment records for all Alaska workers eligible for the state workers' compensation (AS 23.30) and the joint federal-state unemployment insurance program (26 US Code Section 3306). Most wage and salary workers in Alaska are covered by one or both of these programs. The data set contains quarterly records of individual employment and earnings by occupation, industry, employer, and place of work since 2000. The individual records are maintained for administrative purposes, and their confidentiality is protected through state law. However, research staff at the Alaska Department of Labor Research and Analysis Section has access to the data for reporting on the economic status of the Alaska workforce and population, published in the monthly periodical *Alaska Economic Trends* and in special reports.

Separately, the Alaska Department of Revenue Permanent Fund Dividend Division maintains an electronic database of individual

applications for the state's Permanent Fund Dividend (PFD) program. Alaska residents, with few exceptions, are eligible to apply for the PFD after one year of residence in the state.<sup>2</sup> Although applications are voluntary and must be submitted each year to receive that year's dividend, an analysis of eligibility and applications indicated that about 95% of eligible apparently do submit applications annually. Application records for the PFD include age, gender, and place of residence. Alaska Department of Labor research analysts linked the individual records from the PFD applications to the employment security records using individual Social Security numbers to create a combined data set that can be used to analyze employment and earnings by age, gender, and place of residence.

Through the cooperation of the Alaska Department of Labor, Research and Analysis Section, we were able to work with state research analysts to combine successive years of the linked datasets and create a panel of individuals who could be followed over time. In the employment security database, each employer submits a separate record, so if an individual worked for more than one employer during a calendar quarter, there will be multiple records during the quarter for that worker. To reduce complexity of the dataset, the quarterly earnings were aggregated to a single record of total annual earnings for each worker, identifying the employer that accounted for the largest share of earnings that year.<sup>3</sup> After dropping the first two years due to the high level of missing data on one or more of the important information fields, the resulting dataset contained annual observations from 2002 through 2015.

NANA Regional Corporation generously provided the federal tax identification numbers for Red Dog contractors, enabling the state Research and Analysis personnel to identify all workers employed at the Red Dog mine work site, in addition to those employed by Teck itself, during the past 16 years. Red Dog mine contractors performing a variety of roles, including drilling and exploration, facilities construction, transport and loading of ore onto ships, and catering and housekeeping at the worker residence facility. One contractor, NANA Management Services (NMS), provides catering and housekeeping to schools in NWAB communities and the hospital in Kotzebue as well as at the Red Dog mine. It was not possible to identify in the records whether a NMS employee worked at Red Dog or at another site in the NWAB. Jobs in meal service and housekeeping occupations generally require fewer skills and offer somewhat lower long-term earnings opportunities compared to other Red Dog occupations. NMS workers comprised 14% of total Red Dog employees and 21% of shareholder employees in 2017 (Personal communication, Lance Miller, NANA Regional Corporation, Feb. 14, 2018). Since we could not report findings including and excluding NMS without disclosing confidential information, we had to choose whether to include all NMS workers in the Red Dog pool or none. We decided that excluding NMS employees from the study would better represent the effects of the Red Dog mine. NMS housekeeping and catering jobs at Red Dog are similar to NMS jobs already available at other sites within the NWAB and around the state, so arguably not a significant enhanced employment opportunity due to the mine. Additionally, individual NMS employees can move between Red Dog and the

<sup>2</sup> The Alaska Permanent Fund is the state's sovereign wealth fund that receives a percentage of royalties from Alaska state oil and gas leases. Investment earnings from the Fund are shared with most Alaska residents annually through the PFD program. Individuals incarcerated or sentenced for a felony conviction are ineligible to receive the PFD. Individuals absent for more than 180 days are also ineligible with some exceptions, such as for military service or attendance at an educational institution outside Alaska. (Permanent Fund Dividend Division, 2019).

<sup>3</sup> While technically possible for a worker to hold many short-term jobs with different employers during the year, in practice all workers identified as working at Red Dog in a given year earned the majority of earnings that year working at the Red Dog mine.

other work sites without detection, introducing errors of unknown magnitude in estimates of employment duration, earnings trajectories, and mobility.

