United States Department of the Interior

FISH AND WILDLIFE SERVICE
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Anchorage, Alaska 99503-6199

IN REPLY REFER TO:
RE/888.SJ

OCT 27 1995

Memorandum

To: Special Assistant to the Secretary for Alaska

From: Regional Director
Region 7

Subject: Transmittal of Material on Impact of RS 2477 on Alaska Refuges

As you have asked, attached for your review and distribution is an analysis of the potential impacts of H.R. 2081, the recently introduced legislation on RS 2477, on Alaska Refuges. Two representative refuges, the Yukon Flats and Togiak National Wildlife Refuges have been used to analyze the types of impacts that could be expected if "highways" were developed under the auspices of RS 2477 in Alaska.

The development of "highways" across Conservation System Units in Alaska is a major resource issue and we appreciate the opportunity to participate.

Attachments

Potential impacts of pending RS-2477 legislation
on National Wildlife Refuges in Alaska.

In August 1995, the State of Alaska identified 99 routes on 14 National Wildlife Refuges in Alaska as possible public "highway" right-of-ways under RS-2477. Most of the claimed "highways" are listed as foot and dogsled trails. The segments inside refuge boundaries range from 1 mile to 176 miles in length. A summary of "highway" lengths and land status is provided in Table 1.

The 99 identified "highways" across refuges do not represent the extent of possible state right-of-way assertions under RS-2477. Under H.R. 2081, the State, political subdivision, or any individual may make a claim within 10 years of enactment of the Act. The federal government has the burden of disproving a claim within two years. In 1974, the State of Alaska identified at least 30 other "highways", totalling 694 miles, within refuges. Additionally, the State has identified 415 "highways" which cross early federal withdrawals. A number of these may be located on refuges established prior to the Alaska National Interest Lands Conservation Act. These "highways" would need additional investigation to establish that their use pre-dates the original federal withdrawal.

Forty-one percent of the length of proposed "highways" within refuge boundaries are across Native corporation conveyed and selected land. Public access to federal lands beyond these private lands is already provided by a provision of the Alaska Natives Claims Settlement Act. Section 17(b)(1) of ANCSA directed the identification of these public access routes. Most of these 17(b) easement trails follow coastlines or rivers along traditional travel routes. Approximately 529 miles of the State of Alaska's claimed "highways" overlap with existing 17(b) easements.

In addition to RS-2477 "highways", the State of Alaska claims section line easements are valid throughout the state. This means that every square mile of land would have a permanent highway easement along its borders. The potential impacts to wildlife refuges could be enormous if section line easements are developed. There would be approximately 300,000 miles of section line easements blanketing wildlife refuges.

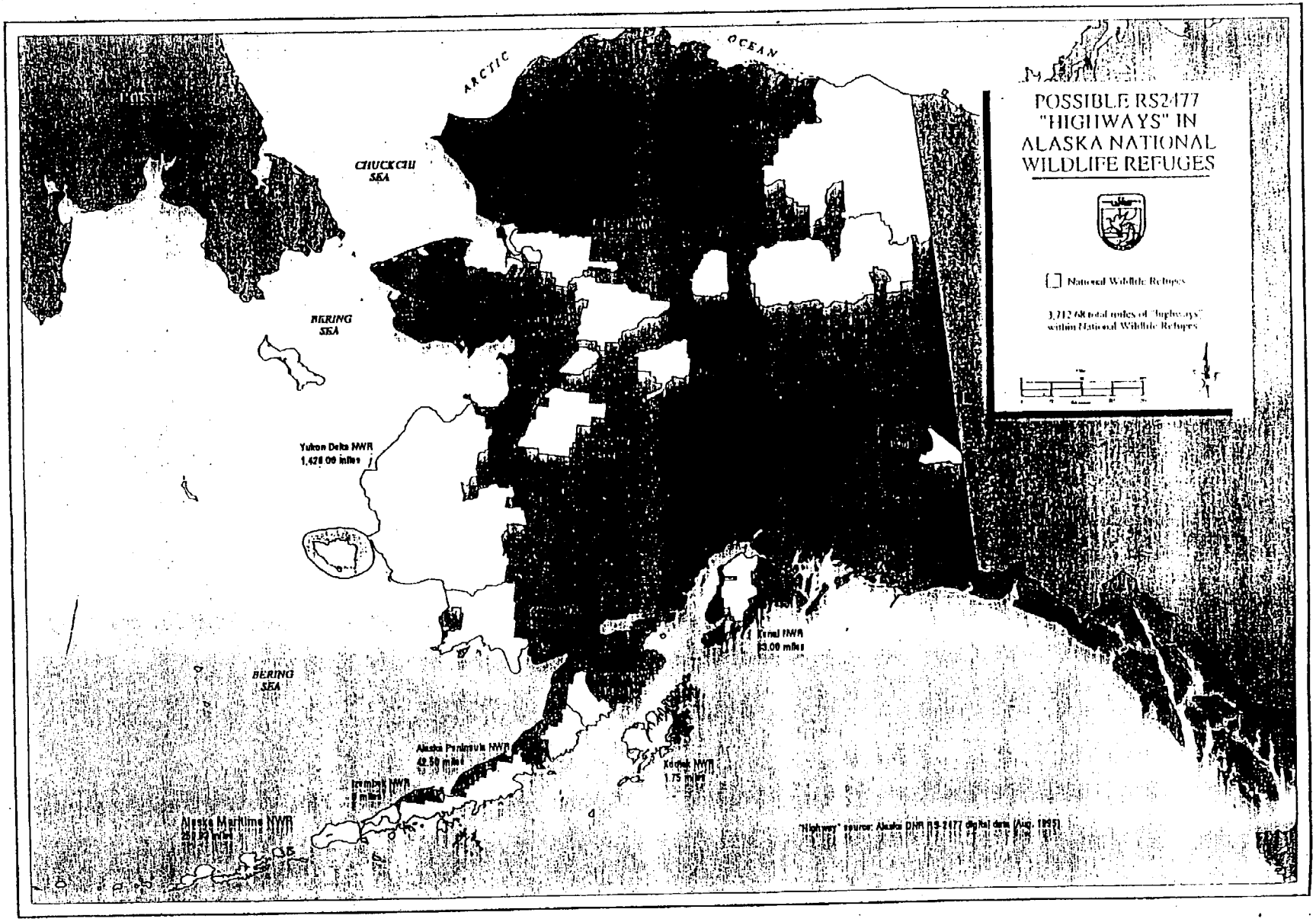
The State claims that section line easements are 66 or 100 feet in width. Terrain would often make it difficult to develop roads in narrow, linear paths along section lines. However, the use of road right-of-ways may not be limited to actual road construction. Utilities such as electrical transmission lines, gas pipelines or railroads could be accommodated in long, linear paths. Utility lines and roads constructed on section line easements would compound the impacts of RS-2477 right-of-ways.

Alaska's refuges encompass a wide variety of terrain types from open coastal plains with a myriad of lakes, to dense spruce/birch forests, to rolling hills and jagged mountain peaks. The proposed access "highways" traverse all of these terrains types. Construction of roadways will have varying physical, biological and visual impacts on the land. The U.S. Fish and Wildlife Service (Service) did not speculate on the feasibility of constructing a

Table 1: Summary of combined 1973 and 1995 proposed RS-2477 "highway" mileages, by land status, within National Wildlife Refuge boundaries.