Although the panel data set provided the ability to track individuals over a decade or longer as they change jobs and move residences, it has some limitations. The federal government does not provide individual earnings information on its employees to state of Alaska. Consequently federal employees cannot be distinguished from unemployed individuals in the data set; however, federal employees accounted for only 1.5% of average annual NWAB employment in 2016 (Alaska Department of Labor, 2016). Place of residence is missing from data set if the individual did not file a PFD application that year. Not filing a PFD application could mean that the person has moved outside Alaska, is incarcerated or sentenced for a felony conviction, or deceased. While NWAB residents do move at relatively high rates within Alaska as discussed below in section 3.3, the rate of moves from rural Alaska to locations outside the state is quite low (Howe et al., 2013). A small percentage of eligible residents do not file. For example, a court order to garnish the PFD for unpaid taxes or child support may lead an individual to skip the application.

### 2.2. Empirical methods

Since individual records are confidential, Research and Analysis staff performed all data management and statistical analysis using computer code written by the authors. Research and Analysis staff provided data summaries and aggregated results after checking the results to determine that no confidential information would be disclosed. The researchers prepared two groups of individuals for comparison. A case group consisted of Red Dog workers hired from NWAB communities. We analyzed the work history, earnings, and mobility of the case group and compared it to a corresponding control group that consisted of NWAB workers with no work history at Red Dog during the study period. We used the Anchorage Consumer Price Index to inflate earnings figures for each year to constant 2016 dollars (AKDLWD, 2019).

#### 2.2.1. Case group: NWAB Red Dog workers

For the study group of NWAB Red Dog workers, we selected individuals in the data that matched all the following criteria:

- worked at Red Dog any time between 2002-2005 – either for NANA-Teck or a contractor (drilling, construction, hauling) – excluding catering and housekeeping (NMS) workers;
- filed for the PFD as a resident of a NWAB community in the year they were hired or first appeared in the data set;
- observed in the data set for at least ten years after first observed working at Red Dog.

The combined criteria resulted in individuals who worked at Red Dog and filed for the PFD as a NWAB resident between 2002 and 2005, and also filed a PFD application for at least nine years after first being observed working at Red Dog. It is not possible to distinguish new hires from returning workers for individuals observed working at Red Dog in 2002. Although the data set does not contain any information on ethnicity, one may presume that nearly all the case group are Alaska Natives, given the high percentage of Alaska Native residents in the 11 NWAB communities (88.4%; US Census 2010) and the ongoing efforts of NANA-Teck to recruit shareholders to work at Red Dog (Haley and Fisher, 2012).

### 2.3. Matched control group

We selected a control group from the panel dataset of individuals with the following criteria:

- never worked at Red Dog between 2002 and 2015;

- at least 18 years old, filed for the PFD as a resident of the NWAB between 2002 and 2005, and at least ten years of PFD applications during the study period;
- had an overall age and gender distribution matching that of the case group.

Several thousand NWAB residents met the first two criteria for the control group. To eliminate sampling error, we represented the control group as the weighted average of all 6,635 (3,295 female and 3,340 male) individuals meeting the first two criteria. To construct the weights, we tabulated the number of individuals in the case group and among controls by gender and age, with age measured in one-year cohorts in the first year each individual was observed in the data set. The weight for each control was equal to the ratio of the number of individuals of that gender and age in the case group to the respective number in the control population.<sup>4</sup>

## 3. Results

### 3.1. Profile of Red Dog workers

According to figures provided by NANA Regional Corporation, over 500 NANA shareholders were working at the Red Dog mine in 2017, or 55% of the total Red Dog operations workforce, excluding NMS (Table 1). Shareholders earned in aggregate nearly \$37 million annually in these jobs, or 48% of Red Dog wages and salaries.

Figures exclude NANA Management Services, and include number and earnings of seasonal as well as year-round jobs.