Refuge	FWS Miles*	Wilderness	Nat. Allotment Patented	Nat. Allotment Selected	Nat. Corp. Conveyed	Nat. Corp. Selected	State Conveyed	State Selected	Other Federal	Conflicting Selections	Total "Highways"	TOTAL MILES
Alaska Maritime	78.50	0	43.48	25.75	87.55	18.65	0	2.15	0	-5.15	13	250.93
Alaska Peninsula	20.00	0	2.00	1.25	10.75	8.50	0	0	0	0	2	42.50
Arctic	234.56	72.82	0.52	2.14	19.62	0	0	0	0	0	12	329.66
Becharof	71.10	0	0	0	0	5.35	0	0	0	-8.32	4	68.13
Innoko	164.00	74.00	0.50	0	18.50	2.00	0	0	0	0	10	259.00
Izembek	0	0	0	0	0	0	0	0	0	0	0	0
Kanuti	44.25	0	5.50	3.50	54.00	7.00	0	0	0	0	4	114.25
Kenai	17.20	9.50	0	0	4.00	5.30	27.00	0	0	0	7	63.00
Kodiak	0	0	0.25	0	1.50	0	0	0	0	0	1	1.75
Koyukuk	6.00	4.00	0	1.50	9.00	0	0	0	0	0	2	20.50
Nowitna	12.00	0	0	6.50	0	0	0	0	0	0	1	18.50
Selawik	81.00	0	11.25	3.75	90.00	32.50	0	0	0	0	6	218.50
Tetlin	72.20	0	0.40	0	15.10	0	0.40	0	0	0	5	88.10
Togiak	44.00	0	2.00	0.25	55.75	43.25	0	0	0	0	7	145.25
Yukon Delta	494.00	0	59.50	66.25	591.75	214.50	0	0	0	0	37	1,426.00
Yukon Flats	331.13	0	20.20	4.09	214.34	97.34	0	0	0.63	-1.12	18	666.61
TOTAL MILES	1,669.94	160.32	145.60	114.98	1,171.86	434.39	27.40	2.15	0.63	-14.59	129	3,712.68
					Total Private = 1,866.83							

*This figure does not include the total mileage under federal jurisdiction. Mileage within wilderness areas and selected native corporation lands are also under federal jurisdiction but were itemized elsewhere in this table.


POSSIBLE RS2477
"HIGHWAYS" IN
ALASKA NATIONAL
WILDLIFE REFUGES
National Wildlife Refuges
3,712.68 total miles of "highways"
within National Wildlife Refuges
ARCTIC
OCEAN
CHUCKCHI
SEA
BERING
SEA
Yukon Delta NWR
1,429.09 miles
BERING
SEA
Kenai NWR
63.00 miles
Alaska Peninsula NWR
42.50 miles
Kodiak NWR
1.75 miles
Alaska Maritime NWR
"Highway" source: Alaska DNR RS 2477 digital data (Aug. 1997)

highway in these remote locations. Instead, we assumed that all identified "highways" could eventually become gravel roads similar to the Dalton or Denali highways.

The Service chose the Togiak and Yukon Flats Refuges for this discussion to represent the types of impacts that could be expected if roads are developed. These examples by no means reflect the entire range of potential impacts on wildlife refuges in Alaska. Proposed RS-2477 "highways" within the twelve other refuges may impact unique natural resource values. For example, several of the proposed "highways" on the Yukon Delta National Wildlife Refuge cross nesting habitat of spectacled eiders, a federally-listed threatened species. In addition, three of the "highways" on the Yukon Delta pass through bristle-thighed curlew habitat. The bristle-thighed curlew is a Category 2 candidate species. These endangered species candidates are but a few examples of fish and wildlife resources at risk

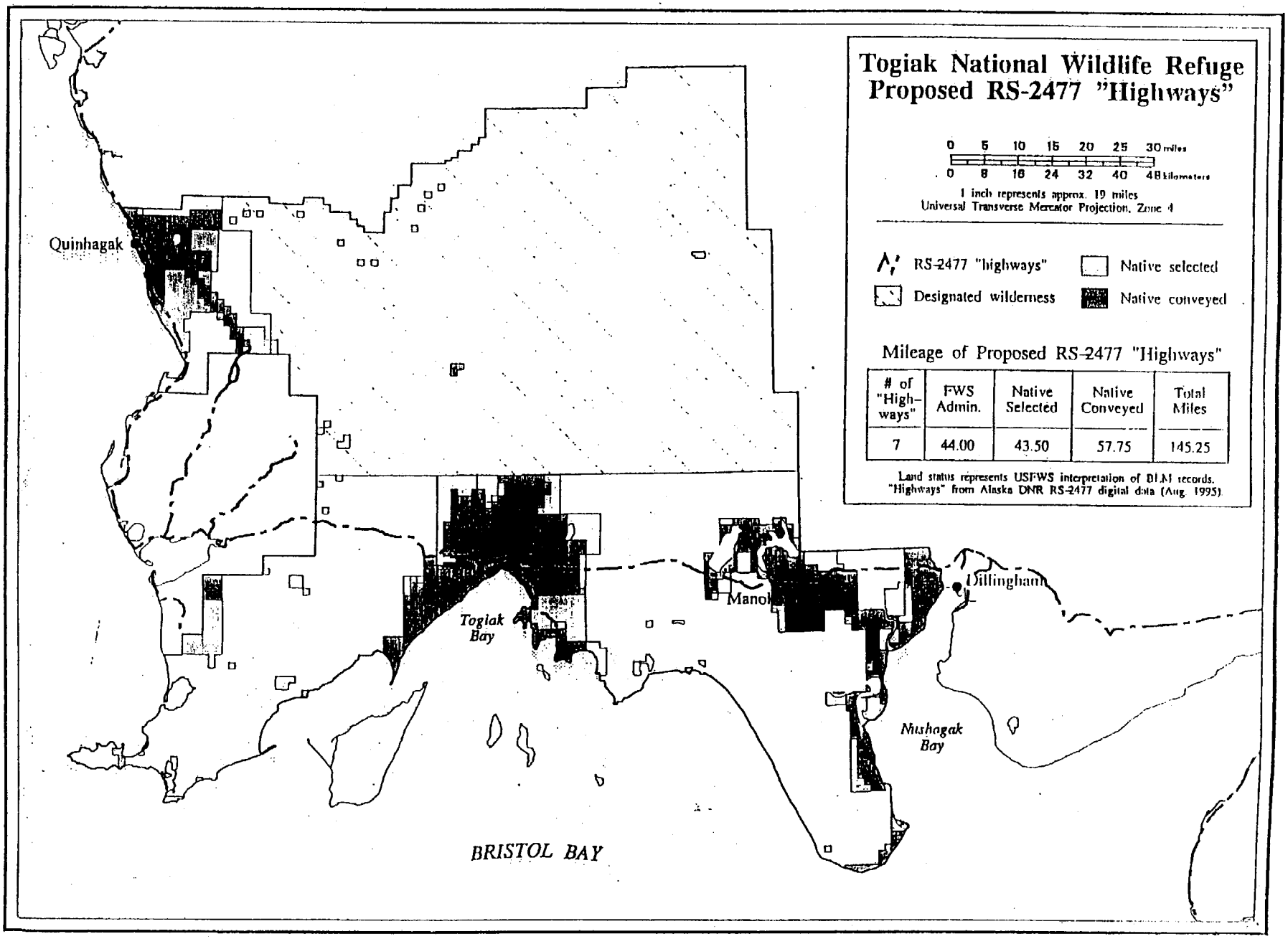
The following discussion outlines some of the easily identified fish, wildlife and cultural resources along the proposed "highways" on the Togiak and Yukon Flats Refuges. The extent of known subsistence use of these areas is also discussed. No specific studies were conducted on the environmental impacts of road construction in these refuges. The information presented was gathered from published sources and interviews with resource agency personnel. Each proposed "highway" is unique and the extent of future road or trail development and use will ultimately determine the impacts on all natural resources.

Togiak National Wildlife Refuge: An example

The Togiak National Wildlife Refuge encompasses 4,011,000 acres of federal land and an additional 692,000 acres of selected and conveyed lands in southwestern Alaska. Kuskokwim and Bristol Bays form the western and southern boundaries of the refuge. The Ahklun and Wood River Mountains dominate the northern half. Within the boundaries mountains, glacial valleys, lakes, tundra and coastal cliffs form a varied landscape. The Kanektok, Arolik, Goodnews and Togiak Rivers all cross the refuge and are vitally important for the Bristol Bay commercial salmon fisheries. Vegetation consists of both arctic and subarctic species. A total of 33 fish, 169 bird, 31 terrestrial mammals and 17 marine mammal species occur on and near the refuge. These wildlife resources include a large and diverse subsistence, commercial and sport fishery, the largest rookery of cliff nesting seabirds in the eastern Bering Sea and the highest density of nesting sandhill cranes in Alaska. Coastal estuaries provide staging and feeding areas for 250,000 waterfowl.

RS-2477 claims on the Togiak Refuge

Five proposed RS-2477 "highways" totalling 140 miles occur within the boundaries of the Togiak National Wildlife Refuge. The "highways" generally connect villages on and near the refuge with each other and to the regional population center at Dillingham.


Togiak National Wildlife Refuge
Proposed RS-2477 "Highways"
0 5 10 15 20 25 30 miles
0 8 16 24 32 40 48 kilometers
1 inch represents approx. 19 miles
Universal Transverse Mercator Projection, Zone 4
RS-2477 "highways"
Native selected
Designated wilderness
Native conveyed
Mileage of Proposed RS-2477 "Highways"
of "High-ways"
FWS Admin.
Native Selected
Native Conveyed
Total Miles
7
44.00
43.50
57.75
145.25
Land status represents USFWS interpretation of BLM records.
"Highways" from Alaska DNR RS-2477 digital data (Aug. 1995)
Quinhagak
Togiak Bay
Manok
Dillingham
Mushagak Bay
BRISTOL BAY

Approximately 30% (44 miles) of the proposed "highways" are on federal lands while the rest are on private patented and Native selected and conveyed lands (Table 2). Portions of two "highways", approximately 4.25 miles, duplicate existing 17 (b) public access easements.

Table 2. Miles of proposed RS2477 "highways" on the Togiak Refuge by land status.

FWS land	Native Allotments (Patented)	Native Allotments (Selected)	Native Corporation (Conveyed)	Native Corporation (Selected)	Other Federal	Total
44	2	0.25	55.75	43.25	0	145

Impacts on fish, wildlife, subsistence and cultural resources

Fishery Resources: Togiak Refuge fishery resources are world-renowned and vitally important to the regional subsistence and commercial economies (USFWS 1990a). Road development could significantly increase public access to every major drainage within the refuge and accelerate conflicts between subsistence and sport fishermen (Lisac, pers. comm. 1995). Also, road construction and maintenance can accelerate erosion processes and modify natural drainage networks (Furniss et al. 1991). These changes can have important biological consequences that may affect all components of a stream ecosystem.

- At least 33 species of fish occur within the refuge. Five species of salmon (chinook, sockeye, chum, coho and pink) are found in every major drainage. Rainbow trout, anadromous and resident char, lake trout, Arctic grayling, northern pike, burbot, whitefish, smelt, and Alaska blackfish are also common throughout the refuge (USFWS 1990a).

- The proposed "highways" pass over 12 drainages identified as key habitat for refuge fishes (USFWS 1986).

- Sockeye salmon are the most important fish species in terms of commercial and subsistence values. An average of nearly 1.2 million fish are harvested annually and escapements are estimated at approximately 500,000 fish (Lisac, pers. comm. 1995). More than 90% of the adult sockeye population spawns above Togiak Lake and in Ualik and Amanka Lakes (USFWS 1990a). Proposed "highway" 215 will pass directly south of Ualik and Amanka Lakes and will cross over the outflow of Togiak Lake.

- Coho, chinook and chum salmon also support important commercial fisheries in waters off the refuge. The combined annual catch averages approximately 475,000 fish. In addition, coho and chinook are important subsistence species with more than 14,000 fish taken annually (USFWS 1990a). Proposed "highways" cross all three of

the rivers (Togiak, Kanektok and Goodnews) that contain the major spawning areas for these species.

- The sport fishery on the Togiak Refuge is valued at $6-10 million annually (Lisac, pers. comm. 1995). This fishery is based on wilderness quality and variety of fishing opportunities.

- Wild rainbow trout stocks support a multimillion dollar sport fishery in southwest Alaska. The quality and quantity of rainbow trout on the Togiak Refuge attracts anglers from around the world. Because rainbow trout are resident species with a limited annual migration, all waters where they occur should be considered important for spawning and overwintering (Faustini, pers. comm. 1995). All six of the rivers that support rainbow trout (Negukthlik, Ungalithluk, Togiak, Goodnews, Arolik, and Kanektok) are crossed by the proposed "highways".

- Current research indicates that the rainbow trout population probably could not withstand a large increase in fishing pressure without suffering a decrease in the size composition (Faustini, Unpubl.).

Brown bears: The effects of roads and road-based developments on brown bear populations has been studied extensively in the lower 48 and Canada. Experience has shown that brown bears can be displaced from prime feeding and denning areas by road construction and use. Bear/human conflicts, such as Defense of Life and Property shootings, generally increase when new areas are opened with roads.

- An estimated 300-400 brown bears use the Togiak Refuge. The south coastal region of the refuge has the highest density of bears (USFWS 1986).

- Brown bears converge on most of the drainages crossed by "highways" 215 and 86 to feed on spawning salmon.

- Brown bears concentrate in July and August to feed on spawning sockeye salmon at a site near Ualik Lake within one mile of "highway" 215 (Aduman, pers. comm. 1995).

- Aerial surveys have revealed that at least five brown bears are known to den within a few miles of "highway" 215 (Aduman, pers. comm. 1995).

Caribou: Numerous studies have been conducted in Alaska and Canada on the effects of road intrusion on caribou behavior and populations. Disturbance of calving grounds and increased harvest seem to comprise the most substantial impacts.

- In 1988, a new caribou herd was established with the introduction of 146 animals onto the Nushagak Peninsula.

- The Nushagak Caribou Herd (NCH) is one of the fastest growing caribou herds in the world and now numbers over 1500 animals (Aduman, pers. comm 1995).

- A first-ever subsistence hunt was conducted in January-March 1995 with 100 permits issued.

- "Highway" 215 would provide year-round access to the northern portion of the NCH range. Increased access and harvest could slow the phenomenal growth of the NCH.

Bald Eagles: Disturbance of nesting bald eagles by road construction and related developments have been documented in the literature. Increased fishing pressure off a road system could lead to abandonment of some nests.