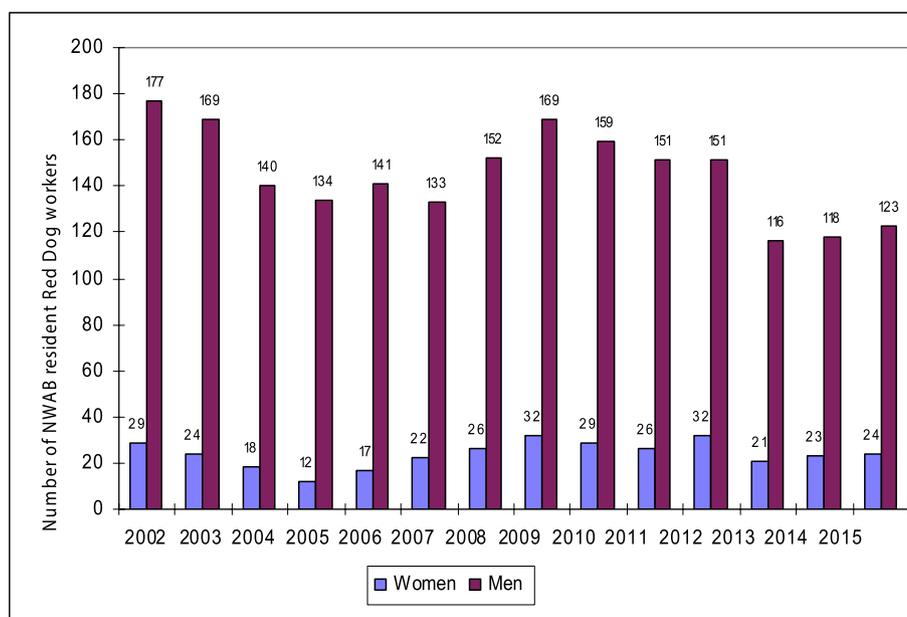
Department of Labor figures show that between 137 to 209 NWAB residents worked for Teck or its non-NMS contractors each year between 2002 and 2015 (Fig. 2) representing about 16% of all Red Dog employees. Even if all NWAB-resident workers were shareholders, a comparison of the numbers in Fig. 2 and Table 1 shows that most Indigenous Red Dog workers do not live in the NWAB. The number of female NWAB-resident Red Dog workers ranged from 12 to 32 over the same period, with no clear trend. The number of male NWAB-resident employees has also fluctuated, but is smaller in recent years than previously (Fig. 2). The \$11 million annual payroll of NWAB-resident Red Dog workers represents 14% of the total Red Dog payroll. Average annual earnings of

**Table 1**  
Red Dog work site employment and earnings in 2017 for NANA shareholders (presumed Indigenous) and other employees (presumed non-Indigenous).

	NANA shareholders	Other employees	Total, all employees	NANA shareholder percentage of total
Employees	517	415	932	55%
Total earnings (\$millions)	\$36.6	\$39.7	\$76.2	48%
Average annual earnings (\$thousands)	\$70.7	\$95.5	\$81.8	

Source: Personal Communication, Lance Miller, NANA Regional Corporation, Feb. 14, 2018.

<sup>4</sup> For example, if there were 7 men hired at age 32 to work at Red Dog, and 100 32-year-old males meeting the first three criteria for the control group, the weight for 32-year-old males in the control group would be 7/100, or 0.07. If no individuals appeared in the case group for a certain age and gender, then there would also be no controls of that age and gender. While it is theoretically possible that all the NWAB residents of a certain age and gender might be Red Dog workers, making the single-year weight undefined, there were in practice at least 10 times as many controls as cases for each gender-age cohort.



**Fig. 2.** Number of Red Dog workers residing in the Northwest Arctic Borough. Source: Alaska Department of Labor, special tabulations. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

NWAB-resident Red Dog workers have remained relatively constant at around \$70,000 in 2016 dollars,<sup>5</sup> about the same as the average earnings of all shareholder employees, shown in Table 1. Among NWAB-resident Red Dog workers, women earned 92% of what men earned.

The local Red Dog workforce is relatively youthful. The median age of workers when first appearing in the data set was 30. One fourth was under 24 and one-fourth was 40 and older. For most, but not all these workers, the year first observed is the year hired. There was virtually no difference in age distribution of men and women workers.

### 3.2. Long-term effects: job tenure and earnings

Job tenure for many NWAB-resident Red Dog workers was relatively short, with a higher attrition rate for women during the first few years (Fig. 3). Thirteen percent of men and 23% of women stayed one year or less on the job. After 4 years, only 54% of women were still working at Red Dog, compared to 69% of men. After that, the gap in attrition between men and women began to close, until there was essentially no difference after 6 years, (Fig. 3). Only one-fourth of initial Red Dog hires were still working at the mine after 10 years.

The contrast in incomes with the population that never worked at the Red Dog mine was striking (Figs. 4 and 5). Even though most individuals were no longer working at Red Dog 10 years after they were hired, a high percentage of men and women hired to work at Red Dog continued to receive higher incomes (Figs. 4 and 5). However, the pattern differs for men and women. The statistics presented here refer to the population with the specified characteristics, not samples, so the concept of statistical significance does not apply. However, one could consider the Red Dog mine workers and the NWAB controls as samples of Arctic Indigenous people, and hypothesize that the Red Dog workers differ from NWAB controls. We include the information needed for testing for significant differences in Figs. 4 and 5, assuming a 5% probability

<sup>5</sup> The \$70,000 average annual earnings figures include earnings of individuals who worked only part of the year. Salaries for a year-round job will be higher. The average annual wage in 2013 for a year-round Red Dog job was reported to be \$99,000 (McDowell Group, 2014). Examples of contractor seasonal work include summer exploration activities, and maritime work at the port, which is frozen and inactive for up to 8 months per year.

threshold. For the percentages working, solid symbols for the Red Dog hires represent significant differences from controls. The error bars for earnings represent 95% confidence intervals for the medians; non-overlapping error bars for Red Dog hires and controls therefore represent significant differences.<sup>6</sup>

For men, the proportion with earnings declined somewhat over time for both Red Dog workers and controls, but remained above 90% for Red Dog hires for 10 years, at least 15% higher than the rate for controls over the entire period observed (Fig. 4). Earnings for men who were employed at Red Dog initially exceed three times that of employed controls. Although the earnings gap narrowed in later years, earnings for employed Red Dog hires remained 80% higher than earnings of employed controls (significant at  $p < .001$ ). The earnings gap for employed women, on the other hand, narrowed more visibly, until there was essentially no difference between the two groups at 10 years (Fig. 5). However, for women, the disparity between employment rates was larger. Nearly all women hired to work at Red Dog continued to receive some income from employment throughout the observation period, while only about two-thirds of similar-aged control-group women earned any wage and salary income. If Red Dog workers and controls are considered as two samples, the different percentages with earnings become statistically significant after year 4, and earnings differences between the two groups are statistically significant for all of the first nine years.

Comparing male to female workers hired to work at Red Dog, the small number of women ensures that no difference in the percentage working is significant. Earnings of employed men are significantly different (higher) than earnings of employed women after 10 years, but not before.

### 3.3. Red Dog employment and residential mobility

Gender disparities in mobility featured prominently among NWAB

<sup>6</sup> Since the earnings of employed individuals are shown as medians. We do not show average earnings – mean earnings of employed persons times percentage employed – however, in our case the average earnings differ significantly whenever median earnings of those employed significantly differ.

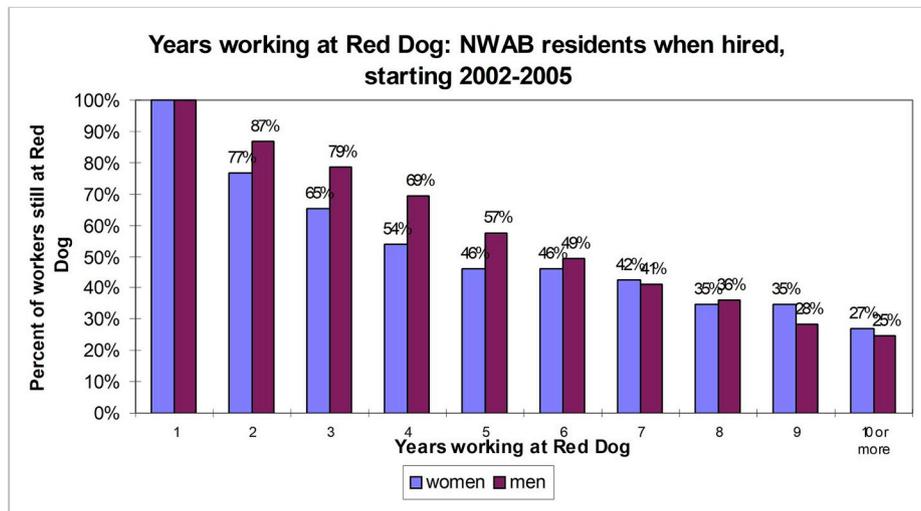


Fig. 3. Percentage of Red Dog workers hired while residing in the Northwest Arctic Borough still employed at Red Dog in successive years. Source: Alaska Department of Labor, special tabulations. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