- Approximately 120 adult bald eagles use the Togiak refuge at some time during the year (USFWS 1986).

- Thirty-six active bald eagle nests are located along Togiak Refuge streams and coastlines (Aduman, pers. comm. 1995).

- Five of these nests are within a few miles of proposed "highways" 86 and 215.

Subsistence: The ANILCA purposes of the Togiak Refuge include the provision of ". . . the opportunity for continued subsistence use by local residents" (Sections 303(6)(B)(iii) and 302(9)(B)(iii). The impact of roads on subsistence depends on whether one takes a short or long-term view. Subsistence users tend to feel that roads will increase their access to subsistence resources. Experience in Arctic environments elsewhere indicates that the availability of subsistence resources declines over time with expanding road systems.

- Road construction and use may cause loss of habitat and/or reductions or displacements of species used for subsistence by local residents.

- Road construction and use could cause increased competition for local resources currently used for subsistence purposes. If unchecked, this competition might create an adverse effect on local subsistence use.

- Road construction and use can increase the extent of subsistence use. This could particularly be perceived as an enhancement on the Togiak NWR, where claimed RS-2477 "highways" provide primarily intra-regional access, without increasing direct access from urban centers.

- Local opinions and feelings about increased road access on subsistence activities and resources need to be taken into consideration. Cultural and social changes may result even from essentially free choices concerning use of subsistence resources.

Cultural Resources: Cultural resources located within a right-of-way will be destroyed if road construction occurs. In addition, the area of impact is much larger than the actual right-of-way and covers all possible "highways" within a corridor. Increased access can lead to vandalism and looting of cultural resources.

Assessing impacts of projects upon cultural resources on federal lands is required by the Archaeological Resources Protection Act (ARPA) of 1979. Sites on nonfederal lands, including Native Corporation lands, fall under ARPA if federal permits or money are used in constructing roads or otherwise improving a right-of-way.

- None of the proposed "highways" have been surveyed for cultural resources.
- Over 400 historic and prehistoric sites are known to occur on the Togiak Refuge. However, known sites are clustered in a few locations that reflect past survey effort.
- Locations of sites are predictable but number, density and size of sites is not. Prehistoric sites will be located along salmon rivers, at lake outlets, at overlooks in the uplands and near tributary streams draining into lakes and rivers (Dumond 1987). Historic sites will be located on historic transportation corridors (RS-2477 "highways").
- Eleven sites are known to exist along the five proposed "highways".
- Four of the proposed "highways" cross areas with a high probability of possessing significant cultural resources. The fifth "highway" is a medium to high probability area.

Yukon Flats National Wildlife Refuge: An Example

The Yukon Flats National Wildlife Refuge encompasses approximately 8,480,000 acres of federal lands and an additional 2,696,000 acres of Native selected and conveyed lands in east central Alaska. Extending east-west along the Arctic Circle, the refuge lies between the Brooks Range to the north and the White and Crazy Mountains to the south. The Trans Alaskan pipeline corridor runs along the refuge's western boundary while the eastern boundary extends to within 30 miles of the Canadian border. The Yukon River bisects the refuge and is the dominant feature of the refuge landscape.

A total of 147 bird, 39 mammal and 18 fish species occur or potentially occur on the refuge. The estimated 40,000 lakes and 25,000 miles of streams that occur on the refuge provide the basis for abundant and diverse fishery resources. These resources support subsistence as well as commercial operations. The refuge is also one of the most productive waterfowl breeding areas in North America (USFWS 1987).

RS-2477 claims on the Yukon Flats Refuge

Eighteen proposed "highways" totalling 667 miles occur within the boundary of the refuge. Approximately 50% of the proposed "highways" are on federal lands while the remainder occur on private and native corporation conveyed and selected lands (Table 3). There are 42 documented 17(b) easements totalling 254.56 miles of trails providing access to public lands across public and private lands within the refuge. Some of the 17(b) easements duplicate portions of 8 of the proposed "highways". The proposed "highways" connect the villages on the refuge with each other as well as with the existing Alaska road system (Steese and Dalton Highways) and major population centers.

Table 3. Miles of proposed RS-2477 "highways" on the Yukon Flats Refuge by land status.

FWS land	Native Allotments (Patented)	Native Allotments (Selected)	Native Corporation (Conveyed)	Native Corporation (Selected)	Other Federal	Total
331.13	20.2	4.09	214.34	97.34	0.63	667

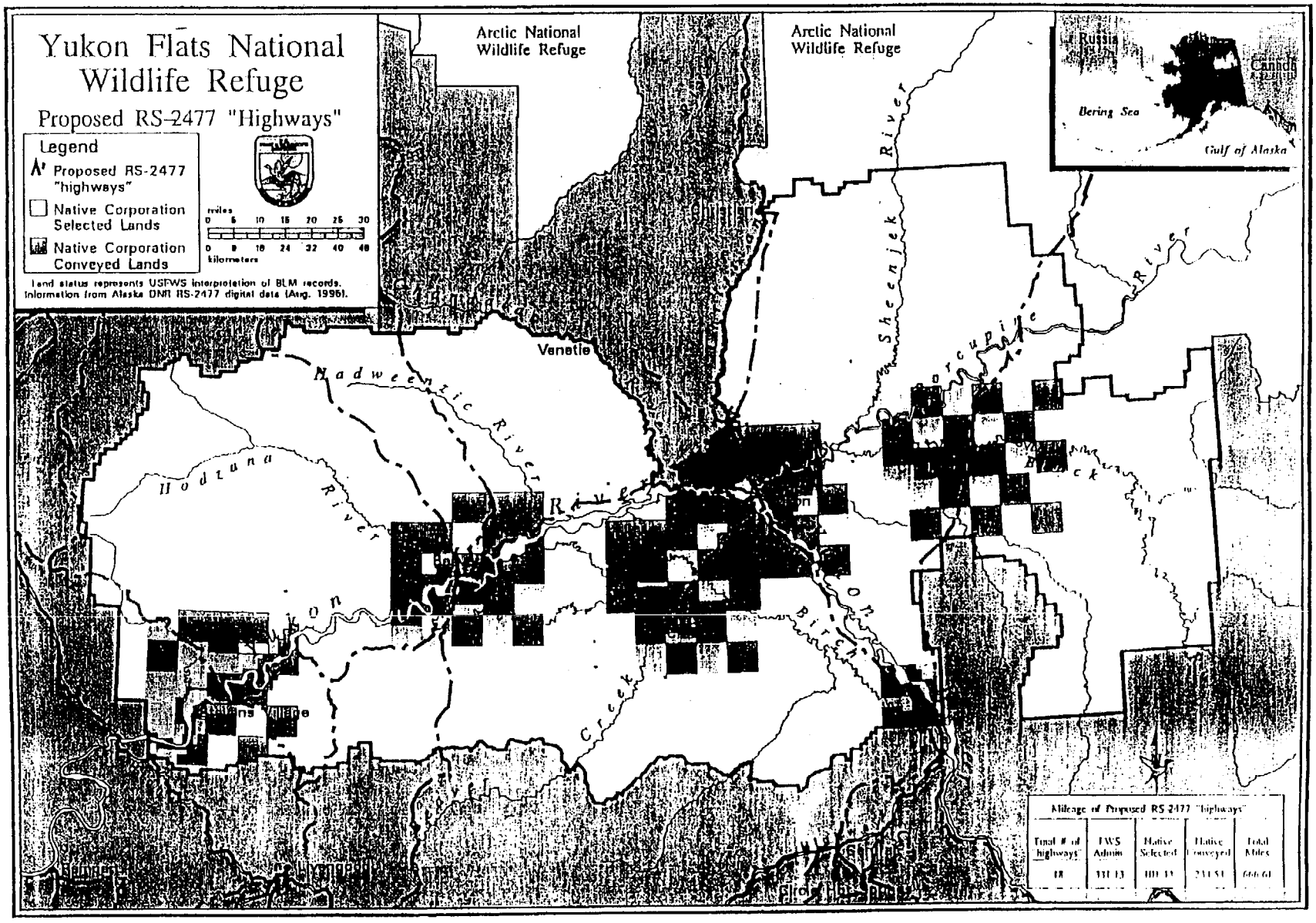
Impacts on fish, wildlife, subsistence and cultural resources

Fishery Resources: Road construction and maintenance can accelerate erosion processes and modify natural drainage networks (Furniss et al. 1991). These changes can have important biological consequences that may affect all components of a stream ecosystem. In addition, road development could significantly increase public access and lead to escalating conflicts between subsistence and sport fishermen (Millard, pers. comm. 1995).

- Approximately 300 miles of the upper Yukon River, as well as 12 major tributaries, and an estimated 40,000 lakes provide habitat for at least 18 fish species (USFWS 1990b).

- The Yukon River chinook and chum salmon runs are among the largest of any river system in North America. Coho salmon are present in smaller numbers. All three species use refuge waters for spawning, feeding, rearing or migration. Other common species include sheefish, northern pike, Alaska blackfish, Arctic grayling and three species of whitefish (USFWS 1990b).

- Residents of villages within the refuge depend heavily on salmon, whitefish and sheefish for subsistence.


Yukon Flats National Wildlife Refuge
Proposed RS-2477 "Highways"
Legend
Proposed RS-2477 "highways"
Native Corporation Selected Lands
Native Corporation Conveyed Lands
Land status represents USFWS interpretation of BLM records. Information from Alaska DNR RS-2477 digital data (Aug. 1996).
Arctic National Wildlife Refuge
Arctic National Wildlife Refuge
Venetie
Madwenzie River
Hodzana River
Sheenjek River
Porcupine River
Black River
Beaver Creek
Russia
Canada
Bering Sea
Gulf of Alaska
Mileage of Proposed RS 2477 "highways"
Total # of highways
FWS Admin
Native Selected
Native Conveyed
Total Miles

- Proposed "highways" cross 8 rivers that are important in the spawning migrations of salmon.

- "Highways" 450, 189, 270, and 67 cross the Yukon River. The Yukon is an extremely important transportation corridor for fish migrating to upstream spawning grounds in both Alaska and Canada.

- Salmon escapement on the Yukon River is subject to an international treaty between the U.S. and Canada.

- "Highway" 67 crosses the Porcupine River and two of its tributaries. The Porcupine River system accounts for a significant portion of the Alaskan fall chum salmon harvest (Millard, pers. comm. 1995). The mainstem provides an important migration route to tributary spawning streams. Four other drainages that support smaller populations of salmon will be crossed by the proposed "highways".

Caribou: Numerous studies have been conducted in Alaska and Canada on the effects of road intrusion on caribou behavior and populations. Disturbance of calving grounds and increased harvest seem to comprise the most substantial impacts (Dau and Cameron 1986, Bergerud et al. 1989, Cameron et al. 1992).

- The refuge contains seasonal habitat for a portion of the Porcupine caribou herd. The herds winter range encompasses the northwestern portion of the refuge. Proposed "highways" 257 and 27 cross winter range and the migration corridor of a portion of the Porcupine caribou herd (Bertram and Vivion, pers. comm. 1995).

- Disturbance on the winter range from development or increased public access could displace caribou from key wintering habitat to less suitable areas. The additional physiological stress from disturbance could adversely affect reproduction and survival (Murphy and Curatolo 1986).

Peregrine Falcon: Peregrine falcons are sensitive to noise and visual disturbance during nesting and rearing periods. These disturbances could result from construction activities and increased public access in the vicinity of a nest (USFWS 1982).

- There are at least 8 peregrine falcon nests on the Yukon Flats Refuge. The American peregrine falcon is a federally-listed endangered species. Refuge surveys have identified nesting sites on the Porcupine and Yukon Rivers within the refuge boundary.

- Portions of "highways" 450 and 476 cross through three peregrine falcon nesting territories along the Yukon River.

Waterfowl: Waterfowl are sensitive to noise and visual disturbance during nesting, molting, and staging. These are periods of great physiological stress and additional stress can displace waterfowl from optimal habitats and adversely affect their reproduction and survival (Henson and Grant 1991, Bangs et al. 1982, Owen and Reinecke 1979).

- An estimated 1.1 million ducks and 6,000 Canada and white-fronted geese commonly nest on the refuge each year. Thousands of snow geese migrate through the Yukon Flats to and from breeding grounds north of the refuge.

- Portions of all of the proposed "highways" within the refuge cross high and moderate density waterfowl nesting habitat. Specifically, "highways" 27, 257, 446, 450, 476, 477, 478, 879 cross high density nesting habitat of mallards, northern pintails or canvasback ducks and would provide public access to these critical areas.

Subsistence: The ANILCA purposes of the Yukon Flats Refuge includes the provision of ". . . the opportunity for continued subsistence use by local residents" (Sections 303(6)(B)(iii) and 302(9)(B)(iii).

- Road construction and use may cause loss of habitat and/or reductions or displacements of species used for subsistence by local residents.

- Road construction and use could cause increased competition of local resources currently used for subsistence purposes, especially on the Yukon Flats, where RS-2477 rights-of-way may provide direct access to the area from urban centers such as Fairbanks.

- Road construction and use can increase the extent of subsistence use.

- Local opinions and feelings concerning the impacts of increased road access on subsistence activities and resources need to be taken into consideration. Cultural and social changes may result even from essentially free choices concerning use of subsistence resources.

Cultural Resources: Road construction activity can damage or destroy cultural resources located within a right-of-way. In addition, the area of impact is often much larger than the actual right-of-way. Access created by the road can lead to vandalism and looting of cultural resource sites.

- There are 52 sites within the boundaries of the Yukon Flats Refuge listed on the Alaska Heritage Resources Survey. Nearly 800 place names and other sites have been recorded. The two or three controlled surveys conducted on the refuge do not permit predictions of location or density of undiscovered sites (Slaughter 1984; Smith 1984).

- Based on broad patterns noted across Alaska, prehistoric sites can be expected to cluster along rivers, especially where tributaries join main branches. Sites will be found around lakes with fish. Hunting sites will be found where game concentrated, on mountain passes, river crossings etc. Areas away from water sources will have fewer and more ephemeral sites.

- Fifty-three sites known to Service archaeologists are located on or near the proposed rights-of-way.

- Undiscovered historic sites will be found along historic transportation routes (RS-2477 "highways"). All of the proposed rights-of-way have a high probability of having significant historic resources.

- Three of the 12 proposed "highways" have a high probability, four have a medium probability, and five have a low probability of possessing significant prehistoric sites.

We have presented a sample of the range of potential impacts on wildlife refuges in Alaska. Togiak and Yukon Flats Refuges are but two of the 14 Alaskan refuges that would be changed forever by this bill. Proposed RS-2477 "highways" within the 12 other refuges, or section line easements in all 16 Alaskan refuges, would impact unique natural resource values not reflected in this discussion.