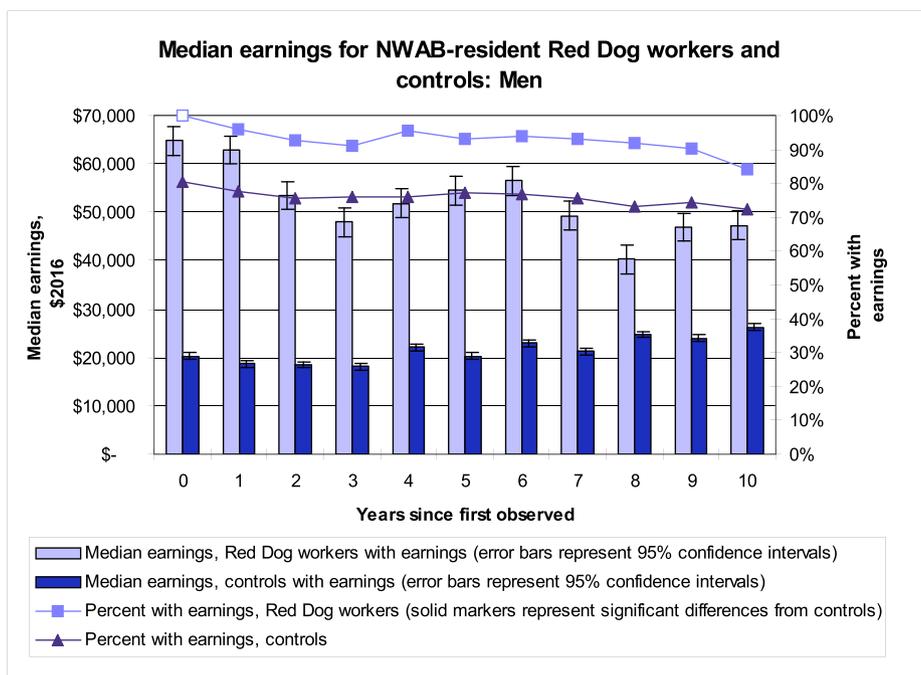


Fig. 4. Percentage of male Northwest Arctic Borough residents hired to work at the Red Dog mine earning wage and salary income, and median annual earnings for employed male workers in successive years after the year hired, compared to the control population of men not working at the Red Dog mine. Source: Alaska Department of Labor, special tabulations. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

Red Dog workers (Fig. 6). About 40% of NWAB-resident women hired to work at Red Dog between 2002 and 2005 no longer lived in the region five years after being hired, compared to about 20% of their male counterparts. After the first five years, there was little net change in the percentage of female NWAB Red Dog hires remaining in the borough, as the number who returned to the NWAB after leaving offset the number of additional leavers. The percentage of male Red Dog workers hired as residents of the NWAB who still lived there continued to decline more than 6 years after the initial hire, considerably narrowing the gender disparities in mobility, as did the resident percentages for both genders of the NWAB control population. After ten years, 62% of female and 72% of male Red Dog hires remained in the NWAB, compared to 68% and 76% of their respective gender controls. One should note that the female outmigration rates were calculated from a small population: 26 women

versus 211 men. Considered as samples, the differences between female Red Dog hires and female controls are statistically significant in years 5 and 7, but not in other years. The smaller percentage differences between male Red Dog hires and controls are statistically significant in years 2 through 4, although not in other years.