A goal of ANILCA was to create refuges that included entire ecosystems. A tenet of modern conservation biology is that fragmentation by roads and development of the unprotected portion of an ecosystem surrounding a park or refuge will degrade or destroy the very resources supposedly protected by that park or refuge. A myriad of roads across these refuges may ultimately result in this same resource degradation by fragmentation ANILCA sought to avoid. The Service may not be allowed to analyze or reroute highways around particularly sensitive resource areas. Each proposed route is unique and the extent of future "highway" development and use will ultimately determine the impacts on all natural resources. We do, however, know the general results of ecosystem fragmentation on parks and refuges around the world. We also know that this bill will not allow the systematic environmental analysis necessary to prevent resource degradation.

PERSONAL COMMUNICATIONS

ADUMAN, ANDREW. 1995. Wildlife Biologist, U.S. Fish and Wildlife Service, Togiak National Wildlife Refuge, Dillingham, Alaska.

BERTRAM, MARK. 1995. Wildlife Biologist, U.S. Fish and Wildlife Service, Yukon Flats National Wildlife Refuge, Fairbanks, Alaska.

DYASUK, JON. 1995. Refuge Interpreter, U.S. Fish and Wildlife Service, Togiak National Wildlife Refuge, Dillingham, Alaska.

FAUSTINE, MARY. A. 1995. Fishery Biologist, U.S. Fish and Wildlife Service, King Salmon Fishery Resource Office, King Salmon, Alaska.

JAMES, DAVID. 1995. Refuge Operations Specialist/Subsistence, U.S. Fish and Wildlife Service, Yukon Flats National Wildlife Refuge, Fairbanks, Alaska.

LISAC, MARK. 1995. Fishery Biologist, U.S. Fish and Wildlife Service, Togiak National Wildlife Refuge, Dillingham, Alaska.

MILLARD, JACK (Monty). 1995. Project Leader, U.S. Fish and Wildlife Service, Fairbanks Fishery Resource Office, Fairbanks, Alaska.

VIVION, MICHAEL. 1995. Wildlife Biologist/Pilot, U.S. Fish and Wildlife Service, Yukon Flats National Wildlife Refuge, Fairbanks, Alaska.

BIBLIOGRAPHY: A limited review of studies on the impacts of roads and human disturbance.

ADAMOVICH, L. 1973. Bibliography on forest roads and the environment. Faculty of Forestry, University of British Columbia. 25pp.

AMSTRUP, S. C. 1993. Human disturbances of denning polar bears in Alaska. Arctic, 46(3):246-250.

ARCHIBALD, W. R., R. ELLIS and A. N. HAMILTON. 1987. Responses of grizzly bears to logging truck traffic in the Kimsquit River Valley, British Columbia. Int. Conf. Bear Res. Manage. 7:251-257.

ART PEARSON and ASSOCIATES. 1980. The potential impact of the Dempster Lateral gas pipeline on grizzly bear and fox in the Mackenzie Delta. Whitehorse: Art Pearson and Associates. 17pp.

AUNE, K. E. and T. S. STIVERS. Availability / Utilization of grizzly bear habitat components on the Rocky mountain east front. Proceedings - Grizzly Bear Habitat Symposium, Missoula, Montana, April 30-May 2, 1985. U.S. Forest Service. General Technical Report Int. 207:99

AYRES, J. M., de MAGALHAES LIMA, D., de SOUZA MARTINS, E. and BARREIROS, JLK. 1991. On the Track of the Road: Changes in Subsistence Hunting in a Brazilian Amazonian Village, in Neotropical Wildlife Use and Conservation. John G. Robinson and Kent H. Redford, editors. p. 82-92.

BAILEY, R.W. and K. T. RINELL. 1960. Forest game research.: decimating factors. W. VA. Div. of Game and Fish; 8pp.

BANGS, E. E., T. N. BAILEY and M. F. PORTNER. 1989. Survival rates of adult female moose on the Kenai Peninsula, Alaska. J. Wildl. Manage. 53(3):557-563.

BARRY, T. W. and SPENCER, R. 1976. Wildlife response to oil well drilling. Canadian Wildlife Service. Progress Notes. Number 67.

BARTON, B. A. 1977. Short-term effects of highway construction on the limnology of a small stream in southern Ontario. Freshwater Biology 7(2):99-108.

BEAK CONSULTANTS. 1977. A survey of fall spawning fish species in waterbodies within the influence of the proposed Alaska Highway Pipeline in Yukon Territory. Foothills Pipe Lines (Yukon) Ltd., Calgary, Alberta. 40pp.

BELANGER, L., and J. BEDARD. 1989. Responses of staging greater snow geese to human disturbance. J. Wildl. Manage. 53:713-719.

BERGERUD, A. T., JAKIMCHUK, R. D., and CARRUTHERS, D. R. 1984. The Buffalo of the North: Caribou (*Rangifer tarandus*) and human developments. Arctic. 37:7-22.

BERINGER, J. J. 1986. Habitat use in response to roads by black bears in Harmon Den, Pisgah National Forest, North Carolina. M.S. Thesis, Univ. Tenn. 103pp.

BESCHTA, R. L. 1978. Long-term patterns of sediment production following road construction and logging in the Oregon Coast Range. Water Resources Research 14:1011-1016.

BLIX, A.S. and LENTFER, J.W. 1992. Noise and vibration levels in artificial polar bear dens as related to selected petroleum exploration and developmental activities. Arctic. 45(1):20-24.

BRODY, H. 1981. Maps and Dreams. Vancouver, B.C.: Douglas & McIntyre.

BURGESS, R. M. 1992. The relative influence of oil-development related disturbance and environmental factors on activity budgets of brood-rearing snow geese at Home Island, Alaska. N. Am. Arctic Goose Conf. Workshop; No. 7. page 35. Abstract only.

BURKHANOV, V.F., Glabina, N.K., Derbyshev, A.S., Puzanova, V.F., Tikhonov, A.V. 1988. Problems in comprehensive development of productive forces in the northern zone. Translation of 'Problemy kompleksnogo razvitiya proizvoditel'nukh sil zony Severa,' in Problemy Severa 21:5-19.

CAMERON, R. D., Reed, D. J., Dau, J. R., and Smith, W. T. 1992. Redistribution of calving caribou in response to oil field development on the arctic slope of Alaska. Arctic. 45:338-342.

CAMERON, R. D., Whitten, K. R., Smith, W. T., and Roby, D. D. 1979. Caribou distribution and group composition associated with construction of the Trans-Alaska pipeline. Canadian Field-Naturalist. 155-162.

CARR, P. C. and M. R. PELTON. Proximity of adult female black bears to limited access roads. 1984. Proc. Annu. Conf. Southeast. Assoc. Fish Wildl. Agencies. 38:70-77.

CLINE, L. D., and Ward, J. V. 1979. The impact of highway construction on a small, high mountain stream. Bull. Ecol. Soc. Am. 60(2):122.

CORDONE, A. J., and D. W. Kelley. 1961. The influences of inorganic sediment on the aquatic life of streams. California Fish and Game 47:189-228.

CURATOLO, J. A., and Murphy, S. M. 1986. The effects of pipelines, roads, and traffic on the movements of caribou, Rangifer tarandus. Canadian Field-Naturalist 100(2): 218-224.