#### 4. Discussion

##### 4.1. Overall findings

Red Dog has had a consistent record of hiring Indigenous workers. NANA shareholders represented approximately 55% of the total workforce in 2017, and 53% in 2010. High Indigenous hiring rates have also been observed for two mines in Canada, including Voisey's Bay (54%

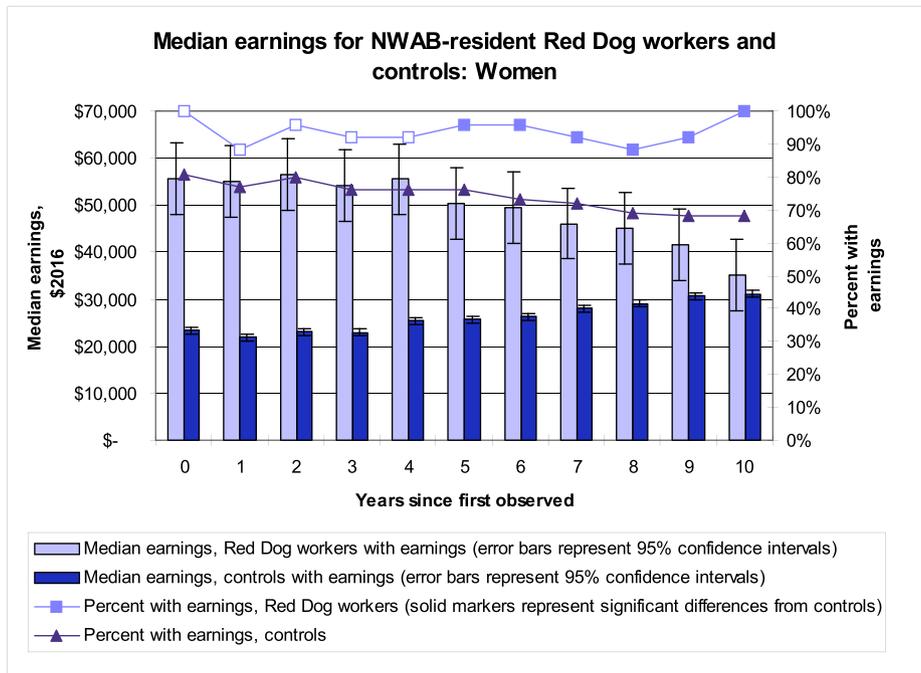


Fig. 5. Percentage of female Northwest Arctic Borough residents hired to work at the Red Dog mine earning wage and salary income and median earnings for employed female workers in successive years after the year hired, compared to the control population of women not working at the Red Dog mine. Source: Alaska Department of Labor, special tabulations. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

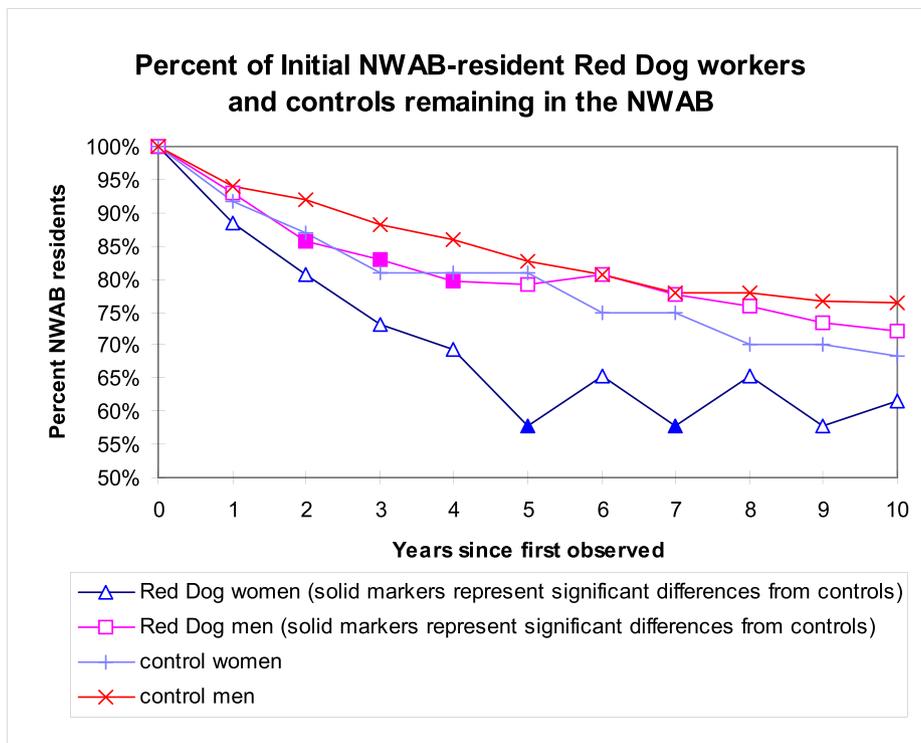


Fig. 6. Percentage of male and female Red Dog workers hired as local residents still living in the Northwest Arctic Borough in successive years after the year hired, compared to the control population of Northwest Arctic Borough residents not working at the Red Dog mine. Source: Alaska Department of Labor, special tabulations. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

(AETG, 2008)) and Ekati (61% (Dominion Diamond, 2012)). Indigenous ownership including land and mineral rights provides power when negotiating impact benefit agreements (Hitch and Fidler, 2007; Sosa and Keenan, 2001). Although the overall Indigenous hire rate was 55%, residents of NANA communities represented only 16% of employees,

and received only 14% of total Red Dog payroll. The ratio of local employees to total shareholder employees – 28% – falls far below the 47% of NANA shareholders reported living in the region in 2015 (NANA Regional Corporation, 2016).

The lack of success in maintaining a local workforce does not appear

to be due to lack of effort on behalf of the NANA-Teck partnership. Teck provides transportation to the mine at no charge to employees from any of the eleven local villages. The 1982 NANA Agreement gives the two closest villages hiring priority over other qualified shareholders. The authors' visits with Teck and NANA personnel indicate a sincere commitment to shareholder and local hire. A 2001 survey of NWAB residents aged 18–64 indicated that a large fraction of the work force – 26% of respondents – had worked at the mine. In addition, 18% had applied but been turned down, and still others do not apply because they do not expect to be hired due to alcohol/drug use, a poor employment record, a mental or physical disability, or lack education (Haley and Fisher, 2012). One-quarter of 18–24 year-old workers lacked the required high school diploma to work at the mine (US Census Bureau, 2013). Our data indicated the job tenure for locally hired Red Dog workers was relatively short: 21% of men and 35% of women stayed two years or less on the job. Remote camps and mining shift work separate workers from home and family for weeks at a time, which may be especially difficult for those with small children at home.

Those who were working at the mine earned much more on average than other local workers of the same gender and age. Figs. 4 and 5 show that median earnings of male Red Dog workers exceeded three times median earnings of employed men in the control group and those for female Red Dog workers exceeded twice the median earnings of employed control group women. Although annual mining wages average almost double the average for the private sector (Loeffler, 2014; McDowell Group, 2014), we show that Red Dog workers remained better paid than their local peers even after most had left Red Dog employment. The finding may be due in part because the particular individuals who worked at the mine were more qualified and motivated to seek high-paying jobs. However, the finding also suggests that skills acquired at the mine may be transferrable to other jobs. Many jobs at Red Dog are not specific to mining: heavy equipment operators, truck drivers, electricians, millwrights, etc. The specific training acquired, as well as experience with industrial work, are likely to be rewarded elsewhere in Alaska's job market. In any case, work at the mine appeared to provide a long-term increase in income for men relative to male controls. Women gained less over the long term both because the women who left Red Dog employment likely had fewer high-wage job opportunities, and because earnings of the control group of women, unlike earnings of male controls, did increase over time.

The rural Alaska population as a whole is quite mobile, with significant gender differences (Huskey et al., 2004). Working age women are more likely than men to leave smaller communities (Hamilton and Seyfrid, 1994), a pattern also found in other arctic regions (Hamilton and Rasmussen, 2010). The long-term consequences of this pattern have led to a gender imbalance in some communities that alters population dynamics and could threaten long-term community viability (Martin, 2009). We found that getting work at Red Dog was associated with a relatively small increase in the likelihood of leaving the NWAB (Fig. 6). The effect on mobility was larger for the small number of women we observed than for the much larger cohort of male workers. After 10 years 28% of the male Red Dog workers originally from the region had left, compared to 24% of the male control group. Although almost 30% more women hired to work at Red Dog had left after 5 years than control women, the mobility differential narrowed after that, to a six percent difference (38% vs. 32%) after 10 years. One should be cautious in drawing conclusions about gender differences in effects of Red Dog employment on mobility, due to the small population of women working at the mine.