DAU, J. R., and Cameron, R. D. 1986. Effects of a road system on caribou distribution during calving. Rangifer, Special Issue No. 1: 95-101.

DICARLO, D. 1972. Peregrine reintroduction. Can. Raptor Soc. 2(1):41-42.

DUMOND, D. E. 1987. Prehistoric Human Occupation in Southwestern Alaska: A Study of Resource Distribution and Site Location. University of Oregon Anthropological Papers #36 1-190p.

EALEY, D.M. 1982. Inspection of wildlife habitat at facility sites along the Norman Wells Pipeline. McCourt Management Ltd; Interprovincial Pipe Line (NW) Ltd. [Sponsor] [Edmonton, Alta.] v, 53.

EVEREST, F. H., Beschta, R. L., Schrivener, J. C., Koski, K. V., Sedell, J. R., and Cederholm, C. J. 1987. Fine sediment and salmonid production: a paradox. Pages 98-142 in Salo and Cundy (1987).

FALL, J. A., and Foster D. J. 1987. Fish and game harvest and use in the Middle Susitna Basin: the results of a survey of residents of the road connected areas of game management units 14B and 16A, 1986. Anchorage, Alaska, Alaska Dept. of Fish & Game, Division of Subsistence, Subsistence technical paper, 143.

FAUSTINI, M. A. (in prep.). Status of rainbow trout in the Goodnews River, Togiak National Wildlife Refuge, Alaska 1993-1994.

FOLLMANN, E.H. and HECHTEL, J.L. 1990. Bears and pipeline construction in Alaska. Arctic. 2:103-106.

FURNISS, M.J., Roelofs, T. D., and Yee, C. S. 1991. Road construction and maintenance. *In* Influences of forest and rangeland management on salmonid fishes and their habitats. American Fisheries Society Special Publication. 19:139-179.

FYFE, R. W., and Olendorff, R. R. 1976. Minimizing the dangers of nesting studies to raptors and other sensitive species. Can. Wildl. Serv. Occas. paper. No. 23. 17pp.

GALLOP, M. A., Black, J. E., Felske, B. E. and R.A. Davis. 1972. Distribution studies of feeding black brant, common eiders, glaucous gulls and arctic terns at Nunalak Spit and Phillips Bay, Yukon territory. In W. W. Gunn and J. A. Livingston (ed). Arctic Gas Biological Report Series 14:153-201.

GIBBONS, D. R., and Salo, E. O. 1973. An annotated bibliography of the effects of logging on fish on the western United States and Canada. U.S. Forest Service General Technical Report PNW-10.

HARLOW, D. I. 1977. The reproductive success and protective effort of peregrine falcons in California, 1977. USDI, U.S. Fish and Wildlife Service. 19pp.

HARLOW, D. I. 1979. The reproductive success and protective effort of peregrine falcons in California, 1978. USDI, U.S. Fish and Wildlife Service. 18pp.

HAUGH, J. R. 1981. Response of raptors to exploration and construction activities in the National Petroleum Reserve in Alaska. Pages 244-252; in W. N. Ladd and P. F. Schempf, eds. Proc. of a symposium and workshop. Raptor Manage. and Biology in Alaska and Canada, 17-20 February, Anchorage, Alaska, USDI, Fish and Wildlife Service.

HAUSLE, D. A., and Coble, D. W. 1976. Influence of sand in redds on survival and emergence of brook trout (*Salvelinus fontinalis*). Transactions of the American Fisheries Society 105:57-63.

HENSON, P., and Grant, T. A. 1991. The effects of human disturbance on trumpter swan breeding behavior. Wildl. Soc. Bull. 19:248-257.

HOREJSI, B. L. 1981. Behavioral response of barren ground caribou to a moving vehicle. Arctic 34:180-185.

HYSSON, J., Adamus, P., Tibbetts, S., and Darnell R. 1982. Handbook for protection of fish and wildlife from construction of farm and forest roads. Best management practices for building activities associated with the discharge of dredged or fill material. U.S. Fish and Wildlife Service. Eastern Energy Land Use Team. Biological Services Program FWS/OBS-82/18.

JOHNSON, T. H. 1983. Response thresholds of breeding peregrines. USDA. U.S. Forest Service. 29pp.

KELLER, V. E. 1991. The effect of disturbance from roads on the distribution of feeding sites of geese wintering in north-east Scotland. ARDEA 79:229-231.

KING, J. G., and Tennyson, L. C. 1984. Alteration of streamflow characteristics following road construction in north central Idaho. Water Resources Research 20:1159-1163.

KLINGER, L. F. 1983. The effects of a gravel road on adjacent tundra vegetation: Prudhoe Bay Waterflood environmental monitoring program. Institute of Arctic and Alpine Reseach, University of Colorado.

KORSCHGEN, C.E., George, L. S., and Green, W. L. 1985. Disturbance of diving ducks by boaters on a marginal staging area. Wildl. Soc. Bull. 13:290-296.

LOOMIS, J. B. 1989. A Bioeconomic Approach to Estimating the Economic Effects of Watershed Disturbance on Recreational and Commercial Fisheries. J. Soil Water Conserv., 44(1):83-87.

LOTSPEICH, F. B., and Helmers, A. E. 1974. Environmental guidelines for development roads in the subarctic. National Environmental Research Center, U.S. Environmental Protection Agency. EPA-660/3-74-009.

MCLELLAN, B. N. and D. M. SHACKLETON. 1989. Grizzly bears and resource-extraction industries: habitat displacement in response to seismic exploration, timber harvesting and road maintenance. J. Appl. Ecol. 26(2):371-380.

MEININGER, C.A., ET AL; SPATT, P.D. 1988. Variations of tardigrade assemblages in dust-impacted arctic mosses. Arctic and Alpine Research. 20(1):24-30.

MURPHY, S. M., and Curtalo, J. A. 1987. Activity budgets and movement rates of caribou encountering pipelines, roads, and traffic in northern Alaska. Can. J. Zool. 65:2483-2490.

MYCHASEW, L. 1988. Access related impacts of backcountry roads to wildlife and management approaches to mitigate them. Dept. of Renewable Resources, 43 p.

NELSON, R. W. 1970. Observation on the decline and survival of the peregrine falcon. Canadian Field-Naturalist. 84(3):313-319.

OLSEN, J., and Olsen, P. 1978. Alleviating the impact of human disturbance on the breeding peregrine falcon II. Public and recreational lands. Corella. 4(3):54-57.

OLSEN, J., and Olsen, P. 1978. Alleviating the impact of human disturbance on the breeding peregrine falcon II. Ornithologists. Corella. 2(1):1-7.

OLSON, S. T. 1975. Wildlife investigations of Alaska.: management studies of Alaska caribou. Calving studies–Steese Fortymile herd. Alaska. Dept. of Fish and Game.

OWEN, R. B., and Reinecke, K. J. 1979. Bioenergetics of breeding dabbling ducks. Pages 71-94 in T.A. Bookhout, ed. Waterfowl and wetlands-an integrated review. Proc. 1977 Symp., Madison, Wis., N. Central Sect., The Wildl. Soc.

OWENS, N. W. 1977. Responses of wintering brant geese to human disturbance. Wildfowl 28:5-14.

PEARCE, A. J., and Watson, A. 1983. Medium-term effects of two landsliding episodes on channel storage of sediment. Earth Surface Processes and Landforms 8:29-39.