#### 4.2. Study limitations

The results described in section 3 represent associations; one cannot infer that employment at Red Dog caused these outcomes to occur. Local workers hired to work at Red Dog are unlikely to represent NWAB residents as a whole. They must have completed high school, be motivated

to seek a shift work job at a remote job site, and pass a drug test, among other qualifications. Consequently, these individuals might have had higher earnings and mobility if Red Dog work had not been an option, and it is possible that the availability of a well-paid job at the mine kept them in the region longer. The study group and control group both included only NWAB residents who had at least ten years of records (PFD applications). Both groups excluded residents who moved into or out of Alaska during the study period. Because ethnicity could not be observed, it is possible that a small percentage of non-Indigenous workers were included in the population of NWAB residents hired to work at Red Dog. The control group definitely includes some non-Indigenous members, including public school teachers, who earn relatively high salaries and highly mobile. If it had been possible to exclude non-Indigenous NWAB residents from the controls, the observed mobility and earnings differences would likely have been larger.

The study excluded NMS (housekeeping and catering) workers from the study because it was not possible to determine which of their NWAB resident workers worked at the Red Dog site rather than in elsewhere in similar jobs unconnected to Red Dog. Most NMS workers are shareholders, but the NMS shareholder workers are more likely to be female, based on occupational averages (Alaska Department of Labor, 2016). If NMS workers were included, the difference in earnings between the Red Dog cohort and the control group would likely diminish.<sup>7</sup> It is not known how including NMS workers might change turnover and mobility.

The data available for the study included only employment and earnings by place of work and place of residence over a 10–14 year time horizon. Consequently, we could not address potential effects over the entire 30 years of mine operations. Because data are for individuals, not households, we could not assess broader social questions such as whether non-local Indigenous mine workers sent remittances to family members still living in the region, or how working at Red Dog may have influenced household subsistence participation and harvest.

## 5. Conclusion

We analyzed the long-term benefits of mining operations under a unique SLO based on a joint-venture partnership between an Indigenous-owned for-profit corporation and a multinational mining company. We compared the trajectories of employment, income, and mobility of local residents hired to work at the Red Dog Mine in Northwest Alaska to peers who never worked at the mine, using a 14-year panel dataset. We found that while the mine did provide significant benefits to Indigenous people, most of the Indigenous workers lived outside the region. These Indigenous workers (shareholders of the NANA Regional Corporation) were generally hired initially from outside the region. For the workers hired from the region, employment at Red Dog brought much larger earnings, and the increased earnings persisted, especially male workers, even after most no longer worked at Red Dog. Employment at Red Dog increased the likelihood that workers would leave the region, but the effect was modest for men and large for female workers only during the first few years after being hired.

The benefits to local residents, although lasting and significant given the limited opportunities in the region, accounted for a relatively modest share of total employment and earnings. The relatively modest benefits received by local Indigenous residents, even in the favorable circumstances of the Red Dog case, suggest that one may need to temper expectations about what extractive industry development can achieve for Indigenous communities. The study results identified two factors involved in limiting the local benefits that warrant further research. One issue is that many more Indigenous men with ancestral or family ties to the region, but living outside the region where jobs are plentiful, went to

<sup>7</sup> NMS shareholder workers earn less on average than other Red Dog workers (personal communication, Lance Miller, NANA Regional Corporation, Feb. 14, 2018).

work at Red Dog than their counterparts still living in the region, where jobs are scarce. The other issue concerns the high turnover rate for local workers who did take Red Dog jobs. A survey of current mine employees might provide insight into why local and non-local Indigenous workers applied to work at Red Dog, their comparative aspirations, and career plans. To address turnover, follow-up interviews with former employees could improve understanding of barriers to extended career employment, and potential remedies. A survey could also help with understanding the role Red Dog work plays in the subsistence economy, either impeding participation by reducing time to hunt and fish, or as enabling it by providing cash for the logistics of getting out on the land.

### Declaration of competing interest

One of the authors (Loeffler) has received payments for consulting services provided to the NANA Regional Corporation within the past five years, for work unrelated to the topic of the article. The other authors have no potentially competing interests to disclose. The NANA Regional Corporation provided data for the study, but played no role in the research design, data analysis and interpretation of data; in the writing of the report; or in the decision to submit the article for publication.

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### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.resourpol.2020.101609>.

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