PHILLIPS, R. W., Lantz, R. L., Claire, E. W., and Moring, J. R. 1975. Some effects of gravel mixtures on emergence of coho salmon and steelhead trout fry. Transactions of the American Fisheries Society 194:461-466.

PLATTS, W. S., Torquemada, R. J., McHenry, M. L., and Graham, C. K. 1989. Changes in salmon spawning and rearing habitat from increased delivery of fine sediment to the South Fork Salmon River, Idaho. Trans. Am. Fish. Soc. 118(3):274-283.

RATCLIFFE, D. A. 1985. Human impacts on environment in relation to past history and biological future of the peregrine. Pages. 22-23 in Abstracts from 1985 Intl. Peregrine Conference, Symposium on management of birds of prey. November 4-6, 1985. Sacramento, CA. Raptor Research Foundation.

REID, L.M., and Dunne, T. 1984. Sediment production from forest road surfaces. Water Resources Research 20:1753-1761.

ROBERTSON, R. J., and Flood N. J. Flood. 1980. Effects of recreational use of shorelines on breeding bird populations. Can. Field-Nat. 94:131-138.

SALO, E.O., and Cundy, T. W., editors. 1987. Streamside management: forestry and fishery interactions. University of Washington, Institute of Forest Resources Contribution 57, Seattle.

SCHOEN, J. W. and BEIER, L. R. 1989. Wildlife Research and Management: Brown Bear Habitat Preferences and Brown Bear Logging and Mining Relationships in Southeast Alaska. Alaska Dept. Fish and Game. 38 pp.

SCHULDINER, P. W. 1979. Ecological effects of highway fills on wetlands: user's manual. Transportation Research Board, National Research Council, 99 pp.

SCHWARZ, L. 1993. Salmon harvest and escapement data for the Chiniak Bay and Kodiak Road system, 1980-1990. Anchorage, Alaska: Alaska Dept. of Fish and Game, Division of Sport Fish.

SEDINGER, J. S. 1990. Effects of visiting black brant nests on egg and nest survival. J. Wildl. Manage. 54:437-443.

SHANK, C.C. 1980. Human-related behavioral disturbance to northern large mammals: a bibliography and review. Foothills Pipe Lines (South Yukon) Ltd. [Sponsor]. Alaska Highway gas pipeline project.

SHIDELER, R. T., Robus, M.H., Winters, J. F., and Kuwada, M. 1986. Impacts of Human Developments and Land Use on Caribou: A Literature Review. Vol I: A Worldwide Perspective. Technical Report 86-2. Alaska Dept. of Fish and Game. Div. of Habitat. 219pp.

SHIDELER, R. T. 1986. Impacts of Human Developments and Land Use on Caribou: A Literature Review. Vol II: Impacts of Oil and Gas Development on the Central Arctic Herd. Technical Report 86-3. Alaska Dept. of Fish and Game. Div. of Habitat. 128pp.

SIDLE, R. C., Pearce, A. J. and C. L. O'Loughlin. 1985. Hillslope stability and land use. Water Resources Monograph Series 11.

SIMPSON, S. G., M. E. Hogan, and D. V. Dirksen. 1982. Behavior and disturbance of molting Pacific black brant in Arctic Alaska. U.S. Fish and Wildlife Service. Anchorage, Alaska.

SINGER, F.J. and J. B. BEATTIE. The controlled traffic system and associated wildlife responses in Denali National Park. Arctic 39(3):195-203.

SLAUGHTER, D. C. 1984. Yukon Flats Cultural Resource Survey.

SMITH, B. J., H. W. BROWERS, T. E. DAHL, D. E. NOMSEN, and K. F. HIGGINS, 1989. Indirect wetland drainage in association with federal highway projects in the Prairie Pothole region. Wetlands 9(1):27-39.

SMITH, C. S. 1984. An Archaeological Reconnaissance of the Hodzana River p.III Associates, Inc. USFWS Contract 14-16-0007-6420

SMITH, W. T., and R. D. CAMERON. 1985. Reactions of large groups of caribou to a pipeline corridor on the arctic coastal plain of Alaska. Arctic. 38:53-57.

SWANSTON, D. N. 1991. Natural processes in Influences of forest and rangeland management on salmonid fishes and their habitats. American Fisheries Society Special Publication 19:139-179.

SWEDBORG, S. E. 1967. Central Montana Fisheries Study: Evaluation of fish habitat destruction in Little Prickly Pear Creek due to construction of interstate highway 15. Montana Fish and Game. 32 p.

TOBIAS, T. 1991. Indigenous knowledge and planning: the Pinehouse experience. Common Property Conference: Second Annual Meeting of IASCP, September 26-29, 1991, Natural Resources Institute, University of Manitoba, Winnipeg, Canada.

TRACY, D. M. 1977. Reaction of wildlife to human activity along Mount Mckinley National Park Road. Unpublished M.S. Thesis, Univ. of Alaska, Fairbanks, Alaska.

TRUETT, J. C., Senner, R. G. B., Kertell, K., Rodrigues, R., and Pollard, R. H. 1994. Wildlife responses to small-scale disturbances in the arctic tundra. Wildl. Soc. Bull. 22:317-324.

U.S. FEDERAL SUBSISTENCE BOARD, 1992. Subsistence Management for Federal Public Lands in Alaska: Final Environmental Impact Statement.

U.S. FISH AND WILDLIFE SERVICE. 1982. Recovery plan for the peregrine falcon-Alaska population. U.S. Department of the Interior, Anchorage, Alaska. 69pp.

U.S. FISH AND WILDLIFE SERVICE. 1986. Togiak National Wildlife Refuge. Final Comprehensive Conservation Plan, Environmental Impact Statement, Wilderness Review. U.S. Department of the Interior, Anchorage, Alaska. 514pp.

U.S. FISH AND WILDLIFE SERVICE. 1987. Yukon Flats National Wildlife Refuge. Final Comprehensive Conservation Plan, Environmental Impact Statement, Wilderness Review. U.S. Department of the Interior, Anchorage, Alaska. 422pp.

U.S. FISH AND WILDLIFE SERVICE. 1990a. Fishery Management Plan Togiak National Wildlife Refuge Fiscal Year 1990-1994. Prepared by King Salmon Fishery Assistance Office, 80 p.

U.S. FISH AND WILDLIFE SERVICE. 1990b. Fishery Management Plan Yukon Flats National Wildlife Refuge. Fairbanks Fishery Assistance Office, Fairbanks, Alaska. 80 p.

WAGNER, M. W. 1991. Footsteps along the road: Indian land claims and access to natural resources. Alternatives 18(2) :23-27.

WEAVER, W., HAGANS, D., and MADEJ, M. A. 1987. Managing forest roads to control cumulative erosion and sedimentation effects. In Proceedings, California watershed management conference. University of California, Wildland Resources Center Report 11, Berkeley, California.

WHITTEN, K.R., and R. D. CAMERON. 1983. Movements of collared caribou, *Rangifer tarandus*, in relation to petroleum development on the Arctic Slope of Alaska. Canadian Field-Naturalist. 97:143-146.

WOLFE, M. D. 1982. The relationship between forest management and landsliding in the Klamath Mountains of northwestern California. Earth Resources Monograph 11. U.S. Forest Service, Pacific Southwest Region, San Francisco.

WOLFE, R. J., and R. J. WALKER. 1985. Subsistence Economies in Alaska: Productivity, Geography, and Development Impacts. Paper presented at the 84th Annual Meeting of the American Anthropological Association.